IBD

Qualifications

REPORT FROM THE EXAMINERS 2011

General Certificate and Diplomas (in Brewing, Distilling and Beverage Packaging)
as well as Master Brewer reports in one handy volume.

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Board of Examiners and Examinations Centres 2011

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The Fundamentals, General Certificate, Diploma and Master Brewer Examinations were held in the following worldwide centres:

Australia	Abbotsford Adelaide Brisbane Bundaberg Hobart Launceston Melbourne Mildura Perth Sydney Yatala
Barbados	St Michael
Cameroon	Douala
Canada	Chambly Creston Edmonton Guelph Halifax London Montreal St John's Toronto Vancouver Winnipeg
China	Yinjiang
England	Alton Bath Blackburn Burton on Trent Bury St Edmunds Burtonwood Hereford London Manchester Northampton Ringwood Sheffield St Austell Stockport Stroud Tadcaster
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Kenya	Nairobi
Lesotho	Maseru
Malaysia	Selangor Singapore
Mongolia	Ulaanbaatar
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Netherlands	Zouterwoude
New Zealand	Auckland Christchurch Dunedin Invercargill
Nigeria	Abuja Ibadan Lagos
Samoa	Apia
Scotland	Aberlour Edinburgh Orkney
Seychelles	Mahe
South Africa	Cape Town Durban Johannesburg Port Elizabeth Pretoria
Sri Lanka	Colombo
St Kitts	Basseterre
St Vincent	Kingstown
Suriname	Paramiribo
Tanzania	Dar Es Salaam
Trinidad	Champs Fleur Laventille
Uganda	Kampala
Ukraine	Mykolaiv
USA	Davis CA Elkton VA Fayetteville, AR Frederick MD Golden CO Irwindale CA Miami FL Milwaukee WI New York NY Philadelphia PA Portsmouth NH Provo UT Roanoke VA Trenton OH Washington WA Windsor VT Woodinville WA
Vietnam	Ho Chi Min City
Wales	Magor Swansea
Zambia	Lusaka
Zimbabwe	Harare

THE STATISTICS

Diploma in Brewing, Beverage Packaging and Distilling, and the Master Brewer Examinations

Number of candidates who sat each module

Exam	Module	2011	2010	2009
Diploma in	Module 1	262	244	206
Brewing	Module 2	228	215	161
	Module 3	147	183	134
	Pass in all modules	**95**	**106**	**61**
Diploma in	Module 1	23	30	22
Distilling	Module 2	29	19	15
	Module 3	18	17	18
	Pass in all modules	**13**	**14**	**13**
Diploma in	Module1	12	11	9
Packaging	Module 2	14	12	9
	Module 3	8	9	0
	Pass in all modules	**3**	**11**	-

Exam	Module	2011	2010	2009
Master Brewer	Module1		6	23
Old Syllabus	Module 2		9	25
	Module 3		16	18
	Module 4		10	19
	Module 5		14	20
	Pass in all modules	-	**9**	**13**
Master Brewer	Module1	41	31	
New Syllabus	Module 2	35	14	
	Module 3	27	2	
	Module 4	12	5	
	Module 5	10	3	
	Pass in all modules	**5**	**2**	

Report from the Chairman of the Board of Examiners

Results for 2011 Examinations

The number of candidates registered for the IBD examinations this year maintained the trend of increasing numbers each year, with over 1400 candidates registering in 2011. Unfortunately, average performance in some of this year's IBD exams, was lower than in 2010.

In total this year, there were 5 new Master Brewers qualifying, with 95 candidates achieving the Diploma in Brewing, 13 the Diploma in Distilling and 3 the Diploma in Beverage Packaging.

Also 116 candidates obtained the GCB and 51 the GCP in November 2010, with 103 and 62 passing GCB and GCP respectively in May 2011. In addition, 19 candidates obtained the General Certificate in Distilling in November 2010 (including 3 Molasses passes) and a further 46 (including 5 passing the Molasses option and 2 passing the Grape option for the first time) in May 2011.

Award Winners

I should like to express my personal congratulations all candidates who have attained qualification this year, especially those achieving distinctions and awards, as follows:

John Berchman Chinonye Njoku (Nigerian Breweries Plc); awarded the 2011 JS Ford prize (overall award for the Diploma in Brewing).

Nikolas SL Fordham (Chivas Brothers Ltd); the 2011 award from the Worshipful Company of Distillers (for the overall Diploma in Distilling Award).

Samantha K Schleyer (South Australia Brewing Co Pty Ltd); the 2011 Hyster award (the overall prize for the Diploma in Packaging).

In addition, **Tran Thi Ngoc Loan** (Vietnam Brewery Ltd) received the Crisp Malting award (for the best paper in 2011 Dipl. Brew. Module 1); **Rob MJ Tummers** (Heineken Nederland BV) was awarded the Brewery Engineers Association award (for the highest result in the Process Technology section of 2011 Dipl. Brew. Module 3); **Leanne Corner** (William Grant & Sons Distillers Ltd) achieved the Simpsons Malt award (for the best paper in 2011 Diploma in Distilling Module 1); **Rodney Donnell** (Old Bushmills Distillery Co Ltd) attained the Gin and Vodka Association prize (for best paper in 2011 Dipl. Distill. Module 2); **Geoffrey K Davis** (Lion Nathan, Australia Ltd) attained the Quinn Glass prize (for the best result in 2011 Diploma in Packaging Module 1); **Bruce Turner** (Meantime Brewing Company) and **Shun Chiun Chong** (Guinness Anchor Berhad) were jointly awarded the MicroMatic prize (for best result in 2011 Diploma in Packaging Module 2); and **Samantha K Schleyer** (South Australia Brewing Co Pty Ltd) also attained the Brewery Engineers Association award for the highest score in 201! Dipl. Pack. Module 3

Congratulations are extended to **Grant McCracken** (Samuel Adams Brewing Co, USA) who obtained the Worshipful Company of Brewers award for 2010 GCB, to for **Craig Buddle** (Lion Nathan Ltd, New Zealand) obtaining the Worshipful Company of Brewers award for 2010 GCP, and to **Paul Gallacher** (Diageo Global Supply, Scotland) and **Richard Guiseppe** (Angostura, West Indies) who jointly received the 2010 GCD Scotch Whisky Association award.

Finally, for this year, the 2011 General Certificate awards are being given to the best candidates from the May round of examinations; next year awards will be based on best results from November 2011 and May 2012. So, the 2012 winners are: **Matthew J Mableson** (South Australian Brewing Co Pty Ltd) and **Matthew E Harris** (Lion Nathan Australia Ltd) who share the Worshipful Company of Brewers award for 2011 GCB; **Laura Dopkins** (Miller Coors, USA) who obtains the Worshipful Company of Brewers award for 2011 GCP, and **Eric W Ryan** (Irish Distillers, Pernod Ricard) who receives the 2011 GCD Scotch Whisky Association award.

Examiners' Reports and New Developments

As in previous years, all the Examiners' reports are published here as this special supplement in the Brewer and Distiller International. However they are also available via the IBD web site, in the Journal (JIB) or by application to the IBD Examinations Administration team at Clarges Street.

All candidates are strongly encouraged to regard these reports as essential reading in that they contain descriptions of the ideal content of answers, sound advice on examination technique and detailed analysis of the year's papers. Also all unsuccessful candidates are recommended to use the relevant reports in conjunction with their individual feedback forms that have been sent to help them to recognize syllabus sections they need to concentrate on for future exams.

The reports below from all the examiners also summarize overall performances and I do not intend to duplicate this information, other than to note that pass rates for the Diploma in Brewing modules (especially 1 and 2) have dropped somewhat this year and I urge all potential candidates to read more widely around the topics including in these modules and not to rely exclusively on information in the revision notes. All candidates are reminded that the exams are set on the syllabus contents and so should be sure to cover the full breadth of the syllabus topics in their preparation and revision.

In addition, as ever, candidates are urged to concentrate on answering the precise questions asked and pay particular attention to preparation, organization and time management.

It is very pleasing to see that the introduction of the new syllabus and examination format for the Master Brewer qualification continues to be well received, judging by the increased number of candidates for the revised modules, especially for the Practical Project module (module 5); a number of excellent dissertations were presented this year.

The increasing interest in the Distilling qualifications (other than the Cereal option) is also very encouraging; this year saw the first successful candidates for the Grape option for the GCD in May.

Diploma in Beverage Packaging candidates are advised that the syllabus content and format has been revised for this year. The format is still 3 modules of 4 units each, but the modular content has been updated to a more convenient structure and module 2 now includes an optional unit on Soft Drinks packaging. This has been introduced after requests from major global companies with packaging operations that include a number of product types.

Candidates already started on the existing syllabus will be able to complete the current programme, since we plan to run parallel examinations for both the existing and new syllabi for the next 2 years. Full details of the new syllabus are included on the IBD website or are available from Clarges Street.

Also new is the Fundamentals in Distilling qualification, for which a training course was run in March this year and a second is planned for this coming November and General Certificate in Spirits Packaging is currently under development; again full details of both of these qualifications can be found on the website.

Pass Marks and Grades

Last year, I thought it would be appropriate, in this report, to remind candidates of the pass marks set for examinations and the grading structures; that information is repeated below. As always, the pass marks are fixed at a set standard and are not varied depending on candidates' results.

(a) Diplomas in Brewing and Distilling

Pass mark for all modules = 45%

Pass

Grade A =	75% and over
Grade B =	65 – 74%
Grade C =	55 – 64%
Grade D =	45 – 54%

Fail

Grade E =	35 – 44%
Grade F =	25 – 34%
Grade G =	less than 25%

NB. For Dipl. Brew. Module 3, candidates must achieve a minimum standard of 35% in both Section A – Packaging Technology and in Section B – Process Technology. This means that in order to achieve the pass mark of 45% overall for Module 3, attaining 35% in either section requires a mark of at least 55% in the other section. Failure to achieve the minimum standards means the overall mark will be graded at E (or less, depending on total percentage attained).

(b) Master Brewer

Pass mark for modules 1 to 4 = 50%

Pass

Grade A =	80% and over
Grade B =	70 – 79%
Grade C =	60 – 69%
Grade D =	50 – 59%

Fail

Grade E =	40 – 49%
Grade F =	30 – 39%
Grade G =	less than 30%

It should be noted that for all modules 1 – 4, candidates must achieve a minimum standard in both papers; 55% for Paper 1 and 45% for Paper 2. Failure to achieve these minimum standards means the overall mark will be graded at E (or less, depending on total percentage attained).

For Module 5 – Project, there are three categories of assessment:
Distinction = 70 (or above) marks / 100,
Pass = 50 to 69 marks / 100,
Fail = <50 marks / 100.

(c) Diploma in Packaging

Pass mark for all modules = 50%

Pass

Grade A =	80% and over
Grade B =	70 – 79%
Grade C =	60 – 69%
Grade D =	50 – 59%

Fail

Grade E =	40 – 49%
Grade F =	30 – 39%
Grade G =	less than 30%

NB. All modules consist of 4 Units; examinations for each unit of all 3 modules consist of one assignment and two written papers (each to be completed in 1 hour) and comprising:
Short Answer Paper: "short answers" and "multiple choice", designed to cover the whole unit syllabus.
Long Answer (Essay) Paper: choice of 1 from 2 questions.

Weighting of the marks for each unit is:

i	Short answers paper	= 35%
ii	Written answers (1 from 2)	= 35%
iii	Assignments	= 30%

Candidates do not have to pass all units within a module in order to achieve a pass grade for that module; marks achieved for all units within a module are totalled to determine the grade achieved for that module.

However, failure to submit an assignment dissertation (of 2500-3000 words) for any unit will annul the results of that unit from the total marks for the relevant module and will require the candidate to repeat that unit assignment AND examination in the following (or subsequent) year, in order to achieve a pass grade for the module. Dissertations are assessed for their structure AND content.

Students who have covered a unit standard through recognized prior learning (RPL) may be exempt from that unit standard. Exemption may be granted upon the receipt of a Portfolio of Evidence. Grades for a module including unit(s) passed by RPL will be based on results achieved by the units taken by examination.

(d) General Certificates (Brewing, Beer Packaging and Distilling) and Fundamentals of Brewing and Packaging of Beer

All these qualifications are examined by multiple choice questions, either on-line (currently available for GCB and GCP) or by paper exams.

The pass marks are set at 66% (40 correct answers from 60 questions for GC exams; 33 out of 50 for FBPB). Candidates attaining 90% or more achieve a Distinction pass and 80 - 89% achieves a Credit pass.

Acknowledgements and the future

So, the IBD Board of Examiners and the Examinations Department have had a busy 2011. New examiners have joined the team to cover the expanding number of qualifications and the increasing numbers of candidates.

This will be my last report as Chairman of the Board of Examiners; I will step down from the role in December this year and hand over to Prof. David Quain (current deputy chairman) and I wish him all success.

I would like to take this opportunity to express my gratitude to all the examiners and moderators, who have been involved for the past 7 years, during my term of office, for their hard work, support and valuable contributions in what has been an extremely active period in the history of the IBD qualification system. Significant changes to several qualifications have been made and new ones have been introduced during this time, all of which have helped to enhance the sound basis on which the IBD stands and to contribute to the continued respect with which IBD qualifications are regarded world-wide.

Thanks are also due to all the Clarges Street-based personnel for all their efforts and support, which ensures the smooth operation and organization of the IBD examination system.

Finally, good luck to everyone, but especially, all prospective candidates for the future.

Dr David G Taylor
August 2011

The Institute of Brewing & Distilling
Examinations 2011

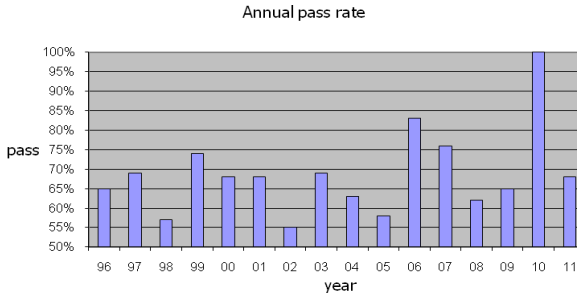
Question Papers and Examiners' Reports

MASTER BREWER EXAMINATION 2011

Module 1 – Raw Materials and Wort Production

This was the second year that the new format exam consisting of a two-hour short questions and multiple choice paper, to test the breadth of the syllabus and a two-hour long essay paper with four questions to be attempted out of a choice of six, to test the depth of knowledge.

Forty one candidates sat the papers with 28 candidates passing, which is a pass rate of 68%.



This pass rate compares favourably with previous years' results (see graph) and is close to the median over the same time span.

Paper 1: Short Questions and Multiple Choice

Barley Agronomy and Handling: 30% of candidates answered the advantages/disadvantages of winter-sown barley correctly.

50% of candidates knew the two reasons for ventilating barley in bulk silo.

Malt and Maltings: 20% correctly identified 'barley' as the answer to 'What is the largest single cost element of making finished malt?'

39% correctly identified the descriptions of specialist malt.

Adjuncts: These questions were answered well.

Hops: At this level 'mildew' or 'aphids' are not sufficient to describe pests or disease which affect hop plants. Powdery mildew, downy mildew or damson hop aphid must be specified. It is not necessary to know their Latin names.

24% identified which analytical method is not suitable for assaying the α-acid content of a sample of hops.

35% correctly identified the process steps for manufacturing type 45 hop pellets.

Water: 46% identified which geological formation is likely to yield accumulations for groundwater in aquifers.

37% of candidates were able to explain how identifying coliform bacteria (*E. coli*) in water supplies can indicate the likely presence of pathogenic bacteria.

Brewhouse Operations: 32% of candidates correctly calculated the cost of making wort with two different malts. Too many candidates ignored the moisture content of the malt (stated in the question) and assumed they were buying completely dry malt.

Brewhouse Design and Layout: In general these questions were answered well.

Plant Cleaning: 48% of candidates selected effective actions which would restore maximum evaporation back to 100%.

Quality and Troubleshooting: 41% of candidates were able to identify an unsatisfactory reason for keeping an inventory (stock pile) of malt at a brewery.

34% of candidates were able to identify three key objectives of an audit.

Brewhouse Management: 34% of candidates were able schedule the correct number of brews in a week.

Paper 2: Essay Questions

Question 1- Why barley?

Several cereals can be malted satisfactorily but barley is the most successful raw material for beer. Compare and contrast the properties of barley and malted barley with other cereals and their malts, which make it so suitable for brewing beer.

This question was attempted by 12 candidates (29%) and of those 5 (42%) passed.

This was the most unpopular question and not particularly well answered. It allowed candidates to demonstrate the breadth of their knowledge about barley and malted barley in comparison with other cereals and their malts, but few took up this challenge. The range of topics could have included agronomy, husk, friability, lipid content, carbohydrate content, gelatinisation, enzyme content and stability, protein and carbohydrate interaction and pH balance. The list is almost endless.

Question 2 – Hops and hop products.

Hops and hop products used in the brewhouse bring various characteristics to different styles of beer. Describe the several ways they are utilised to achieve this diversity.

This question was answered by 32 candidates (78%) with 18 achieving a pass mark (56%).

This was a popular question which elicited some very good answers from candidates who were able to display the breadth and depth of their knowledge of the topic. Other candidates however failed to distinguish between aroma and 'bittering' varieties and some of those that did, neglected to explain how they were used. Others ignored the reduced iso-α-acid extracts such as rho-tetra- and hexa-, but when they were discussed, candidates were acquainted with their various properties. In general the use and purpose of pre-isomerized pellets and extracts was covered well.

Question 3 – Ions in brewing water.

A wide range of ions may be present in raw water. Which ion is the most important in the brewing process? Explain how it affects the mashing and boiling stages. Name eight other ions which can be present in raw water that may either be good or bad for the brewing process and the characteristics of the final beer. Explain how each affects the brewing process and or the final beer characteristics.

This question was answered by 38 candidates (93%) with 22 achieving a pass mark (58%).

This was the most popular question in the exam, and it drew out some excellent answers. All of those who did answer were able to establish that calcium is the most important ion present in the brewing process. A surprising number did not discuss how calcium lowers pH during mashing and boiling or the significance of that effect. As an example, the level of detail I expect a candidate to supply on the other ions would be for

magnesium: *i)* its salts are more soluble than calcium and therefore have less effect on wort pH and beer flavour, *ii)* important enzyme co-factor in yeast, notably pyruvate decarboxylase and *iii)* may produce astringent bitterness unless calcium is present in excess.

Question 4 –Brewery expansion.

A brewery is currently producing 500,000 hl of 4.8% abv all malt beer in large pack. The brewhouse plant consists of a six roller mill, mash conversion vessel, 7m lauter tun, wort kettle with an internal calandria, whirlpool and wort cooler. The brew length is 450 hl at sales gravity and it is operated on a three shift cycle.

Set out a proposal to upgrade the brewhouse in 500,000 hl increments up to a capacity of 2.5 million hl to enable the brewery to produce small pack beer.

State all assumptions and fully explain the reasons for your proposals at each stage

This question was answered by 15 candidates (37%) and of those 9 (60%) passed.

This was the other unpopular question. Those who attempted it made a good exposition of their expansion plans which often included going to high gravity brewing. This must always be accompanied by the caveat: 'with the permission of the brand owner, usually the marketing department, and/or the brand licensor'. It is important when answering question like this one, that the descriptions and calculations are laid out orderly and logically; marks are easily lost if the arguments are jumbled up without any obvious logic.

Question 5 –Wort boiling.

Explain the physical and biochemical reactions occurring in wort during boiling. Identify the key parameters that need to be controlled in this process to ensure that consistent wort is produced.

Describe how the operation of one of these commercially available systems achieves the reactions you have explained: Krones (Steinecker) *Stromboli*™, GEA *Jetstar*™ or Briggs *Symphony*™.

This question was answered by 32 candidates (78%) with 18 achieving a pass mark (56%).

This was a very popular question and there were some very good well structured answers. It was disappointing that many candidates could not recall a comprehensive list of the physical and biochemical reactions which occur in wort during boiling. These reactions play and important role in the quality of the final beer and their control is critical to the process. Lucky the candidate who works in a brewhouse with one of the commercially available systems mentioned in the question; all candidates must endeavour to keep themselves abreast of modern developments by reading journals, accessing the internet and where possible attending Institute of Brewing & Distilling section meetings.

Question 6 – Energy usage in a brewhouse.

Discuss energy usage in a brewhouse and options available to reduce energy costs. Outline an operator training programme to ensure that brewhouse personnel are fully aware of the purpose and benefits of reducing energy consumption.

This question was answered by 34 candidates (83%) with 22 achieving a pass mark (65%).

This was another popular question that elicited a few very good answers along with a slew of mediocre ones. Candidates who focused solely on big capital spends on new boiling or mash conversion systems lost out to those who looked into every nook and cranny of energy consumption and discussed realistic proposals for saving energy. Switching off lights and repairing leaky hoses might not in themselves produce huge savings in energy but they do act to remind everyone of the need to be conscientious with its use.

Operator training plans should include much more than classroom learning and the more imaginative answers included brainstorming, games, bonus schemes (with or without financial incentives) as well as the correct use of monitoring and targeting.

Bob Illingworth
July 2011

MASTER BREWER EXAMINATION 2011

Module 2 – Fermentation and Beer Processing

This year was the second for the new style syllabus and examination. There were 2 papers, the first consisting of multiple choice and short answer questions and the second being a traditional essay style paper. Thirty five candidates submitted scripts for the two papers. Sixteen gained pass grades, a pass rate of 45.7%. There were no candidates at grades A and B, 7 candidates at grade C and 9 at grade D.

Paper 1 – Multiple Choice and Short Answer Questions

Twenty four candidates (68.6%) achieved the required standard in this paper, with 2 very good papers returned.

The paper covered the whole syllabus and many candidates clearly were prepared sufficiently to answer questions across a reasonable spread of topics. However, lack of detailed knowledge in some areas limited the marks for some. There were also instances where the candidates had not read the question well. One question asked about instrumentation in a conditioning tank, but several answers described how they were used to control incoming wort and fermentation. Another question asked how to control the amount of yeast pitched into wort; a few answers described how to get the wort in optimum condition for pitching. The question asking how to define successful outcomes of a CIP process (e.g. no visible soiling in the vessel) attracted several answers describing what detergent concentrations to use or temperatures to employ.

Questions on novel filter aids, the differences between beers fermented in shallow and tall vessels and yeast culturing were generally poorly answered. There was only one correct answer for the COD of yeast slurry (even with a wide tolerance accepted). Most candidates wildly underestimated the value, with some approximating it to, or believing it to be cleaner than, treated effluent.

There were also examples of more than the required number of options supplied for short-answer questions. Candidates must note that the required number will be marked in the order they appear and any further options will be ignored.

Paper 2: Essay Questions

There were no very good papers, three good papers, six disappointing papers and the rest were clustered around the minimum standard.

There were some areas of examination technique that let candidates down. Candidates need only write the question number at the start of their answers. There is no benefit or score attracted by copying out the question from the examination paper. Time management was clearly a problem for some candidates with 3 fairly complete answers presented, and then the fourth was barely started. There were some questions that candidates had either not read properly or had misunderstood the direction required, resulting in irrelevant information being presented.

Several questions were ideally answered by including a well presented labelled diagram, flow chart or graph, or a table of information and comments. This is a simple way of presenting large amounts of information without taking too much time. Diagrams ranged from very good to very poor. The best used at least half a side of paper, were drawn with a ruler and were neatly annotated with appropriate labels. The worst were very small, untidy and without adequate labelling. It is worth noting for future candidates that they are recommended to practice drawing diagrams of all of the main plant

items (vessels, filters etc.) as part of their preparation. Candidates should also note that information supplied in one answer can be referred to in another answer without repeating the information in full.

Question 1

Draw up headline technical instructions to cover the processes from the exit of wort from the wort cooler to the end of the conditioning phase prior to cold storage for a lager beer of original gravity 15^{O}P (1061^{O} OG). State the purpose of each stage and indicate the target values for the important process control parameters.

Nineteen candidates attempted this question with only 6 achieving the pass standard (31.6%). There were no particularly good answers.

This question asked for technical instructions for the processes from wort collection to the end of conditioning, including stating the purpose and target values for the process control parameters. Many answers concentrated only on the latter point and ignored the process instructions required, thus failing to answer the main thrust of the question. For example, the process of wort collection should have been outlined with mention of sterilising mains, diverting from drain to vessel when wort is detected, ensuring temperature and aeration are being controlled to target, profile flow starting and finishing slowly, completing it in a specified time to avoid too much colour pick up in hot wort. All other processes should have been outlined in addition to stating the target values of oxygen levels, yeast pitching rate, fermentation profile and trigger points, yeast cropping, etc.

Question 2

With the aid of clearly labelled diagrams, describe in detail the design of a cylindro-conical fermentation vessel suitable for fermenting 2000 hl of wort. Include in the answer details of utilities and services requirements, and of control instrumentation to automate the operation to minimise manual input.

Describe in outline a calibration and preventative maintenance programme for this vessel that would minimise the risk of it failing to operate correctly.

Thirty candidates attempted this question with 26 achieving standard (86.7%). There were 4 very good answers.

Many candidates achieved acceptable marks with a good diagram where all the component parts of the fermenting vessel were clearly shown and labelled. Better marks were obtained with a calculation of the dimensions, and text supporting the automation and utilities/services requirements as asked for. Some scripts showed only a basic design with little evidence of insulation, cladding, sample points or automation.

The second part of the question, attracting 30% of the marks, sought a calibration and maintenance programme. A brief listing of items, possibly in tabular form, together with the work required and the frequency enabled good marks to be obtained in reasonable time. Some candidates were over-optimistic in specifying the frequency of some calibrations (e.g. weekly for temperature probes), whilst others failed to cover all the necessary items.

Question 3

Describe in detail the operational and control procedures for the processes of yeast cropping, storage and pitching that will optimise the condition of the yeast and the start of the subsequent fermentation process.

Thirty one candidates attempted this question, making it the most popular, with 24 achieving standard (77.4%) including 3 very good answers.

This question, like number 1, asked for operational as well as control procedures, this time associated with yeast management. Most candidates answered in this manner, so marks were elevated. Better answers included details of yeast selection, timing of processes, cleaning/sterilising of tanks and mains before use, equipment and procedures to ensure minimal damage to yeast cells during movement and storage as well as temperature and time specifications. Extra marks were awarded for reference to slurry dilution, avoidance of air contact and an outline of acid washing when necessary. Weaker answers generally failed to mention tank and mains preparation, optimum timing of cropping, or adequate values for storage temperature or time.

Question 4

Discuss the range of procedures available for measuring and accounting for the beer losses between wort collection in fermenter and filtered beer in bright beer tank.

What methodologies can be adopted to minimise these losses?

This was the least popular question, with eleven candidates attempting it but only 2 achieving standard (18.2%). There were no good answers.

The first part of the question, worth approximately half of the marks, sought details of how beer losses can be measured and accounted for. A good start would be a process flow diagram showing all movements in and out of the process stream. Then what was needed was a discussion of the way these could be measured, by flow metering, load cells, differential pressure devices, etc., together with a measure of extract (ABV or OE/OG). Then there should have been an indication of how these individual figures are used to calculate product losses overall and for each process over defined time periods. Very few answers addressed this part in any meaningful way.

The second part of the answer should have included indications of the management processes involved (data analysis, trend reports, target setting, problem solving techniques, operator involvement etc.) in tackling these losses, and the technical procedures that can be used to minimise loss at each process stage. This part of the question was generally answered better, with mention of controlling yeast growth, avoiding fobbing, interface control on transfers and filtration, leaks, centrifuge management, etc.

Question 5

Describe a system of monitoring and control procedures for the process of filtration from cold storage tank to bright beer tank designed to achieve consistent product quality and assured product safety.

Twenty one candidates attempted this question with only 4 achieving standard (19%), one with a very good answer.

This question sought information about monitoring and control procedures in relation to quality and food safety, marks for which were equally weighted. In a reverse of question 1, many answers described the process and had less content about the control procedures. For quality, ideal answers would have described a system of static in-tank analytical measurements and on- or in-line checks of key parameters such as dissolved oxygen, ABV and CO_2. Process monitoring checks such as dosing rates, pressures across filters and temperatures should also have featured. Means of detecting and correcting deviations from set points and ensuring sensors are accurate and reliable were also expected.

The topic of product safety was rarely answered well, and in some cases candidates failed even to address it. This should have included a brief summary of how prerequisites and a HACCP plan would be set up and monitored, and how they would apply to this part of the process. A simple table of potential hazards and their controls would have gained quick marks, e.g. coolant contamination from PHEs, heavy metals from filter aids, trace chemicals from CO_2 and dilution water, CIP residues, foreign bodies, etc.

Question 6

Compare and contrast the features of single-use and reclaim systems for the Cleaning-in-Place (CIP) of maturation/conditioning and cold storage tanks.

For a nominated system, define the cleaning cycle, the operating parameters, and the monitoring and control procedures necessary to ensure the process is successful over a sustained period.

Twenty seven candidates attempted this question with 16 achieving standard (59.3%). There was one very good answer.

The first part of the question was worth 44% of the marks. Many candidates were able to list up to six points of comparison, such as how the systems worked, relative capital costs, water and effluent impact, but few were able to cover aspects such as how to reuse rinse water, flexibility of chemical usage,

ability to perform simultaneous cleans, relative maintenance costs, internal cleaning of reclaim tanks, etc. Some candidates described the use of portable tanks on trolleys with moveable spray heads as an example of single-use systems. Credit was given for these, but the intention was to seek comparison with fixed installation single-use systems involving a buffer tank and closed-circuit cleaning loop.

The descriptions of suitable cleaning cycles were often quite vague and lacked sufficient detail. They should have included details of time, temperature, nature of chemical (not just "caustic" or "acid" or "sterilant") and nature of rinse water (reclaimed, fresh or sterile). Many candidates chose to monitor and control the process only on the basis of swabbing the tank and/or checking the rinse water microbiologically. Sensor calibration, cross-checking chemical strengths, visual checks, audit of the process, alarms and fail-safe procedures should all have been covered.

Jeremy Stead
August 2011

MASTER BREWER EXAMINATION 2011

Module 3 – Packaging and Beer Dispense

In 2011, 27 papers were received of which 13 (48%) achieved the pass standard. This represents a slight improvement on last year's performance.

Pass marks were seen at grades B, C, and D.

Paper 1 was slightly better answered than paper 2 with 15 (56%) passing the first paper as compared with 14 (52%) passing the second.

The overall performance in the examination has not changed significantly with the introduction of the new format. It could be seen that those candidates who scored well in one paper also scored well in the other and vice versa.

Paper 1 – Multiple Choice and Short Answer Questions

This paper covers the breadth of the syllabus and results ranged from 44/100 to 80/100. Marks available per question ranged from 1 to 8 and maximum marks were achieved in every question by at least one candidate except question 2 (where several candidates achieved 7/8). However, even on questions where 6-8 marks were available there were also several instance of candidates only scoring 0 or 1 mark indicating that this part of the syllabus had not been adequately covered.

In general, questions on bottling were answered the best, whilst plant sizing and dispense were answered more poorly overall. This may well reflect the exposure of candidates to the various packaging formats but would therefore re-emphasise the need to attain experience/exposure to the full range of packaging formats in order to score well in this paper.

Paper 2: Essay Questions

In paper 2 there was one unpopular and one very popular question and in general the pass rate for individual questions did not differ greatly from the overall pass rate for the paper.

Again, the best candidates were able to clearly demonstrate their knowledge and direct experience of a topic area. To score a good pass this standard is needed across a range of answers.

Generally, examination technique was good with very little evidence of candidates running out of time through poor planning again this year. However, it was noticeable that several candidates answered two or three questions well, but were not able to maintain the standard for the required four questions in paper 2, indicating that the breadth of the syllabus is not being addressed. It is almost always the case that four evenly spread answers will achieve a better overall result than all the effort being focussed in two or three answers.

As in previous years lack of detail in scripts, typified by answers containing only sweeping generalities, lead to very few marks being scored. For example it is not sufficient at this level to use adherence to a SOP as a solution to poor performance in a packaging plant without detailing what is in the SOP and why it is in there.

QUESTION 1 – Plant Design

An existing bottling line is capable of producing 200,000 hl of beer in 330 ml non-returnable bottles, packaging into corrugate cases. This volume is achieved currently using a 5-day, 2 x 8-hour shift pattern.

The output is to be increased to 400,000 hl and two new bottle sizes, 250 ml and 500 ml, are to be introduced. Further to this, the capability to pack into basket (drop-in) packs (4's and 6's) is required.

Describe what capital plant will be required and, with the aid of a diagram, show how the layout will be modified.

Identify any risks to the successful introduction of this increase in volume and complexity and describe how these risks could be minimised.

This was the third least popular question with 18 (67%) of the candidates answering of whom 9 (50%) achieved a pass making it the equal third best answered question.

The key to answering this question well was to address the significantly increased complexity. Without the complexity, the volume could be dealt with by doubling working hours. Good answers were able to deal with practical solutions to this which did not involve large expenditure on capital items. Conversely, those answers which effectively involved buying a whole new line did not score well.

QUESTION 2 – Dispense System Trials

Describe the key stages needed to develop and trial a new cooling and dispense system for keg beer.

Give details of laboratory and outlet testing which would be needed to approve the new system from both performance and regulatory compliance standpoints.

This was the least popular question with 6 (22%) of candidates answering. Of those answering 2 (33%) achieved the pass standard.

This style of question allows the candidate to display knowledge of the features of a dispense system as well as more general development processes and details of the critical parameters which need to be validated in testing and trialling. The lack of popularity of the question implies that this is not something which candidates are being exposed to, though the answers reaching the required standard were both very competent.

QUESTION 3 – Flavour Integrity

What are the main threats to the flavour integrity of beer packaged in cans? Assume that the bright beer is of sound quality.

Describe the processes and process controls which are used to minimise the risk of these threats to flavour integrity.

This was the most popular question with 26 (96%) candidates answering. There was a wide range in the standard of the answers and 13 (50%) achieved the pass standard.

Most of the answers to this question scored in a narrow band just above and below the pass standard though a couple of both good and poor answers were received. Most candidates could describe one or two threats but to score well greater breadth was needed. Similarly the process/process control part of the question needed to be addressed to score good marks.

QUESTION 4 – Budgets

Describe the components which make up a revenue budget for <u>either</u> a

keg filling or a cask filling operation.

Give examples of situations which can lead to adverse performance against budget and actions which could be taken to deal with these situations.

This was the second most popular question with 23 (85%) of candidates answering. This was the question which was answered the best overall with 15 (65%) achieving the pass standard.

Most candidates were able to produce a comprehensive list of components making up a budget and better answers included detail on relative magnitudes of the items. To discriminate between a pass and a high scoring pass, three to five good examples of correcting poor performance with details were needed.

QUESTION 5 – Supplier Approval

Describe the process of approving a new supplier of glass bottles.

Give details of the information which would be gathered through testing, trialling and visits in order to support an approval.

Once approved, detail methods for validating approval and monitoring on-going performance.

This was the second least popular question with 15 (56%) candidates answering. The question was also the second most poorly answered with 6 (40%) of candidates achieving the pass standard.

The key to a good answer in this question was to ensure all the parts requested were addressed and very high marks were achieved by a couple of candidates who did this. However, just addressing parts, for example just giving (albeit good) detail of a supplier plant audit is insufficient to score well.

QUESTION 6 – Technical Audit

For a bottling line, detail the equipment, process and procedural checks which need to be recorded in preparation for a customer technical audit.

This was a moderately popular question with 19 (70%) of candidates answering. Of those answering 10 (53%) achieved the pass standard.

In order to score well in this question the viewpoint of the customer needed to be taken into account. Poorer answers gave full details of a range of checks and records which a customer would have little or no interest in, whilst missing those which show how on-going quality and supply are maintained.

Jon Brown
August 2011

MASTER BREWER EXAMINATION 2011

Module 4 – Resource Management And Regulatory Compliance

A total of twelve candidates attempted the two examinations.

Paper 1 – Multiple Choice and Short Answer Questions

The multiple choice and short answer questions were designed to cover the syllabus with a range of depths and difficulties.

The results were a little better than in 2010 with the best candidate achieving 73 marks out of 100 whilst the weakest achieved 51.

In general questions on the environment, health and safety and quality assurance were answered more strongly than finance, supply chain and resource planning. Particular strengths were shown in the fields of environmental impacts (Q2), risk management (Q9), auditing (Q14), HACCP (Q15), and barriers to change (Q32).

Q1 (guiding principles of sustainability) was not well answered with the majority of candidates going down a route of the hierarchy of waste which can be an interpretation of one or two principles only. The guiding principles are fully listed in the syllabus itself!

One of the safety questions (Q10 – a list of aspects of Health and Safety regulation, or duty of care, having a direct impact on brewery employees) did not produce the expected good answers. The examiner was looking for specific examples which might have included: risk assessment, personal protective equipment, control of hazardous substances, electricity, pressurized systems, machinery guarding, asbestos, noise, vehicle movements etc.

Paper 2: Essay Questions

Question 1 :

Describe the cost benefit hierarchy for achieving water savings. Explain how the cost benefit hierarchy can be used to provide a structured approach to a water use efficiency strategy.

Three candidates chose to answer this question with disappointing marks (out of 25) ranging from 6 to 12.

The examiner was seeking a description of the cost benefit hierarchy as detailed in the water conservation section of the syllabus rather than a (i.e. any) cost benefit hierarchy. The hierarchy which incorporates "reducing uncontrolled water use (housekeeping)", "improving control (management)", "reusing water", "recycling water" and "design improvements" incorporates principles which can, of course, also be transferred to energy reduction or waste minimization.

Having described the cost benefit hierarchy, the second part of the question should have been straightforward. A structured approach of starting with housekeeping to create a culture of saving (low hanging fruit, quick wins etc) escalating through the stages with additional time and cost required for the more difficult tasks. Step wise reductions in water use would probably require plant or process redesign and capital expenditure – hence the final stage in the hierarchy. The examiner would have expected examples to illustrate answers.

Two submissions favoured a Pareto approach based on a mass balance estimate of water use, essentially a Monitoring and Targeting approach. This can, of course, often be appropriate but does not directly answer this question.

Question 2 :

Explain "Safe Working Practice" and "Permit to Work". Using examples, describe the distinct purposes for each and how each may be developed and improved.

This question was attempted by all candidates with marks ranging from a disappointing 10 to an excellent near model answer 22 marks. As in previous years, Health and Safety management is rightly recognised as an area of high competence for most candidates sitting the Master Brewer examination. This competence was again apparent in four of the submissions this year.

Explanations of SWP and PTW varied considerably but were generally sound. A SWP is the systematic examination of a task in order to identify all hazards. The aim is to produce a safe work method that will eliminate or reduce the risks associated with the identified hazards. This leads to procedures being in place before an activity takes place. SWPs should constantly be reviewed and improved. A PTW is a formal written system used to control certain types of work which have been identified as potentially hazardous. It is also a means of communications between site management, supervisors and operators and those who carry out the work.

One candidate mistakenly stated that PTWs are documents to control activities only when the plant is shut down and isolated. There can, of course, be instances when PTWs cover work (often by contractors) on live electrical systems, breaking into pressurised steam, hot water and gas systems etc. Another candidate mistakenly thought SWPs only apply to maintenance activities.

In answering the second part of the question the better candidates provided credible examples to describe the purposes of SWPs and PTWs. For SWPs examples included cleaning, low level maintenance, fork lift truck operations etc although several candidates pointed out that many operational activities are covered by SWPs these days as a result of statutory requirements for risk assessments. For PTWs, examples included hot work, removing equipment where electrical and / or mechanical disconnection is required, entry into confined spaces, fault finding, many maintenance activities etc. Candidates seemed less sure on how developments and improvements can be made – just two described structured processes of monitoring and periodic review.

Question 3:

Explain how food safety is assured when specifying new plant and equipment. How can Best Available Techniques (BAT) be incorporated into the design and operation of new plant?

Ten candidates attempted this question with marks ranging from 7 to 17.

This question was intended to test the candidate's ability to consider designing in food safety for new plant installations, using best available techniques where appropriate. Most candidates referred to HACCP in some detail but failed to link with the overall design and installation process. Only one candidate referred to BAT, one referred to outside references and one used some very good practical examples but no reference to BAT.

It would appear that in most candidates' minds food safety equates to HACCP and some routine detailed explanations of HACCP can be expected in the answers. Any question on this part of the syllabus will be looking for the ability to set product quality and food safety in the context of new plant development as a holistic approach to balance the requirements of installation cost, efficiency and food safety.

Question 4:

List the principal items in a fixed cost revenue budget and explain how an annual budget is constructed. Explain the fixed, semi-variable and variable components of an electricity budget and how the value of these components can be established for budgeting purposes.

Seven candidates chose to answer this question. Marks ranged from 9 to 17.

There were some wide variations in understanding of fixed costs but some candidates did express a good understanding of base load electricity as fixed, variable as volume related and semi variable as seasonal or product mix related. Some split out office based costs. With refrigeration usually around 50% of electrical costs, the fixed element can often be relatively static.

Although many breweries regard all electricity costs as fixed, a clear understanding of the impact of volume, seasonal or SKU variances will lead to better targeted energy reduction programmes or allocation of overhead costs.

Sub Metering key areas of the brewery by machine or packaging line with a monitoring device or connection to a monitoring and targeting system would provide the time based information to help construct more relevant accurate budgets and assist estimating the impact of an unplanned change in volume or mix. By looking at hourly, daily and weekly consumption over the year and relating to brewing and packaging patterns the data can be analysed to help predict a profile of costs and whether they are fixed, variable or semi variable.

Computers can be used to assist the analysis but statistical methods also apply.

Question 5:

Explain how a forecast can be turned into production plans and schedules. Describe the options for recovery following a long plant breakdown or maintenance overhaul.

This question was answered by six candidates with two poor answers (5 and 6 marks), the remainder being satisfactory (13 to 16 marks). Disappointingly there was no outstanding answer.

In general candidates did not link the market intelligence that is necessary to create a forecast with the detailed time based breakdown to convert into a meaningful brewing plan or related schedule for packaging lines. Factors such as changes in the weather were mentioned but sales promotions or product launches did not feature.

For a cask brewery a minimum of 2 weeks might be necessary to supply more beer, for a brewery conditioned beer, 3 weeks and above would be normal. Most breweries will have some kind of buffering in conditioning tank or have developed beers that can be quickly created from a mother brew but that does not reduce the need for as accurate forecasting as possible.

Forecasts will come in from the various trade channels as finished goods in various pack types which will require working back into the different brews required over varying times. It is also critical to re-assess on at least a weekly basis to ensure the longer term forecast is still valid on a rolling basis.

An overhaul is a planned event so would normally be planned for a quiet time of year, if that exists and stocks would normally be built up to cover the stoppage. Shelf life is a consideration that makes even a 1 week shutdown on a cask line difficult but 2 weeks for a can line relatively easy. Start up after a major overhaul can often be slow as each part of the plant comes to life and contractors are normally retained for a few days to ensure the works have been carried out satisfactorily.

A major breakdown would be more difficult to deal with particularly if stock levels are maintained at low levels or make to order levels. Options for recovery would include: 24 hour working, use of another plant or outsourcing, re-scheduling or rationing customer orders and substitution with other products. The effect on customers is damaging so a full enquiry and plan to eliminate the problem would be carried out.

Question 6:

Explain the five "lean" principles. Propose a strategy for the "lean" journey.

Seven candidates attempted this question with only one good answer. Marks ranged from 7 to a very good 19.

The question was specifically targeted and narrowly focussed on Lean Manufacturing which merits its own section in the syllabus within the broad category of World Class Manufacturing. Candidates are expected to read around and study the syllabus sections and texts on Lean Manufacturing are readily available. Had the question asked about the broader World Class Manufacturing, two candidates would have provided very good answers including detailed drawings of the WCM Parthenon with its 5 columns and foundation stones and descriptions of key themes – asset care, administrative excellence, quality, set-up time reduction, preventive maintenance and so on. At least two other candidates attempted to address the question by explaining the virtues of continuous improvement, the Deming cycle etc. again in the context of WCM.

As the candidate who provided the one very good answer explained, the five lean principles are "value", "the value stream", "flow", "pull" and "perfection".

Again, the one very good answer provided a sound strategy for the lean journey and fitted closely with the examiner's own model:

Get started (6 months): Find change agent, get lean knowledge, find a leader, map value streams, expand scope.

Create a new organisation (6 months through to year 2): Reorganise by product family, create a lean function, devise a policy for excess people, devise a growth strategy, remove anchor draggers, instill a perfection mindset.

Install business systems (Years 3 and 4): Introduce lean accounting, relate pay to firm performance, implement transparency, initiate policy deployment, introduce lean learning, find right-size tools.

Complete the transformation (By end of year 5): Apply same steps to suppliers / customers, develop global strategy (if appropriate), transition from top-down to bottom-up improvement.

Robin Cooper
August 2011

MASTER BREWER EXAMINATION 2011

Module 5 – Dissertation

General comments

This is the second year of the dissertation format for module 5, with ten submissions (three in 2010) all of which achieved the required standard.

There were three dissertations that were awarded 'distinctions', seven were awarded 'pass' grades, but three of these were of borderline standard.

The examiners were very pleased with the dissertations received and the feeling is that the concept brings out capabilities not necessarily seen in traditional written examinations or the original module 5 case study.

As with last year, the topics were wide ranging and would have been very beneficial to the candidate's organisation as well as the candidate. All the topics had either financial, quality and capacity benefits – or a combination of all three, and again there were examples of how attention to detail and often quite simple, low cost solutions could make significant improvements to an operation.

The high 'pass' rate is a reflection of the time and effort put in to carry out and write up a project. It is easier to go into a three hour exam with limited preparation than to carry out a 6 month project where an unsuccessful entry would have meant far more time and effort wasted. Although not in examination conditions, the overall demonstration of knowledge and experience shown in the dissertation is generally higher than with traditional written exams. It is interesting to note that all candidates who submitted a dissertation did well in modules 1-4, and five achieved master brewer status.

Choice of topic

These were very diverse, ranging from an IOB assessment of new malting barley, to the installation of a new packaging laboratory and a major capacity upgrade in an overseas brewery. There were other dissertations covering brewery quality improvement, and others on plant enhancement and optimisation.

The choice of topic was important when considering the overall standard of dissertations, with the best submissions being narrower in scope and easier to structure and write up. Candidates were also better able to define measure and discuss the results and how the project went, as well as demonstrate their own personal involvement.

Topics, such as major brewery developments, tend to be overly complex and are not easy to write up . These projects can become more of a project commentary rather than results driven and it is difficult for the examiner to assess the level of the candidate's contribution.

Dissertation structure

The way in which candidates structured dissertations, made a big contribution to the overall mark. Candidates who had read and followed advice in the syllabus and last year's examiner's report achieved higher marks than those who had not.

The distinction standard submissions had a limited, clearly -defined scope, were well structured and had measurable success criteria where the benefit to their organisation was easily identified.

Submissions from borderline candidates often lacked structure, or failed to give a proper 'purpose' or set clearly defined 'success criteria' for their project. A lack of structure could lead to a 'fail' assessment, and a lot of good work could have been wasted for the sake of not following IBD guidelines and recommendations.

There is some confusion over the terms 'background', 'purpose' and 'success criteria'. These terms may vary in different organisations, but to help future candidates the examiner's view is :

'background'
This is a 'scene setter' and describes the situation and context in which the project is carried out.
'purpose'
The purpose of a project is 'why' it is being carried out. It can nearly always be answered by '….in order to ….'

'success criteria'
This is a list of measures or actions which support the 'purpose' and can be used to demonstrate the degree of success of a project. They can be measures e.g. of efficiency (OEE), financial, improvements in quality. It is good practice at the end of a project to review the outcome against the original success criteria. E.g. – the original set success criteria could be 'to increase the overall efficiency (OEE) of a bottling line from 55% to 75%'. The project review would report what was achieved e.g. 'the original success criteria was achieved and the OEE was increased from 55% to 78%'

'executive summary'
The inclusion of an executive summary was recommended in last year's report. Half of the candidates provided this and it gave the examiner an early and brief insight into the overall project. In some projects, the word 'abstract' may be a more suitable title.

'presentation of results'
Results tables and comparisons, where appropriate, against the project 'success criteria' are very beneficial. A long list of descriptions such as: 'the air in headspace in bottle beer was significantly improved' was good to know, but submissions at master brewer level should contain more detail, reporting of how much in quantitive terms the improvement had been.

'assessment of how the project went'

The better submissions described what the candidate themselves could have done differently, and any difficulties they had. The poorer submissions focused more on problems outside their control. However, one candidate had plant delivery delayed due to a tropical typhoon; this is relevant information there was certainly no control over. The same candidate also lost key installation and commissioning staff for one month over the Chinese New Year at a critical time, which would also have been troublesome!

Presentation
The general formatting of dissertations this year was very good, with none of the problems encountered in 2010 being evident.

Most submissions were within the 8-10,000 word requirement, one or two were over this, with a maximum of 12,000. Note that none of the distinction level dissertations were over 10,000 words.

Paul Buttrick
Richard Westwood
August 2011

DIPLOMA IN BREWING EXAMINATION 2011

Module 1 –Materials and Wort

The examination was sat by 261 candidates, compared with 244 candidates in 2010 and 209 in candidates in 2009. The pass rate for the examination this year was 52%. This compares with a pass rate in 2010 of 65% and 2009 of 74%.

The grade distribution was as follows (2010 in parenthesis):

A:	2 %	(1%)
B:	8%	(14%)
C:	18%	(22%)
D:	24%	(28%)
E:	22%	(18%)
F:	16%	(12%)
G:	10%	(5%)

Once again the examiners request that you number each question that you have answered clearly in the examination booklet as well as marking on the front of the examination booklet what questions were attempted, for example, Q1, Q2 etc, in this way sections or parts of answers will not get mixed up. It is of utmost importance for the candidate to indicate clearly on the first page of the examination booklet the questions, in order, that they have answered. It is also better if the candidate starts each question on a fresh page. The very best candidates showed an ability to write quickly, legibly and clearly, using diagrams that were accurately labelled to enhance their answers. One troubling trend noted regarding this years' examination was some candidates' failure to recognize what the question was asking. There continues to be candidates that have difficulty in writing legibly or coherently which does make it much more difficult for the examiner to correctly assess their paper. In the case of those candidates that were close to pass/fail this inability may have been an impediment to receiving a passing grade.

Question 1

What are the most important qualities of a barley malt destined for use in conjunction with an adjunct of unmalted cereal in a brewery grist (8)?

Give typical specifications for each of these quality parameters for <u>either</u> an ale <u>or</u> lager brew and explain their relevance to the brewing process (12).

This question was attempted by 234 candidates (89%) with 56% achieving the pass mark. Part B was generally better answered than Part A. In Part A, the examiner was looking for a list including barley variety, free from pests and contamination, low in dust with whole kernels in terms of physical characteristics. More importantly, in terms of use in conjunction with adjunct are enzyme activity, free amino nitrogen content, moisture, extract, modification and colour. Many made the incorrect assumption the examiner was looking for the barley selection criteria for malting. In Part B, many of the candidates did not identify the brew type (ale or lager) and it was left to the examiner to infer as to which the specifications pertained. Additionally, many of the candidates did not explain the specifications relevance to the brewing process. Top answers matched qualities from Part A with their specifications, in addition to other important malt specifications and provided the linkage to the brewing process.

Question 2

With respect to their chemical and physical properties, list and discuss six attributes of adjuncts which have a significant bearing on their functionality and use in brewing (12).

Give an account of the range of commercial enzymes that are relevant to brewing (manufacture of adjuncts, mashing, cereal cooking) and briefly discuss their advantages and disadvantages (8).

This question was attempted by 169 candidates (65%), with 54% achieving the pass mark. Once again, many candidates did not answer the question posed by the examiner in Part A. Many spent their time listing all possible adjuncts and their manufacture, while that was not the question asked. The examiner was looking for attributes such as decreased protein levels thereby increasing beer stability (lowering haze potential) and reduced capacity for microbial infection-thereby improving shelf life. Lower lipid material present when using adjuncts reducing staling reactions and guarding against loss of head retention. Less cell wall material is present when adjuncts are used which reduces beta-glucan and pentosan thereby improving viscosity, lautering and filtration. Adjuncts contain different proteins and proportions of proteins, which may improve or reduce head retention. Different temperatures of starch gel temperatures in adjuncts may impose additional processing steps (i.e. cooker). Altered fermentable sugar spectrum in adjuncts could affect product flavour profile and of course lighten the colour of the final product. In Part B, many candidates listed several commercial enzymes without detailing their use in brewing. Others listed trade names without a description of use, while several candidates simply listed those enzymes that are present in malt barley. The top marks were received by those candidates that listed several of the criteria required of commercial enzymes (i.e. must be stable and consistent, microbiologically pure, no side activity enzymes, free from bacterial proteases) as well as the source for the enzymes discussed (deep stirred fungal or bacterial cultures). Candidates who received top marks listed and discussed heat stabile amylases, amyloglucosidases, b-glucanases and papain. Other enzymes discussed included mixed (alpha and beta amylase), glucose oxidase and Diacetyl reductase.

Question 3

The following treatment processes may be required for brewery water supplies. For <u>each</u> process, explain briefly why the treatment could be necessary, how the procedure is carried out and its relevance to beer quality:

Demineralization (5)
Selective ion removal (5)
Activated carbon treatment (5)
Sterilization (5)

This question, attempted by 179 candidates (69%) with 68% achieving the pass mark, was generally answered well. Candidates that achieved top marks clearly explained the process (with the aid of a diagram) as well as linking the requirement and relevance to the brewing process. Demineralization is a carried out to completely remove any ions in the water that may cause off-flavours in beer or interfere with chemical reactions in the brewhouse, and can be achieved through distillation, boiling along with using lime to precipitate harness, ion exchange or reverse osmosis (RO). Demineralised water can be used in boilers to reduce scale, or in water softener feed as well as a feed to prepare brewing liquor (with appropriate mineral re-addition). Selective Ion removal is a process whereby an unwanted ion is selectively removed, to be replaced by another through anion or cation exchange resins. Top marks were received for those candidates that detailed the exchange processes. RO is another process that can be used for selective ion removal. Ions that are harmful to the brewing process if too high in concentration such as copper and iron can be removed to enable proper brewing process and yeast metabolism as well as the elimination of beer off-flavours. Activated carbon treatment is used to remove organic material as well as colour and odours. Activated carbon is derived from coal or coconut and has high internal pore volumes such that impurities are absorbed into this honeycomb. The activated carbon has a finite capacity and must be regenerated on a regular basis by heat (hot water) or steam sterilization (to remove microorganisms that will build up on such a system). Activated carbon can be used to remove halogens such as chlorine and limit the formation of trihalomethane. Water from this system can be used in the brewhouse as well as for feed for dilution water. There are many ways to sterilize water to remove microorganism, including boiling, chemical (chlorine, chlorine dioxide, ozone) physical treatment (filtration or ultraviolet light). Top marks were given to those that detailed these processes.

Question 4

Provide an account of the range of hop products available to add bitterness to beer and describe their typical usage. (12)

Discuss the relative advantages and disadvantages of each product, and, in particular, their utilization efficiencies in the brewery. (8)

This question was answered by 238 candidates (91 %) with 50% achieving a pass mark. The standard of answers to the question was extremely variable with some very good papers and some extremely poor answers. In many cases the candidates did not read the question or instead decided to answer the question they wished had been asked and wasted their time and received no marks for irrelevant facts. Despite the question clearly stating that the question was about adding bitterness, many candidates discussed aroma and many also included some very detailed hop chemistry. The list of hop

products included by candidates was variable and should have included – whole hops, Type 90 pellets, Type 45 pellets, stabilised hop pellets, isomerised hop pellets, hop extracts produced with either solvent or CO^2 (liquid or supercritical), IKE, PIKE, IHE or PFB, reduced hop extract (RHO, Tetra, Hexa). The candidate should also have provided a brief description of their production and how and where they are used in the process. These products have been in focus in the last few years particularly with the dramatic rise in hop prices a couple of years ago and also the supply difficulties. This raised the importance of utilization efficiencies in the brewery and in many cases justified the extra processing costs needed for these products. Many candidates did not quantify the efficiencies achieved for the various products and were given reduced marks. A good answer would have also discussed the balance between increased efficiency and product cost. The advantages and disadvantages of each should also have been included and this should have been more comprehensive than simply quoting reduced storage space and improved stability.

Question 5

Explain the physical principles underlying the mash separation process. (5)

With reference to these principles compare and contrast the design and operation of a traditional Mash Tun, a Lauter Tun and modern Mash Filter. (15).

This question was answered by 228 candidates (87 %) with 49% achieving a pass mark.

The first part of the question was looking for Darcy's law

$$Q = \frac{-kA\,(\Delta P)}{\mu\, L}$$

Q	units of volume per time
K	permeability of the medium
A	the cross sectional area to flow
ΔP	differential pressure
μ	Viscosity
L	the length the pressure drop is taking over

The negative sign is needed because fluids flow from high pressure to low pressure. The various factors should have been discussed and their relevance in mash separation explained.

This part of the answer was generally well answered although there were some alarmingly bad answers. The law was also credited to either Dalton or Stokes by several candidates.

The second part of the question was an opportunity to describe how these principles are applied to the traditional Mash Tun, Lauter Tun and a modern Mash Filter. Many took this part as an opportunity to solely describe the mash separation processes, rather than actually concentrating on how they exploit Darcy's law and their relative efficiencies in this respect. This would have included the relative bed depths, filtration surface areas, the opportunity to apply pumped or squeeze pressure, opportunities to reduce the viscosity by raising the mash temperature prior to separation and also the relative permeability of the mash due to the difference in grist composition. The typical grist compositions should also have been provided.

There were many candidates who seemed to be unaware of the design features of a traditional Mash Tun and either described a Mash Conversion Vessel or a strange hybrid of a MCV and a Lauter Tun. Candidates for this examination should have an awareness of all the equipment likely to be found in modern breweries.

Question 6

Describe the physical and chemical changes that occur during wort boiling including why they are important and how they are affected by the boil conditions. (20).

This question was answered by 246 candidates (94 %) with 61% achieving a pass mark.

This was a very popular question and was generally well answered as would be expected with what is a core part of brewing knowledge. There were however some alarmingly poor answers and these may indicate candidates who are totally unprepared for an examination at this level. There also seems to be a misconception that Strecker degradation reactions lead to colour formation, whereas this specific reaction produces aroma compounds.

Some candidates included a lot of information on kettle design (again answering the question that they wished had been asked!) which was not needed except where it demonstrated how the boil conditions could be changed. Many candidates also only listed the physical/chemical changes without any indication of how they are influenced by the boil parameters.
A good answer would have included the following.

Wort sterilisation.
Enzyme denaturing and fixing the wort composition.
Concentrating the wort and also why this is important with modern processes.
Colour development including Caramelisation, Maillard reactions and polyphenol oxidation.
The stripping of volatiles and also the production and removal of DMS.
The significance of adding aroma hops late in the boil.
pH reduction and the associated reactions.
The precipitation of calcium oxalate.
The solubilisation of alpha acid and the isomerisation to iso alpha acid.
The dissolving, mixing and sterilising of adjuncts.
Protein precipitation.
The extraction and precipitation of tannins and polyphenols including hot and cold break.
The production of reducing compounds and their significance to the beer.

Question 7

List the various parameters that may be used to characterize brewery effluent and how they are determined. (8).

Outline the sources of waste water and the relative contribution to these parameters, from all brewery operations including packaging and briefly describe how they may be reduced. (details of effluent treatment plants NOT required). (12).

This question was answered by 128 candidates (49 %) with 66% achieving a pass mark.

The standard of answers to this question was extremely variable. A few candidates obviously had a good knowledge of this part of the syllabus and produced very good detailed answers which scored good marks. The majority of candidates, however, appeared to choose this question as 'filler' as they were running out of questions of which they had sufficient knowledge. This was very apparent with the first part of the question where the candidates had obviously heard of BOD and COD but did not understand what they measured and in particular how the determination was carried out. The second half of the question was also often answered in a very waffley style on the basis that if they scattered around as many facts as possible they may pick up a few marks. The question also clearly states that 'details of effluent treatment plans NOT required' but still there were quite long answers covering aerobic and anaerobic plants. The answers may be very good but will not attract any marks at all if they are not what were asked for.

The first part of the question was about characterizing brewery effluent and factors such as BOD_5, COD, suspended solids, pH and temperature were required as a minimum as they are either normally the basis of charging for effluent treatment or are subject to a restriction. The examiner was also looking for details of how each of these factors is determined.

For the second half of the question the candidate should have taken the entire brewery and packaging operations and covered the sources of effluent from each area including the reason for the production, the expected contribution to the above parameters from each source and how each could be reduced. A summary across the entire process showing the relative contributions to the factors would lend itself to a tabular answer.

Question 8

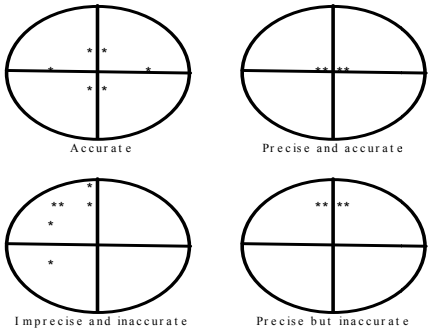
Define the terms *accuracy* and *precision* in relation to a series of instrumental measurements. Draw a diagram to illustrate the distinction between them (6)

Define the meaning of the terms *repeatability* and *reproducibility* and explain how they apply to methods of analysis in the laboratory (4)

Write brief notes on the techniques which are typically used in the brewery analytical laboratory to measure EACH of the following parameters:

1. **Malt Friability (3)**
2. **Total Nitrogen (content of malt, adjuncts wort) (4)**
3. **Free alpha-amino Nitrogen in wort (FAN) (3)**

This was least attempted question with only 114 candidates (44%) choosing to answer. This question also had the lowest pass rate at 43% achieving the pass mark. Accuracy is defined as the ability of an analytical method to provide results equal to the true value while precision is the amount of variation in a method. Top marks used diagrams to describe the differences (accurate, precise and accurate, imprecise and inaccurate etc).



Repeatability (r_{95}) is traditionally defined as when repeated analysis of the same sample, by the same analyst using the same equipment at the same time gives results that fall within the stated range 95% of the time. Repeatability is generally used as an internal laboratory check.

Reproducibility (R_{95}) can be used as a between laboratories method check and is defined as when repeated analysis of the same sample by different analysts using different equipment at different times time gives results that fall within the stated range 95% of the time.

Malt friability is measured using a Friabilimeter in which the crushability of malt is determined. Malt is added to the device and crushed and the amount that passes through a screen determines the final number (F %=(50-weight of residue) X 2). Typical values should be above 75% and peak around 95%.

Total Nitrogen can be measured a number of ways, by digestion (Kjeldahl), by combustion (Dumas) or by near IR. The Kjeldahl method has three major steps: digestion, distillation and titration. During digestion, the nitrogen-containing organic matter is broken down in a strong acid to create ammonium sulfate. During distillation, excess base is added to convert ammonium [NH_4^+] to ammonia [NH_3]. This is boiled and the released ammonia gas is condensed into a receiving solution. This solution is titrated to quantify the amount of ammonia ions and the amount of nitrogen can then be calculated. In the Dumas method, a ground sample is combusted with oxygen, reduced to nitrogen, and measured with a thermal conductivity detector (much like gas chromatography). These methods both measure nitrogen so a factor of 6.25 must be applied to convert to protein.

Free amino nitrogen is measured by reaction in Congress Wort with ninhydrin, which is then measured spectrophotometrically. FAN may also be measured using HPLC with fluorescence detection. Typical values in wort are around 150 ppm.

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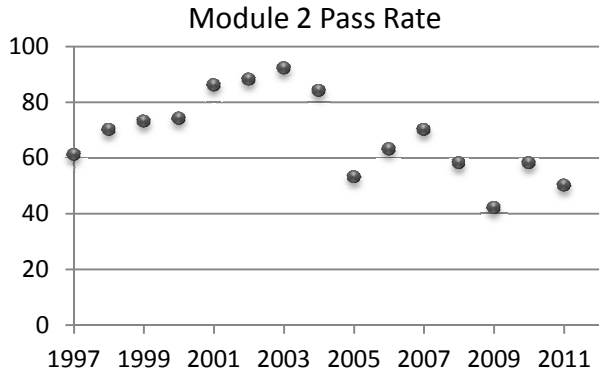
August 2011

DIPLOMA IN BREWING EXAMINATION 2011

Module 2 – Yeast and Beer

In all there were 228 submitted scripts which built on the 215 from 2010 and maintained the step change from 2009 (161 scripts) and 2008 (166 scripts). This was the first year that Module 2 was examined by two examiners who - with a common marking scheme - split the papers equally and marked the complete book. In all 114 candidates achieved a pass grade to give a pass rate of 50%. This (see below) continues the 'middle quartile' performance seen in recent years which - during the last seven years – results in an average pass rate of 56 ± 6%.



Analysis of the grades (Table 1) shows that in 2011 there were more A and B passes than any year since 2007. This is encouraging. However, once again 50% or so of the grades straddled the D/E bands. Of some concern this year, the split between pass and fail was similar whereas in previous years the split has favoured the 'pass' D grade.

Table 1: Overall pass/fail rates and grades

Passed	**114**	**50%**
Grade		
A	2	0.9%
B	13	5.3%
C	38	16.7%
D	61	26.8%
Failed	**114**	**50%**
Grade		
E	58	25.4%
F	34	14.9%
G	22	9.7%

As ever, analysis of questions that were answered and the corresponding pass rate was illuminating. Four questions (Q1, Q3, Q4, Q5) were answered by 80% or more of the candidates, three (Q2, Q6, Q8) by 65-70% with Q7 being least popular with 48%. This year the success rate with the questions was broadly similar (49 ± 7%) unlike 2010 where the average whilst higher was also wider (58 ± 16%).

Table 2: Performance by question

Question	Answered by	Passed by	Passed %
1	183	94	51
2	160	66	41
3	184	77	42
4	198	128	65
5	207	113	55
6	166	67	40
7	110	50	46
8	147	77	52

Moderation
Of the 228 manuscripts, 82 at Grade boundaries were moderated by Alastair Pringle with 39 gaining marks and 24 remaining unchanged.

'Do's and don'ts' for success in this (and other) examinations!
Building on last year, rather than adopting a wordy approach to suggestions and guidance for future candidates here are our 10 'top tips' in the form of do's and don'ts.

- Do read the question, reflect on what is being asked and then plan your answer. Mind mapping is helpful and, pleasingly, increasingly used.
- Do answer six questions – however briefly.
- Don't play 'hunt the question' with the Examiner. New question, new (right) page. The answer should be on successive pages not scattered haphazardly around the answer book. There is no need to leave two or more empty pages between answers.
- Do mark up questions attempted on the front page and in the order answered. Also number your answers within the answer book.
- Do write as legibly as you can. If it's unreadable marking is difficult and will potentially miss things. Break-up your answer, use paragraphs and headings to improve the reading 'experience'. Also don't use liquid paper to manage corrections, a line through is good. Spelling is nice but by no means critical.
- Do make an effort with drawings and schematics – use colour, label legibly and use an appropriate scale.
- Don't begin your answer by writing the question out and please don't use a pencil to write your answers.
- Don't waffle, crack jokes or appeal to the Examiner to be kind, sympathetic etc.
- Do manage your time.
- Do add lists and tables if they add value – ensure they are appropriate and contain enough 'meat' to support the answer.

Questions and answers

As ever some pointers for candidates, mentors and trainers.

- The questions and answers are firmly based on the syllabus. The revision notes provide a firm grounding but understanding is key. Learning and then replaying them – especially when irrespective of context – does not guarantee success.
- Reading around the subject can make a huge difference. Read the popular brewing press particularly the readable articles linked to Diploma content. Similarly pdf's of useful articles can be sourced from the IBD website (see Learning/Learning Resources/technical and training material and reading list).

Question 1

Describe how and why brewery fermentations are controlled and managed (20 marks)

The focus of this question was on the inputs and outputs. Marks were split between the 'how' (15) and the 'why' (5). Considerations in the former included yeast cropping/storage, yeast pitching rate/viability, wort quality and composition, wort oxygenation/aeration , FV geometry (headspace, pressure), present gravity and ethanol, temperature control and profile and diacetyl management.

The 'why' captured product quality and consistency of flavour and aroma together with broad impact of yeast growth on flavour, ethanol yield, cycle time and capacity.

Comment - whilst a broadly formulaic question less than convincing (and poorly rewarded) answers included comment on brewhouse procedures (this is paper 2 'beer and yeast'!), CIP and HACCP with the stock download of glycolysis and other metabolic pathways.

Question 2

Critically review the methods available for the measurement of (a) yeast viability (10) and (b) yeast pitching rate (10)

With 'yeast viability' the examiners expectations were for answers that considered the 'pro's and con's' of the primary methods (methylene blue and plate counts). Particular focus was on simplicity, speed and limitations. Three marks were awarded for consideration of more niche methods (e.g. slide culture/microcolony, safarinin O, aniline blue/crystal violet/rhodamine B) or more speculative (flourescence methods, ATP/NADH).

Similarly with 'yeast pitching rate' the focus (8 marks) was on the standard approaches (wet/pressed/spun weight v cell count via haemocytometer and methylene blue together with on-line viable biomass monitors. Niche methods - particle counter and turbidity/NIR – were recognised with two marks. Consideration of the pro's and con's include simplicity v skills, application, cost, accuracy, in-line v off-line, responsibility for sampling and testing and representative sampling.

Comment - this question achieved a relatively low pass rate of 41%. The clues to a good answer are in the question ie 'critically' and 'methods'. A number of candidates gave a blow by blow account of MeBlue staining and many others trotted out a raft of 'vitality' methods (which ere not asked for!) ATP had a surprising number of supporters as a handy method of controlling pitching rate. Some were clearly confused between the use of MeBlue to determine viability and its use together with a haemocytometer to establish a viable cell count. Many answers on the on-line biomass technology were very woolly indeed with little comprehension of the technology behind the approach.

Question 3

Describe the nature, purpose and function of processing aids available for use during beer maturation/cold storage (20)

A straight forward question with marks awarded for an appreciation of the role of the process and the nature, purpose and function of the various processing aids e.g. finings (isinglass, auxiliary), tannic acid, enzymes, silica gels, PVPP together with combined treatments.

Comment – again the clue was in the question. Regrettably no marks were awarded to those candidates who threw in colour, hop products, PGA, gases, fermenting wort etc, etc. In passing 'brand names' should not be used when describing a processing aid.

Question 4

(a) Outline the basic principles and operating procedures of successful beer filtration (10)

(b) For two of the following, outline the strengths, application and weaknesses in brewery operations of:

- powder filtration (5)
- membrane filtration (5) and
- cross-flow filtration (5)

In the first part, definitions were rewarded ('filtration', 'primary' 'sterile') together with the underpinning Darcy's equation and its interpretation. Good answers included an understanding of the types of filtration and powders together with building a filter bed. An appreciation of parameters – temperature and impact of beer OG and the use of dearated liquor- was also expected.

For the second part, typically a mark or so was given re 'applications' with four marks for 'strengths' and 'weaknesses'. Strengths included cost, flow rate, efficiency (powder), sterility and flow rate (membrane), versatility and flexibility (cross-flow). Weaknesses included disposal, H&S, labour, water usage, footprint (powder), need for pre-filtration, cost plus cleaning (membrane), energy costs, beer losses, cost of cleaning and capital costs (cross-flow).

Comment - A popular question with a good pass rate of 65%. Repetition of the same points was not rewarded nor was lengthy rambles on centrifugation or upstream processing to minimise haze components. A number of candidates depended upon a complete description of powder filtration as a complete understanding of the spectrum of filtration systems used.

Question 5

(a) Describe the components in beer that impact on beer foam (10) and

(b) What other factors impact on the appearance of dispensed draught beer in a glass in a retail outlet (10)

A meaty question where in part 'a', good answers included a consideration of gases, hydrophobic glycoproteins, (reduced) iso-alpha acids, divalent metal cations, foam formation and stability, raw materials, processing and yeast. In part 'b' there was much to choose from including gas type and blend, temperature (beer and glass), dirty glassware, dirty dispense lines, nucleation sites, shape of glass and pouring technique sparkler/creamer, beer colour and clarity.

Comment – this year's most popular question (91%) and second best pass rate (55%). However some candidates simply pitched in a bunch of keywords without any attempt to provide context. For part 'b' some candidates ignored the question and just braindumped – to little useful effect - a collection of paragraphs often about haze formation.

Question 6

(a) Compare and contrast the use and role of 'descriptive tests' in the assessment of beer (10) and

(b) Write brief notes on the contribution to beer flavour and aroma of:

- **Ethanol (2)**
- **Higher alcohol (2)**
- **Dextrin (2)**
- **Diacetyl (2)**
- **Hydrogen sulphide (2)**

The first part of this question was specifically about 'descriptive tests' (and not difference tests). Marks were awarded for positioning and application e.g.

- New product development
- Establishing differences between products
- Quality Control
- Shelf life studies
- Correlation to laboratory data/responses

Good answers considered the types of descriptive tests, their delivery, analysis, training requirements and scale. Specifically three types were anticipated (i) simple or free-form, (ii) trueness to type/flavour profile and (iii) ranking tests.

The expectation of the second part of the question was for a punchy paragraph or so pulling together different snippets of knowledge about the contribution to beer aroma and flavour. In an ideal world this would include the source, impact on flavour and aroma, descriptors, diversity (where relevant), directional flavour threshold and, where appropriate, any process insight impacting on concentration.

Comments – (a) many candidates misread the question as comparing/contrasting 'descriptive tests' with 'difference tests'. The question was specifically and exclusively focussed on comparing and contrasting descriptive tests. With 'b' some poor, fragmentary answers which were rewarded with half marks. The Examiners were looking for rounded and full answers to glean the full two marks.

Question 7

Outline the source and impact on quality of:

- ***Saccharomyces diastaticus* (4)**
- ***Lactobacillus* (4)**
- ***Megasphaera* (4)**
- ***Obesumbacterium proteus* (4)**
- **using the wrong production yeast (4)**

Four marks were awarded according to the simple formula of characterisation (e.g. Gram stain, mobility, substrate utilisation), source (water, air, yeast, gas lines) and impact on quality (products of metabolism, impact on flavour and aroma, turbidity, processing etc).

Comments – The least popular question which was answered by 48% of the candidates. As ever, minimalist answers were awarded minimal marks – again looking for well rounded answers not a few listed (and occasionally random) words. Again the clue is in the question – 'wrong production' yeast should not trigger an answer built on wild non-brewing yeasts.

Question 8

(a) What parameters should routinely be measured in final package (10) and

(b) Why are they measured and what are the principles behind the method of measurement (10).

A general question that leant itself to a tabular approach identifying the parameters that are typically measured, the 'why' and then the 'how'. Acceptable and popular parameters included specific gravity, alcohol, bitterness, colour, clarity, pH, diacetyl, microbiology, flavour etc. An understanding of the context of the measurement was expected at a 'headline' level together with the basics – but not great detail - of the individual method of measurement.

Comments – whilst good answers reflected a good and wide understanding and included a reasonable "range" of normal values and units expected, the examiners were surprised with sparse quality of the poor answers especially as knowledge of the 'what' was readily rewarded.

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Toby Eppard
August 2011

DIPLOMA IN BREWING EXAMINATION 2011

Module 3 – Packaging and Process Technology

The Module 3 Exam was sat by 144 candidates, a decrease on the 183 candidates in 2010, possibly as a direct result of the high pass rate of 74% in 2010. The pass rates, grades and details of candidates' performance on individual questions are shown in the tables below.

		Candidates	%
Passed			
Grade	A	8	5.6
	B	20	13.9
	C	36	25.0
	D	34	23.6
	Overall Pass	94	65.3 %
Failed	E	24	16.7
Grade	F	19	13.2
	G	3	2.1
	Overall Fail	48	34.7 %

Table 1: Overall Pass/Fail Rates and Grades

Diploma in Brewing Module 3 - June 2011

Question	Answered by:	Passed by:	Passed by %
1	132	90	68
2	82	68	83
3	58	18	31
4	103	74	72
5	51	40	78
6	105	62	59
7	101	73	72
8	133	80	60
9	32	16	50
10	57	45	79

Table 2: Performance by Question

General Comments

The overall pass rate of 65.3% was down on the previous year and so too were the Grade A and Grade B passes, reflecting a drop in standard rather than a more challenging paper. It was particularly disappointing how little knowledge some candidates demonstrated of their brewery's operations: for example how CO_2 is stored and generated, how labellers or kegging plant operate and the materials of construction of their vessels.

As in previous years, a lack of in-depth understanding of the engineering principles was evident in too many papers;for example the principles of heat transfer or fluid flow. Lack of this understanding can be seriously limiting for candidates in trying to answer a question that is slightly different to previous examples that they have seen. The Examiner is looking for the basic principles to be understood and how to apply them to problems.

Diagrams were generally poor, with just a few exceptions, and, since diagrams are often asked for in this exam, there is a necessity for candidates to be able to draw diagrams that are neat, clear and of a sufficient size so that detail can be seen. It is not an art exam, but diagrams are an essential means of communication for engineers and technologists.
Most candidates that passed the exam achieved a good balance between packaging and process technology, with only four candidates failing the exam by achieving less than 35% in either Section A or B, but with an overall mark of 45% or greater.

And so to the individual questions:.

Section A – Packaging Technology

Question 1

Describe in detail, and with diagrams, the manufacturing process for <u>one only</u> of the following primary packages:-

Two piece beverage can and can end. [20]
Non-returnable beer bottle and crown cork. [20]

The question was popular, being attempted by 92% of candidates and was reasonably answered by most candidates, with a 68% pass rate. Several candidates wasted valuable time drawing a fully annotated diagram of a beer bottle, which was not requested and contributed nothing to the description of the manufacturing process. Diagrams of the manufacturing process were however required and It was important to set out the manufacturing operations in the correct order; for example a can has to be printed before being necked-in and flanged since it would not be possible to print easily onto profiled surfaces.

For NRB manufacture, the alternative moulding processes are blow-and-blow and narrow-neck-press-and-blow, yet many candidates outlined press-and-blow which is OK for wide necked jars, but not applicable to NRBs. Some candidates correctly stated that press-and-blow was for wide necked jars but still went ahead with diagrams and descriptions – another time wasting exercise.

Descriptions of crown cork manufacture were generally poor, with often the existence of oxygen scavenging corks being the only information offered. It was a common mistake to specify aluminium as a raw material. It is too soft for crown corks, which are made from stainless steel, electro-chrome plated steel (TFS or ECCS) or electrolytic tin plate (ETP). Aluminium is used in twist off caps and roll-on pilferproof caps, but these are not crown corks, the design of which has been ostensibly unchanged since their invention and patent in 1891. The liner however has changed from cork, through foil-lined cork to PVC plastisol or PVC dry-blend. Better answers described the double-lip seal for improved low-pressure retention.

Unfortunately two candidates decided to describe the production process for the filling of the primary package, which was not what the question required.

Question 2

Draw a fully annotated layout of a keg packaging plant from the offloading of dirty kegs to the warehousing of filled kegs, showing the main items of equipment and explain the function of each main plant item. [15]

Give an explanation of the working principles of one system for the accurate control of the beer contents in keg, given that the empty keg tare weights of the keg population being handled are not consistent. [5]

This was not a popular question, only 57% of candidates having a try, but the success rate was high at 83% passing. The unpopularity may be due to unfamiliarity with large pack processing, but it is in the syllabus and therefore candidates should know about it. So the standard of answer was high with good detail on plant items and a good understanding of their function. The last part of the question was less well answered and required a little thought. If keg weights are not consistent, as is the case on many older populations, then a single gross weighing of the filled keg will not determine accurate contents. In addition, kegs are usually sold by keg size, which is a volume: 50L, kilderkin, firkin etc. so any weight measurement would need to be corrected by the beer's SG to get the volume.

There are several options:-

- Transponders or barcodes on the kegs can carry the keg identity linked to a database of the tare weights, which can be used on-line to determine the net weight of contents and then, using the beer SG, the volume.
- The keg can be weighed at the sterilisation station to determine its tare weight and then filled and reweighed.
- An average tare weight for the whole population can be used. This is inaccurate on individual kegs, but will demonstrate compliance over a large sample size.
- Meter filling can be used and will be accurate provided regular calibration is carried out, either out of line or on-line using pre-tared kegs.
- Meter filling can be used with a calibration performed say each shift by brim filling the first kegs on each lane/head, and with knowledge of the average overfill, a meter calibration can be completed.
- Using a volumetric filler, on which the volume to be filled is pre-measured in a calibrated chamber before filling into the keg.

Question 3

Calculate the theoretical yield of CO_2 from the fermentation of 1000 hl of wort, collected at a density of 1070 kg m^{-3} assuming that the sugars fermented are equivalent to a 17% w/w glucose solution that has been 90% fermented. [5]

Explain why the theoretical yield of CO_2 is not achieved in the brewery. [5]

Outline a specification for the quality of CO_2 supplied to a beer packaging line and explain the potential contamination risks in both on-site produced CO_2 and purchased CO_2. [5]

Describe how gaseous CO_2 and N_2 for use in packaging can be generated from stored liquid supplies. [5]

Given that carbon dioxide is the major gas used in breweries for a number of purposes such as the blanketing of tanks and fillers, for the purging and back the pressuring of packages and as a vital integral part of the product itself, it was disappointing that only 58 candidates chose to answer this question on CO_2 and only 18 candidates achieved a pass mark. The calculation of the yield of gas required knowledge of the stoichiometric equation for the conversion of glucose to alcohol and carbon dioxide and needed to be stated as the starting point for this question. An answer of 8003.6 kg was expected and there is a list of reasons why the theoretical yield is not achieved in breweries. In older CO_2 recovery plants, collection of gas from FV below 99.5% purity was not advised since the non-condensable impurities could cause high pressure lock-out in the liquefier and low grade CO_2 collected with a high DO. Plants with a distillation capability are able to collect CO_2 down to 80% purity, but there will still be venting losses at the start of fermentation. At the end of fermentation the beer is saturated with CO_2 and the vessel itself still full of gas. The CO_2 recovery plant will have losses at various points throughout the process. And finally the yeast will create biomass and utilise carbon for metabolism instead of for CO_2 production.

Given the high annual cost of bought-in CO_2 to breweries, it was surprising the lack of knowledge on a specification for CO_2. Parameters of interest apart from the percentage purity would be oxygen level, total volatile hydrocarbons and aromatic hydrocarbons in particular, absence of oil residues and sulphur compounds.

For on site production, oxygen levels are critical, particularly if the CO_2 is to be used in carbonation of beer. Aromas from esters, higher alcohols may not be of concern in the product but carbonyls, sulphur compounds and nitrogen oxides need to be minimised.

For purchased gas, oxygen again will be critical, but given the likely source of the gas being industrial/petrochemical, the maximum levels of hydrocarbons need to be specified. In addition the use of oil lubricated

compressors are common industrially so a specification is required to ensure that oil filtration is in place and effective. A specification does not guarantee the quality of CO_2 delivered, but without a specification the supplier is not obligated to meet any quality standards.

Most breweries will have on-site generation of CO_2 and/or N_2 gas from stored liquid supplies, so it was amazing how few candidates were aware of how the gas was produced from the liquid. For small demand, headspace gas from the liquid storage tank can be taken direct, but the vapourisation depends on heat pick-up into the tank. Since these tanks are very well insulated either by vacuum or with urethane, this heat pick up is very low and there is a danger of dropping the tank pressure/temperature if control systems are not in place to prevent it. If the tank is taken past its design limits, a failure may be caused in the tank construction materials. Therefore, an external vapouriser is normally used, taking liquid from the tank through a steam-heated vapouriser for CO_2 or an air vapouriser for N_2 and then pressure reducing to supply pressure. An energy saving option is to use the liquid CO_2 to cool the brewery refrigerant, it being vapourised at the same time, although control and balancing of the heating and cooling loads may not be straightforward.

Question 4

Draw a diagram of a single-deck tunnel pasteuriser for small pack. Explain how the packages are moved through the pasteuriser and show how the water flows are arranged between zones for energy and water conservation. [8]

Draw a diagram showing temperature profiles through the pasteuriser for both the water sprays and in-package. Explain :-

- **how the pasteurisation units are controlled during normal running and in the buildback/stoppage situation, and**
- **how checks are made to ensure that the specified PUs have been applied. [8]**

Describe the measures taken to minimise corrosion damage to the packages and to the pasteuriser itself. [4]

The tunnel pasteuriser question was tackled by 72% of candidates and well answered with a 72% pass rate. Recycling of heating/cooling waters was well explained for energy conservation and diagrams of the temperature profile through the pasteuriser were mostly well drawn although it was a common mistake for the spray temperature in the cooling zones to be higher temperature than the package temperature – this won't work! Control of PUs in normal running and in the build-back/stoppage situations was generally well explained.

Corrosion control of pasteuriser and package was poorly covered. For cans, discolouration of the ring-pull can be a problem if cans are inverted in the pasteuriser and bottle crowns can corrode, (if not stainless steel), or need to be well coated or a corrosion inhibitor added to the sprays.

The pasteuriser itself can be made of stainless steel, which is costly, but can be long-lived if chloride levels are minimised. Carbon steel for construction will require corrosion inhibitor addition to the zones and galvanic protection can be used with a sacrificial anode to limit material loss.

Broken packages encourage biological growth, bad aromas and a drop in pH that can cause attack of aluminium cans. Biological growth can be controlled by chlorine, bromine or quaternary ammonium addition and with a periodic "boil-out" or deep chemical clean. . .

Question 5

Outline three of the available technologies for the labelling of non-returnable beer bottles. [10]

For ONE label type only, describe in detail and with diagrams the design and operation of the machine for label application including the options for label coding. [10]

The most unpopular question in Section A of the paper, attempted by only 51 candidates but with a high pass rate of 78%. Most candidates were able to name three alternative labelling formats from the list of wet glue patch labelling, pressure sensitive (self adhesive), sleeving, wrap around and applied ceramic labelling and to outline the technology. The question did not specify glass NRBs, so labelling technologies for PET and PEN bottles were acceptable answers., but not can decoration although attempted.

The labeller diagrams ranged from extremely good, to very poor and the common fault in many attempts was in drawing things so small that including any detail was not possible. Labellers are not easy to draw and to get the turrets, for example, in a wet glueing application all turning in the correct direction to pick up glue and label in order is quite difficult, especially if attempted in 3D. A plan drawing would be easier and quite acceptable. Descriptions of the operation and design were generally well done as reflected in the high pass rate.

Section B – Process Technology

***Q*uestion 6**

Explain the key considerations in the selection of suitable primary and secondary refrigerants for brewery applications. Give examples of primary and secondary refrigerants in common use in breweries, their advantages and disadvantages, and explain why safety and environmental constraints are making their selection increasingly difficult. [6]

Describe, with diagrams, the basic principles of operation of a closed circuit vapour compression refrigeration cycle and the function of the main components. [6]

A brewery refrigeration system is operating on ammonia with an evaporator temperature of -13°C and a condenser temperature of 27°C. Calculate the Coefficient of Performance (COP) for the system. [5]

Explain why COPs of this magnitude are unlikely to be achieved in a real working system and what would be the effect on the COP of increasing the evaporator temperature and/or reducing the condenser temperature. [3]

A pressure-enthalpy diagram for ammonia is supplied on the last page.

A popular question answered by 73% of candidates with a 59% pass rate.

Apart from a few candidates who were confused about which were primary and which were secondary refrigerants, the first part was well answered, with good explanations of safety and environmental concerns.

The phrase "primary refrigerants need to change phase easily" was nonsensical – what would make it difficult to change phase? - and such statements should be avoided. The right answer would have talked about the need for a high latent heat and phase change at convenient temperatures and pressures to avoid excessive engineering costs.

The vapour compression cycle was well explained by most, but all too often the diagrams of the components and the p-h diagrams showed no arrows to indicate direction of flow.

The pressure-enthalpy chart was not easy to read but these charts are dense with information but with care they can be read. Provided the figures taken from the chart were in the right ball-park, indicating that the candidate was reading the chart correctly, the marks were given and a COP of about 4.9 was expected. In practise, parasitic loads such as pumps, mechanical inefficiency and friction cause losses that reduce the COP.

Increasing the "stretch", by increasing evaporator temperature and/or reducing condenser temperature will both increase COP since compressor work is reduced, but also the saturated liquid line moves more to the left giving more kJ per kg of refrigerant.

(Some candidates may not have received the pressure-enthalpy chart, but full marks for this part of the question were given if the COP was defined and explanation offered as to how the calculation could have proceeded with the chart)

Question 7

Explain the term "net positive suction head" (NPSH) and discuss its importance in the pumping of liquids in the brewery. [5]

A centrifugal pump with an NPSH of 5 m is pumping wort from a

whirlpool, open to the atmosphere, to a wort cooler. If the wort is at 95°C and has a vapour pressure of 0.8453 bar, calculate the minimum distance below the whirlpool outlet that the pump must be positioned to prevent cavitation until the whirlpool empties. [10]

Data:
Atmospheric pressure at the whirlpool = 101 kPa
Wort flowrate is constant at 360 hl h^{-1}
Wort density = 1060 kg m^{-3}
Length of pipe from whirlpool to pump = 15 m
Pipe internal diameter = 100 mm
Friction factor ϕ = 0.001
Acceleration due to gravity = 9.81 m s^{-2}

Darcy's friction equation: $$\Delta P_f = 4\phi \frac{L}{d} \rho u^2$$

Explain the measures that can be taken in the design of the suction pipeline, the pump positioning and its operation to minimise the risk of cavitation. [5]

A popular question attempted by 70% of candidates of whom 72% passed. However NPSH was not well explained in many answers. It is the pump head in meters specified by the pump manufacturer, over and above the critical condition for cavitation, which occurs when the system pressure equals or is less than the fluid's vapour pressure. In the brewery it is of relevance in pumping hot fluids, (such as wort from the kettle), which are close to their boiling point.

The calculation should have given an answer of 3.515 meters of head, but despite being given Darcy's Friction equation, some candidates chose to use their own versions, which not surprisingly gave the wrong answers! It was also evident that several candidates had memorised an equation relating to NPSH, but with little idea of how to apply it, or what each term denoted. A note perhaps for trainers to teach how Bernoulli can be applied in all situations rather than giving "off-the-shelf" equations that can be used in particular circumstances, for example if NPSH is mentioned.

Another common fault was errors in calculations caused by not rounding up or down correctly, giving erroneous answers. Although not heavily penalised, it demonstrated slack methodology.

Most candidates scored well in defining the actions to be taken to minimise the risk of cavitation, which helped to boost the pass rate.

Question 8

Describe, using diagrams, the design of a plate heat exchanger. [8]

Calculate the water:wort flow ratio required and the number of plates to cool wort in counter-current flow from 98°C to 15° using a plate heat exchanger and the data given below:- [8]

Data:

Area of each plate = 0.75 m^2
Wort specific gravity = 1.060
Wort flow rate 360 hl h^{-1}
Specific heat of wort = 4.0 kJ kg^{-1} K^{-1}
Specific heat of water = 4.2 kJ kg^{-1} K^{-1}
Heat Transfer coefficient = 3000 W m^{-2} K^{-1}
Cooling water inlet temperature = 4°C
Cooling water outlet temperature = 80°C

Give one example in the brewery of a co-current flow application and one example using counter-current flow, other than the one described above, explaining the reason for the choice of the particular flow regime. [4]

A favourite question attempted by 92% of candidates and with 60% passing.

The question asked for discussion of the design of a plate heat exchanger, so diagrams such as a flash pasteuriser circuit or a wort cooling circuit did not receive marks. Instead, diagrams of the plates, showing for example ports and gaskets, the plate pack showing how plates are arranged and clamped by tie bars, the flow pattern etc. were the diagrams expected. The relevant design features – thin stainless steel or titanium plates, small gap between plates, embossed pattern, turbulent flow, easily opened, easily reconfigured etc. etc, - were the type of comments that scored well, particularly if values were included such as the plates being 0.5 – 0.8 mm thick. Stainless steel is not a good heat conductor, but the thinness of plate means that the x/k term is insignificant compared to the film heat transfer coefficients.

The calculation involved initially converting hl h^{-1} to kg s^{-1} followed by a heat balance so that the water and wort flows could be calculated and expressed as a ratio. Since the basis of the water:wort ratio, mass or volume, was not specified in the question, both answers were accepted and should have been 1.04:1 and 1.102:1 respectively. In calculating the area and the number of plates required, the log mean temperature difference should have been calculated, and a mark was deducted if the average was used. However, some candidates still struggle to find the correct temperature differences to use in the LMTD: they are the temperature differences between the two fluids at each end of the exchanger and not the temperature drop or temperature increase along the exchanger. The number of plates came out as 110.1, which rounds up in this situation to 111 plates.

Although the question asked for a brewery application other than wort cooling as used in the calculation above, many candidates still insisted on using wort cooling as their counter current example with no marks awarded for not reading the question.. A common example used was a pasteuriser with an energy efficient 96% regeneration between the hot pasteurised beer and the cold incoming non-sterile beer. For co-current, almost all candidates used the example of chilling beer into cold storage to avoid freeze-ups since the beer will be very close to its freezing point.

Question 9

Using diagrams and equations, explain the response of a controller to a disturbance entering the system when using each the following control actions:-
proportional action
proportional plus integral action
proportional plus integral plus derivative action. [10]

Give one example in the brewery of a control loop where on-off control would be the best choice and one application where PID control would be the better choice, explaining the reasons for these choices. [6]

Explain how in a modern control system, the PLCs, control loops and field devices can be fully integrated without the need to hard wire each component back to a central control room or panel. [4]

Although this should have been an easy "textbook" question, it was not liked and attempted by only 22% of candidates of whom half achieved a pass mark. For each of the control actions, P, PI and PID, a diagram was expected showing the response following a disturbance and better answers would also have shown the effect of large and small gain, integral time and derivative time, together with the equation linking control action to the error. It is textbook information so will not be outlined here.

The second part of the question asked for examples of on-off and PID control in the brewery. On-off control can be used when oscillation about the setpoint (dead band) can be tolerated or where there is a long response time, for example due to a high thermal mass. A good example would be control of refrigerant to the cooling panels of a fermentation vessel. It is usually the simplest and cheapest form of control. The control of the filling of a silo or tank between two fixed level probes was offered by a few candidates as an example of on-off control but was not accepted. This is viewed as batching, and not on-off control since a setpoint is not evident. Control of the level in a tank to a setpoint of a full-span level measurement device would be accepted as on-off control, since the controller is reacting to an error signal between actual measured value and setpoint.

PID is used when oscillation and offset are not tolerable and will be applied in situations for example of small thermal mass and very fast response to change. PID tends to be more expensive and more complicated but essential for example for in-line dilution of high gravity beer and temperature control of heat exchangers.

The final part of the question was looking for an explanation of networks and distributed control as the modern alternative to single stand-alone PLCs or large mainframe computer and miles of hardwiring.

Question 10.

For FIVE of the following duties, specify the best material/s of construction, the reason for the choice and the alternative materials available with their advantages and disadvantages. [4 marks each]

Malt storage silos
Finings storage tank
Hot brewing liquor storage tank
Bulk caustic soda storage tank
Beer cold storage tank
Liquid CO_2

The second most unpopular question answered by only 40% of candidates and with a 79% pass rate.

Malt silos are usually either reinforced concrete or mild steel, often galvanised, with concrete being first choice in the tropics where its insulation properties can avoid condensation problems likely with a steel construction. Wood construction was mentioned and is still in use in some much loved breweries.

Finings (isinglass or auxiliary) are usually acidic and isinglass ready-for-use finings also need to be stored cool, so stainless steel jacketed tanks are often first choice. Plastics can be used but it is more difficult to arrange the cooling. It is important in answering such questions to define which plastics might be used and polypropylene is the most common, with good strength and inertness.

Hot Liquor tanks are problematic for the following reasons: the water is hot, it may contain chlorides, it is low in dissolved oxygen and, in hard water areas, may deposit scale. Austenitic stainless steel (304 or 316) are therefore often a poor material for this duty since it is likely to experience stress corrosion cracking and pitting and shielding corrosion due to breakdown of the passive chromium oxide layer. The corrosion resistance of ferritic stainless steels is required, usually in combination with austenitic as a duplex steel – a 50:50 mix.

Cast iron was the traditional choice for this duty, but it is brittle and tanks have failed suddenly and catastrophically (the great Boston molasses flood of 1919 was from a cast iron storage tank). Plastics are not chosen because of deformation with temperature, but mild steel is an option, particularly if coated or lined to minimise iron pick-up.

Caustic soda should not be stored in aluminium tanks as some candidates suggested. The tank would rapidly dissolve, producing hydrogen gas and a possible explosion risk. Austenitic stainless steels or polypropylene are possible choices, with preference for stainless since the tank may need to be heated since 50% caustic will freeze at 5°C. Carbon steel is cheaper and some iron pick-up may occur but not usually a problem on CIP circuits. Fibreglass tanks cannot be used since caustic soda can attack the glass fibres in the composite material used in its construction.

Beer storage tanks are now usually stainless steel, which is light, cleanable and cost effective. Mild steel tanks lined with glass or epoxy resin have been used in the past with success. They are strong, but heavy, more difficult to clean since care must be taken in selecting a lining-compatible detergent and high initial cost.

Liquid CO_2 storage tanks usually operate at 18 bar and -20°C, but with a safety margin (in accordance with ASME or ISO codes) to withstand 24 bar and -35°C. The selection of the type of carbon steel to cope with these pressures and temperatures is critical. Failures have occurred where temperature cycling was allowed to exceed the design limits for the steel. Tanks are insulated with urethane and aluminium jacketed or constructed as a vacuum insulated tank. Stainless steel 304 can be used but is more costly. Some candidates specified the bottles used for localised storage, constructed from steel or aluminium and these were accepted as an alternative answer.

Brian Eaton
August 2011

DIPLOMA IN DISTILLING EXAMINATION 2011

Module 1 –Materials and Fermentable Wort

Cereal Option

There were 14 candidates for the 2011 Module 1 (cereal) Diploma and 10 passed comfortably (71% pass rate). What concerned the examiners, however, was the wide discrepancy between the average "pass" score of 60% and the average of the failures at 31% (two of whom also failed the multiple choice questions in Section A). It was obvious from the scripts returned from the latter candidates that they were just not adequately prepared for this level of qualification. There was only one pass at Grade A (>75%) and one at Grade B (65% - 74%) and these were also the only two candidates to pass in Section A and in all four questions they had selected in Section B. The other 8 successful candidates scored well in Section A but depended on answering only one or two questions well in Section B to gain their overall pass.

The purpose of the multiple choice questionnaire used in Section A of the examination is to test the candidates' overall knowledge of **all three** categories of fermentable extract - cereal, molasses and grape. Most of the higher graded candidates scored well over all of these but it was noticeable that those at the lower end are still too reliant on scoring high marks in their own discipline to pass this part of the examination. This is a high risk strategy whereas a little more study of the basics of molasses production and grape must would guarantee better results in this section (representing 27% of the total marks) and would set up a good basic mark before starting on the more challenging essay questions.

The questions in Section B were answered well in only a few cases and when the question was in several parts there was a tendency, even in the best answers, to over elaborate on the parts the candidate knew well to the detriment of the others. The best marks are only achievable if the **whole** question is answered fully. The questions in Section B also required a certain amount of practical knowledge to supplement the theoretical. Previous examiners' reports have emphasised that text book knowledge has to be supplemented by practical experience to achieve a good pass in the Diploma examination and this year's results again demonstrated this. For example, the second part of Question 2 required such practical knowledge and it is sad to report that there were only four passes out of the nine candidates who answered this question.

The general comments above are discussed more specifically in the following report on each question in Section B.

Question 1

Give an account of the practical procurement of malting barley (for malt and grain distilling) from harvest field to intake at a malting plant, and describe the necessary quality controls at each stage.

This question was attempted by 11 candidates but only 5 passed (average score 10.9/20). The emphasis was on the practice of barley **procurement**, which meant discussion of the different routes green barley from the harvest field can take before reaching the malting plant as ready- to- steep barley. Only one candidate described different types of contract (farmer/maltster or farmer/ third party merchant for wet or dried, dressed barley) and few discussed the process of barley drying and storage prior to malting. Barley specifications were generally well defined but only one candidate mentioned the practicality of a QMS for the scheduling of deliveries either to the drier/storage facility or to the maltings. As in previous questions of this type , which emphasised the QC and process controls required at **each stage** of the processes leading up to **intake,** there were too many answers which included full germination energy and capacity tests or even micro-malting, as tests carried out at this final stage. If these had been discussed as a necessity within a QMS for **pre-delivery** samples, then they would have been very acceptable. However the only good answer gave a description of tetrazolium germination staining tests (and their drawbacks) as the only acceptable intake control for this parameter. Similarly a good discussion on the need for dormancy testing was discounted because this is not an intake control procedure but if this candidate had stated that such tests should be made prior to delivery, at the appropriate stage further up the supply chain, then a good mark would have been awarded.

Question 2

Describe, with the use of graphs, typical kilning programmes for each of the following types of distilling malt:

Standard un-peated malt for malt distilling
Heavily peated malt for malt distilling
Malt for grain distilling

AND

Describe the influence these different kilning cycles have on subsequent malt quality

Only 4 candidates passed this question out of the 9 who selected it (average score 10.7/20). The standard of the graphical representation of the different kilning cycles was adequate in terms of starting and finishing air-on and air-off temperatures but only one or two answers showed the effect of lowering the air-on temperature (for grain distilling malt) on the time to the break point. Nobody had any idea about the quantity or quality of peat required to kiln highly peated malt or the effect that burning large quantities of moist peat has on the humidity (and hence the heat content) of the kilning air supply. Most answers rightly stated that peat smoke is preferentially adsorbed onto malt during the free drying stage but only one candidate demonstrated that high concentrations of peat derived phenols are only achieved by extending this part of the cycle (either by reducing the air-on temperature, smouldering large quantities of wet peat or by temporarily stopping primary air heating).

The second part of this question was very badly answered. In fact, nobody knew what the secondary effects of extending the pre-break time was, other than yielding higher DP or DU in grain distilling malt. What was required was an explanation of how reducing the air-on temperature to 40^0C also reduces the air-off temperature (to ca.20^0C). Since this is only a few degrees above normal germination temperature, malt modification and enzyme synthesis continues in the free drying zone so contributing to higher levels of DU in malt for grain distilling but with a possible lowering of DP because of protein autolysis if the endosperm over modifies. Conversely, the higher heat content of humid kilning air leads to higher air-off temperatures during the pre-break kilning of heavily peated malt (e.g. 60^0C air-on at 20% RH will generate a 30^0C air-off at 100%RH) and this will have a "stewing" effect on malt, since the time to the break is also longer. So it is not uncommon for heavily peated malts to have lower DP (because of proteolysis) and lower apparent fermentability (because of higher TSN and lower wort pH). Ideally, additional information on typical peat/malt ratios, moisture content and combustion temperatures of peat would have given top marks but the side effects of burning large quantities of peat on malt quality was the main requirement.

Question 3

Give a detailed description of the enzymic breakdown of starch from raw barley, through the malting and mashing processes, to fermentation in a malt distillery.

This was one of the two most popular questions with 13 candidates choosing to answer. However only 6 passed what was a fairly straight forward question (average score 12.1/20). What spoiled even the best scripts was an unnecessary description, with elaborate diagrams, of the whole process of barley germination. What was required was a focus on those aspects of germination which lead to the synthesis of starch degrading enzymes, those enzymes which modify the endosperm to allow access of the saccharifying enzymes to starch granules, the partial erosion and pitting of large granules and the preferential degradation of small granules. However, the hydrolysis of starch during mashing was generally well described although some answers did not include gelatinisation as an essential prerequisite of conversion. Most candidates recognized the importance of dextrin hydrolysis in an unboiled wort and the best answers included an explanation of how limit dextrinase is activated by lower pH during fermentation.

Question 4

Describe and compare the processing of maize and wheat from intake up to, but excluding the disposal of grain residues in a grain distillery and evaluate the advantages and disadvantages of each type of cereal.

Only three people chose this question and they all answered well (average score 14.3/20). All the main differences between wheat and maize were

described and discussed (i.e. intake specifications, pre-cleaning, cooking/milling requirements, yield v price, and spirit quality) Additional points such as wheat protein/pentosan deposits on still plates and cleaning difficulties were mentioned in the better answers.

Question 5

Describe, and explain the purpose of, the quality and process control procedures and measurements which should be carried out at the following process points:

- **malt intake at the distillery**
- **milling of malt**
- **mashing-in of malt**

This was the second of the two most popular questions with 13 responses. Again there was a poor pass rate with only 6 fairly good results (average score 8.7/20). It is unfortunately not the first time that some candidates have confused the intake of **malting** barley at a malting plant with **malted** barley at a distillery. Consequently the worst answers in part (a) gave detailed accounts of malting barley analysis instead of finished malt. Others described malt analysis in the laboratory with very little mention of sampling procedures and rapid intake checks such as moisture /screenings tests and visual inspection at the point of distillery intake. The best answers were those which listed best practice QMS procedures and checks for malt intake (e.g. supplier scheduled delivery and tonnage, supplier analysis docket v specification, intake sampling/quality checks, pre-cleaning to storage bin etc.). Malt milling in part (b) was answered better with quoted values and methodology for grist analysis and process controls for cleaning/destoning. The answers to part (c) however, again displayed a general lack of practical knowledge. It was not good enough to state that automatic controls on the Steele's masher delivered the requisite thickness and temperature of mash into the mash tun. Mashing water volumes/ temperatures and returned sparge volumes/ temperatures and appropriate mixing (if any) should have been mentioned along with how the mashing in temperature is related to the striking temperature and the specific heats of grist and mashing liquor. Grist/liquor ratios should also have been discussed with typical values.

Question 6

Give an account of how the management of malt and grain processing can be modified to minimize water usage and describe the potential positive and negative effects this may have on wort production.

There were only two responses to this question and both candidates answered fairly well (average score 13.5/20). They both correctly focused on increasing working gravities and the recycling of low gravity sparge. In grain distilling the potential problems of cooking higher concentrations of cereal were discussed along with the advantages of milling as opposed to whole grain cooking when working at higher gravities. Both candidates also discussed the risks of slow run off in all malt thick mashes, potential fermentation problems and potential spirit quality issues when wort gravity is increased. However, better marks would have been awarded if there had been some discussion on the upper limits to high gravity mashing and cooking and what the consequences would be if those limits were exceeded. The other area where savings can be made is in cleaning and hygiene control. The use of recycling IPC systems was discussed but the use of cooling towers to reduce condenser water consumption was not acceptable. The question specifically asked for water savings in malt and grain processing so again it must be emphasized that candidates must read and understand the question before answering.

George Bathgate
July 2011

DIPLOMA IN DISTILLING EXAMINATION 2011

Module 1 –Materials and Fermentable Wort

Molasses Option

The module 1 molasses option exam was sat by 9 candidates. 7 passed, 1 grade A, 2 grade B, 1 grade C and 3 grade D. The multiple choice section results showing various levels of knowledge, and in some cases, desperately little. The main downfall on this part of the exam was the lack of knowledge of grape derived spirits. Candidates at Diploma Distiller level are expected to have a basic understanding across all three substrates and candidates would be well advised to study accordingly and not hope to "wing-it" on knowledge of their elective substrate alone. For the written questions, most candidates gave answers that showed good levels of knowledge of the subject though several candidates did not supply the level of detail required to achieve good marks at the diploma level.

Question 1

Compare, with advantages and disadvantages, the agronomics, processing, yield and molasses quality of sugar cane versus sugar beet for the production of alcoholic beverages.

7 candidates answered this question. The average mark was 14.2. Most candidates gave satisfactory answers. Candidates who did well covered the four key areas outlined in the question and gave reasoned comments on the relative advantages and disadvantages between the two molasses types.

Question 2

a, Explain the role of laboratory proficiency testing and how inter-laboratory collaborative checks are organised.

b, Explain the terms repeatability, r(95), and reproducibility, R(95), for lab analysis and describe how they can be utilised in the setting of product specifications.

This question was attempted by 6 candidates. The average mark scored was 8 with only 3 people achieving greater than 50%. The first part was only partly answered with little mention of how checks would be organised. It was expected that candidates would have knowledge of and define the Ƶ score process and its importance.

Given that the answer could be straight from a textbook, part 2 was poorly answered by almost all candidates with repeatability and reproducibility being described without any explanation of the significance of the r(95) or R(95) values. Similarly the link as to how they would be used to set product specifications was not discussed in any detail by any candidates.

Question 3

Describe the main micro-organisms that occur in molasses and their effect on the processing of molasses, spirit production and on the final spirit quality.

7 candidates attempted this question. 4 candidates gave very good answers by describing the main micro-organisms and giving detail on the effect on both the process and product quality. Some answers showed a lack of detail both in terms of the specific micro-organism and a lack of what effect it had on the process. The high scores gained by some candidates showed this question delivered a high mark if you knew the level of detail needed in the diploma level exam.

Question 4

Describe in detail the growing and harvesting of sugar beet and its subsequent processing into molasses.

This question was answered by 6 candidates with an average score of 10.1. The answers to this question were disappointing since, to gain the full marks, candidates only needed to describe the end-to-end process of making molasses. Candidates missed in general the harvesting of the beet and described the sugar extraction and molasses production poorly in that key sections of the process were missed.

Question 5

Outline the deficiencies in nutrients and vitamins that can occur in sugar cane molasses and sugar beet molasses and describe the additions that the distiller might make, with target values, to remedy these deficiencies.

2 candidates attempted this question. This was surprising as candidates who work in the molasses spirit industry should have no problem identifying the three main areas of deficiency, nitrogen, phosphate and b-vitamins. Similarly the actions a practical distiller needs to take to compensate for these deficiencies should have been straightforward. Additional marks were given where other deficiencies were described and also the differing levels of deficiency in both types of molasses.

Question 6

Outline a typical specification for molasses for spirit production and explain the significance of each parameter in the processing of molasses to spirit.

8 candidates attempted this question. The average score of 12 reflects that most candidates supplied good answers. This question was again one that is a fundamental requirement of people who work in the molasses spirit industry. To achieve maximum marks candidates needed to explain why the specification was important and to give the specification ranges, rather than giving only a single figure number.

Douglas Murray
July2011

DIPLOMA IN DISTILLING EXAMINATION 2011

Module 2 – Fermentation, Distillation and Maturation

The Module 2 examination had 29 candidates, of whom 10 failed. That 65.5% pass rate and the average mark (including the fail marks), 48.8%, were were only marginally higher than last year, but the pass statistics of 1 grade A and 8 at grade B were a substantial improvement. The other passes were 3 of grade C and 7 of grade D, similar to 2010.

Although no-one wrote about brandy, I was pleased to see so many answers which concerned molasses rather than cereal spirits. However, brandy, rum and whiskies may require different answers to a particular question, so it is important to specify which version you are answering. For example, mention of yeast nutrient supplements is correct for brandy or rum but wrong for whisky, therefore that part of an unidentified fermentation answer can not be marked. It is not necessary to keep to the same spirit for all answers, e.g. the grape version of question 5 requires more effort than cereal or molasses for the same mark, so a brandy distiller might prefer to discuss rum or whisky for that one. Also, I do not keep a record of the choice of previous answers, so please make it clear **at the start of each answer** what you are writing about when questions are identified on the exam paper as potentially variable. In 2011, these questions were 2, 3, 4, 5, 6 and 8 of Module 2 and 4 and 6 of Module 3.

It was obvious from some answers that the GCD workbook was being used as revision or study material for Diploma (see comments on question 3). I can not emphasise enough that there is a wide difference between CGD and Diploma in both the level of knowledge required and ability to discuss that knowledge. Grade A and B marks in a Diploma examination, perhaps C as well, require not only a good understanding of the content of the relevant IBD Revision Notes, but also the ability to add additional information or discussion from other study material and/or personal observation. Even in question 1, where few if any candidates could have had practical experience, some good answers brought in material additional to the relevant section of the Revision Notes.

Many times over the years I have advised candidates that for a good mark they must answer the **complete** question well. An absolutely perfect answer concentrating on only one part of the question can not score more marks than allocated to that section, and worse, an equally brilliant explanation of some related topic scores zero if it does not concern the actual question. This year there seemed to be an unusually large number of good responses to only part of a question (so, lower mark), or to something irrelevant, scoring 0. Also, five Module 2 candidates answered only 4 or 5 of the questions. They all failed the module even though some of the individual answers scored well. It is possible to pass on only four answers, but in practice that is unusual. So once again I will try to convince candidates that even if you know only a little about the topic of your choice of final question(s), you are likely to get more marks for what you do know than you could possibly gain by spending the time instead on embellishing previous answers.

Question 1

Describe the sequence of events in one generation cycle of *Saccharomyces cerevisiae*, illustrating your answer with sketches of the changing internal structure. [20]

This question was answered by 23 candidates; 18 (78.3%) scored pass mark or above. The average mark of 10.7/20 included a wide variation of marks according to the widely varying standard of sketches and descriptions. The request for sketches of the changing internal structure of the cell should have warned candidates that limiting the discussion to the G1, S, G2 and M phases of nuclear division was insufficient for a full answer. In fact the best answer, a very competently explained and illustrated description of the cytology of cell growth, did not mention G1, S, G2 and M at all. However, an account of that aspect of nuclear division was a useful supplement to many answers, provided they concentrated mainly on cytology.

Question 2

Explain the formation of the following flavour congeners by yeast metabolism, and briefly describe the factors in a distillery fermentation which influence their concentration: *iso*-butanol, diacetyl, ethyl acetate, volatile sulphur compounds. [5] marks each.

Part of the answer would come from recollection of the appropriate pathways, e.g. conversion of acetolactate to valine and isobutanol, or to acetoin and 2,3 butanediol and then by non-enzymic reactions to diacetyl. Although there were some poorly marked exceptions, most candidates were aware of the importance of acetyl-CoA and its homologues in ester production during fermentation. It was right to mention that production of volatile sulphur compounds is related to sulphate in the water, but in the context of a biochemical question I expected the side-reactions of biosynthesis of S-amino acids to feature in the answer to part (d). Chemical formulae were much appreciated, to the extent that minor faults such as showing the iso-CH3 group of iso-butanol in the wrong place were ignored. However the pathways, whether in words or formulae, had to show the correct compounds. The effects of temperature and nutrient status of the fermentable medium (including N supplement in the case of grape and molasses fermentations) were the most important factors influencing the amounts of these four compounds but, particularly in the case of wine, other suggestions would have been welcome. Only 9 of the 16 answers scored pass mark or above, so the average was a disappointing 9.4/20.

Question 3

Give an account of the progress of a typical brandy, rum or whisky fermentation, from pitching (inoculation) to collection of the final beer (wash, wine). Include an explanation of the checks or tests throughout the fermentation to confirm acceptable progress. [Tests for microbiological contaminants are not required] [20]

Several aspects of the progress of fermentation were required for a good answer: the general principle of lag, log and stationary phase, of course, in addition to the various biochemical changes. As a minimum, nitrogenous and fermentable sugar nutrients, ethanol content and pH were expected, but cereal candidates had the additional obligation to mention the sequential uptake of the individual sugars (which only two thought to do). Although not specifically requested, it was hoped that graphs would be provided, and they were in the majority of answers. A small number of candidates, perhaps progressing from success in the Certificate examination, lost marks by showing changing yeast numbers in the fermentation vessel (washback) by

the pictorial system of the GCB and GCD workbooks. I have no recollection of that system ever being used in a GCD examination, and is certainly unacceptable at Diploma level. For the second part, tracking the falling specific gravity was obviously important, and since it is common practice to check temperature, that too was expected. Those wishing to reveal their knowledge of testing for contaminants had to save that for question 4, although brief mention of measuring viability or vitality of pitching yeast was acceptable here. The average mark 11.6/20 was second best for this module, but it would have been even higher if so many candidates had not included a huge amount of marginally relevant detail before beginning the real answer. At least half of the 26 answers devoted too much time and space to methods for all or most of the following: pitching with dried, cream and cake yeast, and an account of all the possible methods for measuring pH, specific gravity, temperature and yeast viability and vitality. As a result, many answers were short on the information that was really wanted, and 4 failed.

Question 4

Select two significant micro-organisms, other than the process strain of *Saccharomyces cerevisiae*, which could be present in the must/wort for brandy, rum or whisky fermentations, or in the culture yeast. Discuss their adverse and/or beneficial effects and describe the methods for their detection in the laboratory. [20]

Numerous variations on the answer were possible, but for cereal-based fermentations *Lactobacillus* from malt and a wild yeast from either a distillery source or as a contaminant of the culture yeast were chosen most often Options for grape must and molasses were much wider, particularly if completely or partially "natural" fermentation was discussed (but it wasn't). The word "contaminant" was not used in the question in order to encourage discussion of beneficial effects, e.g. lactic bacterial growth, within limits, is favourably regarded as a contribution to rum or whisky flavour. Finally, traditional methods for detection during fermentation obviously require a selective medium, and discussion of the means of suppressing culture yeast to detect the presence of bacteria or other yeasts was necessary for a complete answer. Essentially all 18 answers followed that plan, although with a wide range of accuracy and amount of detail, with 6 at the lower end below the pass mark, and average mark 9.7/20. Several suggested immunofluorescence or polymerase chain reaction methods for detection, which were accepted as a valid answer to that part of the question, but they may only work for recurring infection by the same organism, e.g. the lab is unlikely to stock antibody to a contaminant never encountered before. Many answers implied, although few specifically stated, that lactic acid distilled as a flavour congener. Only one candidate thought to mention that the acid itself is non-volatile; it is lactic esters, mainly ethyl lactate, which contribute to the sensory profile of the spirit.

Question 5

Explain why it is necessary to collect separate fractions during batch (pot) distillation of spirit beverages, and describe briefly the procedure for choosing when to "cut". [12]

Since the first and final fractions are successively recycled to the next spirit distillation, how is it that the congeners they contain do not accumulate in the still system to unacceptable levels? [8]

All candidates answered this question, but 7 failed and few scored much above the basic pass mark. So despite the relatively high percentage (76%) passing, the average mark was only 9.7%. Many of the poorly marked answers were actually quite good accounts of the distillation process, but regarded fractionation as established fact and made no attempt to explain why it was necessary, even though that was the whole point of the first part of the question. One candidate provided a good answer based on gin, but my intention was discussion of brandy, rum or whisky distillation, to which the following comments refer. Basically, the reason for fractionation is to produce the required mix of flavour congeners in the spirit. In practice the heads/spirit cut point can be determined by time, and the spirit/tails by % abv of the distillate, but why are these particular time and abv values chosen?

For cereal and molasses-based spirits the first part of the question concerned spirit distillation only. The reasons for rejecting heads/foreshots and the increasing concentration of low-volatile congeners associated with the feints/tails fraction had to be explained, and to do that well required a graph of congener concentration vs time. Had anyone chosen brandy distillation there would be the additional obligation to discuss fractionation of the first (wine) distillation to remove methanol formed from pectin. It was also important to mention that recycling of the heads/foreshots of all spirit distillations was not just for flavour reasons, since the low-volatile congeners dissolved from the inner surfaces of the still by the strong first runnings would cause haze in the final product. So, artificially-induced cloudiness (or not) was one of the expected tests for a decision on when to cut. The second part of the question concerned the various losses in operating the still system. Most of the medium-volatile congener content of wash eventually appears in the spirit, but only a smaller proportion of the high- and low-volatile congeners. However, some loss of uncondensed high-volatiles at the start of each distillation, and more substantial loss of the low-volatiles discharged with the spent contents of the stills, keep the system remarkably well in balance. Also, the low-volatile high-MW congeners in the heads fraction will be lost with the spent lees of the next distillation, and recycling the volatile S compounds gives the copper surfaces another chance to remove them.

Question 6

Describe, and illustrate in graphical form the typical distribution of flavour congeners over the height of the rectifier column of a continuous distillation of cereal, grape or molasses spirit. [8]

Explain how the amount of congeners collected in the spirit can be controlled (i.e. increased and decreased) if (a) the congener is less volatile than ethanol [6]; (b) the congener is more volatile than ethanol [6] In each case name the congener of your example.

I expected no problem with reproducing the distribution profile to answer the first part, except for the usual crop of freehand axes without calibration. For the second part, since fusel alcohols are the important congeners which are less volatile than ethanol, the amount at the spirit plate can be controlled by adjusting the rate of removal of "fusel oil". Some discussion was required of the effect on the "bulges" of propanol, butanols and amyl alcohols on the graph by adjusting their removal to the fusel oil still or decanter, or allowing them to accumulate. High-volatiles can be "pushed" up the column by an increased fusel oil concentration lower down, but the resulting increased higher alcohol content at the spirit plate may be unacceptable. In that case, adjustment of the top condenser may be a better option. Although impracticable during a particular run, it is also possible to reduce the amount of high-volatile S congeners in the next by increasing the amount of active copper in the vicinity of the spirit plate. Incidentally, I was surprised by the number of candidates (of malt whisky background?), who lost marks by discussing phenolics or the high-MW esters of yeast fatty acids as their examples of low-volatile congeners. Such compounds are irrelevant in continuous distilling since even if they do reach the rectifier column in the hot spirit vapour, they will immediately be returned to the analyser/ stripper in the hot feints. The low-volatiles of the question were the higher alcohols, which at the ethanol concentrations where they accumulate are of lower volatility than ethanol itself. This was a straightforward question on continuous distillation, so I was surprised that 10 of the 23 attempts failed (57% pass rate), and the average mark was only 10.0/20.

Question 7

Give an account of the chemical changes caused by toasting/charring the inner surface of an oak cask and explain their importance to the maturation of the spirit. [20]

Adding to my disappointment with question 6, no. 7 was even worse with a failure rate of 11 out of 23. Only 52% pass rate and average mark only 9.7/20 is inexcusable for maturation, which is as important to brandy, whisky and dark rum production as the fermentation and distillation stages. Everyone knows there will be a question on maturation, and there are not many possible variations. The first part required an account of the products derived from heating the major oak components cellulose, hemicellulose, lignin and tannins, but it was also necessary to mention that charring produces activated carbon which removes various unwanted congeners by absorption. Then, as far as time allowed, an account was required of the reactions of lignin degradation products with alcohol and dissolved oxygen, as very important changes contributing to flavour development during maturation. Of course the other three main components also required mention, but since their increasing amounts in spirit over the course of maturation are essentially by simple extraction, they could be covered more briefly. Although explanations of the chemical reactions of lignin derivatives in words alone or with the assistance of chemical formulae were equally acceptable, it was interesting to note that the best-marked answers all made use of formulae.

Question 8

Describe the general principles of Total Quality Management. [10]

Discuss their implications in maintaining quality and safety in the manufacture of one of the following: brandy, gin, rum, vodka or whisky. [10]

Although only 9 candidates chose this question, it was obvious they well understood what they were writing about. With so many excellent answers, question 8 produced the highest average mark in this module, 12.6/20. Coming from a quality-driven industry, most candidates should have had no difficulty in describing their experience of ISO9001, or equivalent, in operation. With regard to "food" safety, except for the health risks of over-indulgence (which were irrelevant to the answer), distilled spirits are inherently much safer than other food products. However, glass fragments in bottles and microbial infection from dilution/reducing water are just two examples of safety risks requiring robust precautions, and some excellent accounts were produced of HACCP procedures, and the general theme of safety to the **consumers**, particularly in the second part. I was very pleased with the majority of answers on quality, most importantly aroma and flavour (or their absence in the case of most vodkas). Safety of the distillery **staff** and the fire and explosion risk of distilled spirits are part of the Module 3 syllabus, so these aspects were rightly ignored. Unfortunately 2 candidates failed to achieve the pass mark, apparently running out of time for this last question.

Iain Campbell
July 2011

DIPLOMA IN DISTILLING EXAMINATION 2011

Module 3 – Process Technology

Eighteen candidates sat the Module 3 examination. Unfortunately 3 failed (83.3% pass rate), bringing the over-all pass mark down to 53.7%, a disappointing fall from last year's 64.9% average. However, up to 8 candidates failed in each of the individual questions and the module passes were achieved by some good marks balancing other failures. Unfortunately that often happens in examinations, but I hope that such a pattern of marks was not deliberately planned. Anyone concentrating on only a few units of the module syllabus in the hope of enough good answers to compensate for fail marks is following a dangerous plan of study. The only other comment I wish to make on the module as a whole is that some candidates showed a shocking lack of knowledge of some basic aspects of process technology. My comments on questions 1 and 5 refer mainly to the calculations, but some descriptive answers to various questions also included seriously wrong statements. At first sight the results appear reasonable with 1 pass at grade A, 4 at B, 3 at C and 7 at D, but the number of fail marks buried in these statistics, and the low average mark compared with recent years, give cause for concern.

Question 1

Explain why loss of heat energy by convection and radiation is an acceptable part of the distillation process, and describe how still design and operation can increase or decrease such losses. [12]

Calculate the energy lost by convection and radiation during a 4 hour beer/wash distillation in a still of which the combined pot and neck surface area is 36 m^2. Ignore any temperature drop across the vessel wall and any heat losses during heating to the average distillation temperature of 95^{O}C. [8]

Data: Average temperature of still house - 20^{O}C
Convective heat transfer coefficient from surface - 10 W m^{-2} K^{-1}
Stefan-Boltzmann constant - 5.67 x 10^{-8} W m^{-2} K^{-4}
Emissivity of still surface - 0.5

With the calculation as an obvious clue to my expectations, the descriptive part of the answer should have referred mainly, if not exclusively, to heat losses from still surfaces. Attempts in some answers to widen the range of convection/radiation examples actually lowered my opinion of the authors' technological awareness, e.g. most heat exchangers work by heat transfer, and the convection and radiation losses from a column still (invariably well lagged) are negligible. So it was better just to discuss the significance of heat loss and the resulting condensation and reflux on the inner wall of the neck and upper part of the pot, giving an account of the effect on reflux of shape of the neck, and slope of the lye pipe to the condenser. Other aspects of still design could also be mentioned if they specifically concerned convection/radiation (but a "purifier" off the lyne arm/lye pipe did not). The word "operation" was an invitation to discuss the effect on reflux of distillation rate, etc. Surprisingly, several candidates got the radiation calculation wrong by using ^{O}C instead of kelvins, but my main irritation was seeing the answer as a huge number of joules rather than the more appropriate kJ or MJ, thus**:** loss by convection, 27.0 kJ s^{-1}; loss by radiation, 11.2 kJ s^{-1}; combined loss over 4 h, 550.1 MJ. Note, just one decimal figure, **not** the complete display on the calculator. All candidates attempted this question; despite 5 failures the average mark for the question was a reasonable 11.6/20.

Question 2

A 2-column continuous still with a total top condenser and partial reboiler receives a single liquid feed stream at bubble point temperature, containing 20 mol % ethanol and 80 mol % water, which enters the system at 200 kmol h^{-1}. Assume there are only two output streams: the top distillate (D) and bottom product (W). Of the ethanol entering the column, 90% leaves in the distillate stream, 80 mole % ethanol.

Calculate the molar flow rates of the streams D and W. Also, what is the ethanol concentration in the distillate measured as % w/w? [6]

In practice, for distillation of potable spirits, other streams will also be drawn from the still system. Also, for beer (wash) of significant solids content, a reboiler may or may not be appropriate. Discuss these situations, including reasons for the side-streams, and their subsequent treatment. [14]

Essentially the calculation was an exercise in converting between mol % and % w/w, and unusually for this examination came first, since the essay was based on criticising the simple still design of the first part. There, no account was taken of the need to remove a fusel oil stream, or to maintain a continuous slow loss of high-volatiles from the top condenser; so discussion of these requirements was required, and was provided in the majority of answers. With regard to the reboiler, I was hoping for comment on whether it is advisable in a still operating with a substantial solids content in the beer/wash, e.g. as encountered in grain spirit distillation of wash plus the cereal solids. Otherwise, the greater efficiency of a reboiler compared with steam injection, also less dilution of the stillage, may be seen as advantages of indirect use of steam. There were many good answers, but 5 of the 12 attempting this question scored below the pass mark, bringing the average down to 10.7/20.

Question 3

Discuss the principles of operation, and the factors that influence the choice of one type of sensor for remote measurement of each of the following: (a) volume of spirit in a receiver vessel [10] and (b) alcohol concentration in spirit distillate [10]

Now that candidates come from so many different countries I have to be aware that their national regulations will not be exactly the same. But I don't believe that UK is the only country where the excise authority has a say in what instruments are permitted for the two measurements of this question. I think only 2 persons mentioned excise approval, but purchase and running costs, accuracy, reliability, fast response and safety in an alcohol environment were in the majority of answers. The commonest cause of a low mark was lack of information on how the instruments work, but a smaller number did not notice that the question specified remote measurement, which a hydrometer and dipstick are not. Again, 5 of the 12 candidates attempting the question failed; combined with relatively poor pass marks that resulted in a disappointing 8.8/20 average mark for the question.

Question 4

Describe, with the aid of a process flow-sheet, the stages in the purification of fermentation gas to food-grade CO2.[10] and with the aid of a diagram, describe one suitable type of solid-liquid separation equipment for separation of insoluble material from stillage (spent wash) of continuous distillation of rum or grain whisky. [10]

All 13 answers essentially began their description at the preliminary scrubber tower, but how to collect CO2 from the fermentation vessel is important. It can not be collected until vigorous fermentation has expelled all air from the FV/washback head space. And later, also to prevent contamination by air, collection is stopped when logarithmic growth of yeast slows down. However, most candidates gave good to excellent explanations of the purpose of the purification columns (in the correct order) and the refrigeration and distillation stages to produce purified liquid and solid CO2. The fail marks for the poorer answers were inevitable with suggestions like a caustic scrubber column to purify the CO2.

Clarification**:** for stillage from molasses and some cereal worts, the principal particulate material would be yeast, with a disc centrifuge the most appropriate separation apparatus. However a decanter centrifuge would provide a more useful liquid/solid separation system for spent wash with grains as well as yeast. A good drawing and reasonable account of the operation of either machine would score a good mark anyway, but I was pleased to see so many candidates gain bonus marks for explaining the role of the centrifuge in the complete process. Over the two parts of the question the average mark was 9.8/20, including the negative contribution of the 3 fail marks.

Question 5

Explain in words, and with sketches of velocity profiles in pipes, the difference between laminar and turbulent flow. [5]

Cold wort of density 1060 kg m^{-3} and viscosity 0.003 Pa s flows through a 50 mm iinternal diameter circular pipe at a rate of 3.5 kg s^{-1}. [1 Pa s = 1 kg $m^{-1}s^{-1}$] Determine the mean velocity (u) of the wort in the pipe and determine the centre-line velocity (u_{CL}) given that:u = 0.5 u_{CL} for laminar flow; u = 0.82 u_{CL} for turbulent flow. [5]

Water at 80^{O}C fed at 3.9 kg s^{-1} through a counter-current heat exchanger heats cold water from 8^{O}C to 70^{O}C. What is the flow rate of cold water if the heat exchanger is operated to cool the hot stream to 20^{O}C? [5]

What is the total plate area of the heat exchanger? [5]

Data:
Specific heat of water = 4.2 kJ $kg^{-1}K^{-1}$
Overall heat transfer coefficient of the heat exchanger = 850 W $m^{-2}K^{-1}$

This question was answered by 16 candidates, with widely varying results. Candidates are expected to know the basic equations on which calculations are based, but I was shocked to see that at least three did not not know the p r^2 formula to calculate the x-section area of the pipe. For the first part, reasonable sketches accompanied by a brief explanation, and mention of Reynolds numbers associated with each flow type, were assured of good, often full, marks. Although here I give only the answers the the second part (u_{mean} 1.68 $m.s^{-1}$; u_{CL} 2.05 $m.s^{-1}$), I expected those sitting the examination to show full working. That is in your own interest, to get credit for the parts that are calculated correctly. In in the third and fourth parts, where despite the question stating clearly that it was a counter-current heat exchanger, a surprising number of candidates decided to calculate for co-current instead. Again with our usual generosity some compensatory marks were awarded if the rest of the calculation was done more sensibly. For those practising calculations for future examinations, the flow rate of cold water was 3.77 $kg.s^{-1}$ and the total plate area required 105 m^2.

Question 6

Define Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) and explain briefly how each is measured. Why are the values of BOD and COD of pot still residues significantly different? [7]

Give an account of the charges and restrictions associated with the discharge of effluent from distillery operation to a municipal effluent treatment plant. [6]

Describe how distillery procedures can be monitored and modified for optimal compliance with these factors. [7]

This was by far the worst-answered question of this module. It is true that waste water has only recently become incorporated in to the Module 3 syllabus, but since the same material had previously been in Module 1 there is no excuse for the lack of knowledge. Although 2 of the 10 candidates choosing this question passed with good marks, the rest failed, bringing the **average** mark down to 6.6/20, i.e. in the grade F fail range. It was obvious that most of these 8 failed candidates had absolutely no idea of what BOD and COD mean, or how to determine them. The following is necessarily only a brief account, but provides the essential information for a good mark. BOD is the amount of dissolved O_2 (DO) required, most conveniently measured by DO probe, for microbial oxidation of effluent in 1 litre of the local river water over 5 days, whereas COD is the titrated amount of $K_2Cr_2O_7$ consumed in fully oxidising the effluent. The advantage of the chemical method is that oxidation is complete within 2 hours. The difference between BOD and COD values for the same sample arises from the dichromate oxidising various organic and inorganic materials which the microbial flora of river water are unable or too slow to utilise, e.g. acetate, which is one reason for the COD value of still waste being so much higher than its BOD. The UK Mogden formula, like its equivalents elsewhere, includes service charges, but otherwise in most countries the charge is based on volume, BOD/COD and suspended solids. In addition to upper limits on these three factors, restrictions will certainly include temperature, pH and amounts of detergent/sanitisers and toxic metal ions, of which Cu is usually the most important in a distillery context. Some candidates unsuccessfully tried to make the third part easier by describing a bio-plant. It should have been obvious that the answer required an explanation of how a distillery which was committed to discharging to the sewer could reduce costs by changes to production procedures.

Question 7

Draw a steam-heated beer (wash) still and its associated shell-and-tube condenser, showing one design of the equipment to prevent damage by accidental pressure changes. Explain the likely causes of such pressure variations and describe briefly how the safety equipment operates to prevent damage.[6]

Indicate on the same drawing the sites most liable to wear, and explain why these areas are the most susceptible.. Also explain the differences in corrosion rates that are likely to occur between stills heated by: (a) steam coils or pans, or (b) direct firing by gas or other hydrocarbon fuel or (c) solid fuel [6]

Discuss the advantages and disadvantages of constructing continuous stills of stainless steel rather than copper.[8]

For the still itself, the drawing and explanation was expected to include at least pressure and vacuum safety valves, either separate or combined in a single anti-collapse valve. Some discussion of the required dimensions was also hoped for, but seldom appeared. A liquid column is normally sufficient protection for the condenser. In all stills, an important factor in corrosion is the removal of copper by reaction with sulphur compounds. Additional wear results from direct firing, by the requirement for mechanical scraping inside the base of the still to remove baked-on beer/wash solids, and further abrasion outside the base by ash particles from solid fuel. Finally the greater structural strength and resistance to corrosion of stainless steel are advantages for continuous still construction, although sacrificial copper is required at various locations in the system and particularly in the vicinity of the spirit plate. The 15 answers included 5, mostly marginal, failures which lowered the average mark, but 11.3/20 is not too bad.

Question 8

Starting with the raw materials, describe briefly the production of clear glass bottles for distilled spirits. [10] and Give an account of the bottle-filling procedure for distilled spirits, paying particular attention to how accurate fill volumes are consistently achieved. [10]

This was in one sense a straightforward question to answer, but hard work to commit as much as possible of the relevant information to paper in the 30 min available. At first I thought it would be unrealistic to expect great detail in even the best answers, but I was pleasantly surprised by how much information many of the 11 answers did include on raw materials, mixing and melting stages and moulding of the bottles. Obviously answers to the second part had to concentrate on the filler, and the best answers gave that adequate attention, but a brief account of cleaning and prior inspection of the bottles, and labelling and case-packing was a welcome addition to many answers. Although not specifically requested, it was hoped that a good answer would include sketches of the design and operation of the filling system, and many did. Sketches of bottle moulding were also appreciated in many answers to part 1. Unfortunately two of the candidates obviously ran out of time before reaching a pass mark, but this was by far the best-answered question of the module with an impressive average of 13.2/20. So I am pleased that this report has a happy ending.

Iain Campbell
July 2011

DIPLOMA IN BEVERAGE PACKAGING EXAMINATION 2011

2011 has been the fourth year for this examination, with candidates sitting all three of the modules.

Each Unit of the Diploma in Packaging was assessed in three components, viz. assignment (30%), short answer questions (35%) and one long answer question from a choice of two (35%). The Unit scores were then combined to give an overall mark and grade for the Module. As with the Diploma in Brewing, an overall pass in the Diploma is only awarded when all three Modules have been successfully completed.

6 candidates sat Module One and achieved a pass rate of 60%, 5 candidates sat Module Two and achieved a pass rate of 83% and 4 candidates sat Module 3 with a 100% pass rate. As a result of the combination of the results of the last three years 4 candidates also completed and were awarded their Diploma in Packaging.

Whilst detailed commentary for each unit section is given in the report below there were some common themes which need to be brought to the attention of candidates.

The overall standard of the Assignments continued to show a generally good improvement again this year compared to last, although some areas continue to be regular issues. The key areas looked for were relevance to brief, quality of discussion, range of references accessed and appropriate use of them, extent of analysis and evaluation, comment and originality. The assignment focus is designed to allow the candidate to gain clear, practical knowledge of their plant and how it operates – however evidence of this was often lacking from some submissions. In general the length and depth of the assignment was improved this year, with most candidates submitting responses of the correct length. The use of references and acknowledgements at the end of the assignment is an area which generally most candidates could still do to improve upon and is something which is highlighted in the Examiners report each year.

The short answer questions were a mix of multiple-choice, short answer, multiple answer, calculation and labelling questions which were designed to test the candidate's breadth of knowledge of the overall syllabus. This section showed a continued decline in results compared with previous years which does give cause for concern at the candidates' breadth of knowledge of the syllabus. However if was encouraging to see that the calculation questions did receive better attempts than in previous years.

The long answer question section required the candidate to choose to answer one question from two. These questions were set at a similar level to those used in the Diploma in Brewing and are designed to test a candidate's in depth knowledge of a particular area of the syllabus. As a result these questions clearly showed which candidates had only a superficial knowledge of their chosen subject. Good candidates were able to provide some excellent answers, but there were clear issues with some of the knowledge levels for candidates in some specific units.

Ruth Bromley
July 2011

Module 1:
Unit 1 – Packaging Theory and Materials

(a) Assignment
This assignment was designed to show that the candidate understood the past, present and future manufacturing processes, specifications and development options available for a non-primary packaging material.

For a non-primary packaging material of your choice, outline the manufacturing process and its route through the supply chain to point of use. Obtain the current specification for the material and explain how this has developed over the last 10 years in line with your market requirements.

Investigate whether this material is delivered within this specification and how this is tracked and monitored. Include within your investigation how the material is maintained within specification from delivery to the point of use on the packaging line.

With today's emphasis on cost and waste reduction, investigate ways in which the material and its specification impact on line performance and output requirements. Discuss the options available to enhance the material's performance and the potential benefits and risks that these would bring to line and business performance.

11 candidates submitted assignments with a wide range of standards – ranging from two very poor submissions and four good ones.

A good answer started by explaining the history behind the material they had selected and then went on to explain what developments had taken place and why these were important in their marketplace. Candidates should have then explained how material specifications are checked as the material is first delivered to their site, how it is stored and then any checks prior to the use on the line. Better candidates explained how they used vendor assurance processes to help with the quality assurance and some explanation of non-conformance recording and processes were expected. A significant number of candidates failed to highlight how their chosen material should have been stored prior to use.

On the final section a number of candidates explained how material loss could be reduced, but very few added any financial evaluation to their answers.

(b) Short Answer Questions
10 candidates sat this exam paper, with scores ranging from 7 to 25 and just over half of the candidates achieving >50%. Candidates showed a very limited knowledge of the key materials manufacturing processes (e.g. cans, kegs, crowns etc) as well as being weak on materials testing processes and procedures.

(c) Long Answer Questions

Question 1 : Materials Functions & Properties

Using a table, briefly describe the function and basic properties of primary, secondary and tertiary packaging materials. [12]

List three examples of each type of packaging material used within a small pack environment and explain any specific storage requirements for each of these materials. [9]

Selecting a primary material of your choice, provide details of the consumer information that is required along with details of how these are checked on the production line. [14]

Nine candidates answered this question with scores ranging from 4 to 25.

In the first part of the question candidates needed to differentiate function and properties of each type of materials – this was not done by a significant number of candidates, and should have been an easy way for the candidates to display their knowledge.

The section on materials storage generally provided very poor answers which only provided headline details. Information here should have included factors such as dry, clean, pest controlled, temperature control, use of FIFO, stacking ability, full and part pallets.

The final section on consumer information was looking for both brand and legal checks including analysis, operator verification, supplier VA, record keeping and traceability. This section was where most candidates picked up some marks – although traceability was not well documented.

Question 2 : Bottle Specifications, Production & Delivery

Detail the key components that you would expect to find within the manufacturers' production specification for a non-returnable bottle. [15]

List any key control and check points within the bottle manufacturing process for a non-returnable bottle. Outline why these are important and what you would expect to see at these stages in the process. [12]

Briefly explain how the quality of the incoming bottles is managed by the production site before the bottles are filled. [8]

Only one candidate chose to answer this question and the answer provided was very weak and did not cover the level of detail expected by the

examiners. The detail required on the bottle specification should have covered the manufacturing processes, dimensions, analysis, testing, weights etc as well as the palletization and delivery format.

The checks in the manufacturing process should have covered the different aspects of both the on line QC and analysis process. This should then have led to a description of tolerances and inspection frequencies.

The final section on incoming bottle quality should have included pallet checks, visual inspection, and storage location and conditions, before moving on to highlight rinser / washer verification procedures and the potential use of EBI facilities.

Ruth Bromley
July 2011

Module 1:
Unit 2 – Beer Appreciation

A total of five candidates completed the assignment and examination this year.

(a) Assignment
This assignment was designed to show that the candidate understood the brewhouse operation and wort production process.

After visiting the brewery which supplies beer to your packaging line, describe the key pieces of equipment used from raw materials intake up to and including wort cooling. Explain how each of these processing steps and the materials used at each stage can have an impact on wort quality.

From your study, highlight any high risk areas that you notice which could impact on the final product quality.

Of the 6 submissions, 5 achieved a rating of good and 1 satisfactory.

The majority of candidates produced clear, well written answers with a good overall structure and plan. The better candidates used well designed flow sheets to illustrate their submissions.

The examiner was looking for a good summary of brewhouse plant and its operation with reasonable attempts to assess the risks that wort production can have on finished beer quality, in terms of key product specification details. These, of course, include fermentability and hence on alcohol production and final gravity, but also on all the major beer attributes of flavour (such as esters and higher alcohols) and bitterness, colour, pH, head formation and haze potential.

In the main, all candidates achieved these objectives.

(b) Short Answer Questions
In contrast to the assignment results, the results for this paper were disappointing; only 2 of the five candidates achieved more than 50%. In the main, questions on raw materials and brewhouse were answered better than yeast and fermentation questions. However, the examiner was rather surprised by the lack of knowledge displayed for filtration systems and key contributions to beer losses during beer processing.

(c) Long Answer Questions

Question 1 : Maturation

Describe, in outline, the scientific principles underlying the maturation/conditioning stage of the brewing process, including clarification and non-biological haze stabilization of beer. [25]

Outline the methods available for predicting finished beer shelf life, based on haze stability. [10]

Neither of the 2 candidates who answered this question presented a satisfactory answer.

The examiner was expecting essentially a "bullet point" list of the various key activities occurring during beer maturation with short notes to indicate the candidate's understanding. Answers should have included some details on beer clarification by particle sedimentation (based on Stokes law), augmented by centrifugation, and /or finings, plus the formation (at low temperatures) of protein/polyphenol complexes and their sedimentation.

Treatment with protein adsorbents (silica hydro- and xerogels), protein precipitants (tannic acid) and binding of polyphenols (PVPP) are the major methods of stabilizing beer against haze formation.
Other functions important during maturation include flavour development (reduction of diacetyl, removal of volatiles, such as acetaldehyde and sulphur compounds), carbonation (either by CO2 addition or by secondary fermentation aided by "krausening"), plus adjustment of key product specification factors, such as bitterness and colour.

Finally, just a few brief notes describing haze prediction methods were required for the second section. Such methods include heating/ cooling cycles, high temperature "forcing" tests, Chapon rapid chilling test and measurements of beer polyphenol contents and levels of sensitive proteins (saturated ammonium sulphate precipitation test).

Question 2 : Foam, Stability and High Gravity Brewing

For each of the key stage in the brewing process, including the contribution from raw materials, discuss, in outline, the factors which influence foam formation and stability in packaged beer. [20]

AND

List the advantages and disadvantages of "high gravity brewing" of beer. [15]

Again, the 3 candidates attempting this question fell short of providing truly satisfactory answers.

The examiner had anticipated that answers on foam formation would have included some knowledge of the importance of hydrophobic proteins derived from malted barley for beer foam formation and that excessive proteolysis during malting and mashing can have detrimental effects on the level in beer of these foam-positive proteins. In addition, use of wheat as an adjunct can enhance the level of such proteins. Further, other key factors influencing the ability of beer to make foam include isomerised hop alpha acids, especially the reduced compounds, such as "tetra – hop", plus the addition of foam stabilizers like PGA. In contrast, the absence of foam negatives compounds such as malt lipids and grease residues from plant and packaging machinery are equally important. Similarly, the need for "quiet" beer transfers to avoid excessive in-process foaming is very important, since once foam has been produced, the active proteins and other components (such as Tetra-hop) do not re-dissolve and that foaming ability is then lost; this is especially important for the movement of bright beer and package filling.

Finally, correct levels of carbonation and even the presence of nitrogen gas are important foam factors.

For the section on "high gravity brewing ", the examiner was again expecting answers in a "bullet point" style.
Key advantages include:

- Cost effective increases in brewery capacity, without necessity for major capital plant investments in terms of additional brewhouse equipment and fermentation/maturation vessels.
- Reduced beer losses.
- Reduced energy usage.
- Improved flexibility of products (concept of a "mother" beer from which other products can be prepared by dilution and blending.
- Improved haze stability, due to potential for lower temperature cold storage.
- Improved flavour stability.

The major disadvantages relate the more concentrated mash required, leading to:

- Poorer extract recovery (although this is less of an issue with mash filters).
- Need for additional fermentable extract, usually derived from liquid adjuncts (therefore the need for increased syrup storage capability).
- The need to balance the level of fermentable sugars with FAN to avoid excessive ester formation during fermentation.
- Reduced hop utilization.

- Decreased foam formation (due to the lower content of hydrophobic proteins).
- The need for large volumes high quality, de-oxygenated water for final product dilution.

David Taylor
July 2011

Module 1 :
Unit 3 – Beer Preparation, Micro Stabilisation for Packaging including Small Pack Filling Operation

A total of nine candidates completed the assignment and examination this year.

(a) Assignment
This assignment was designed to show that the candidate understood the influence of the filling process on the quality of packaged beer.

For a packaging line of your choice, describe with diagrams the plant and procedures which minimize:
- **Unwanted beer dilution**
- **Variation in CO_2**
- **Loss of foam potential**
- **Oxygen pick-up**
- **Under pasteurization of beer.**

Your answer should explain why it is important to minimize these parameters.

Selecting <u>two</u> from the above list, describe <u>three</u> of the most common faults encountered and the current preventive or corrective actions used. Draw conclusions on current performance and make recommendations for future improvements.

Of the 11 submissions, 6 achieved a rating of good, 3 were satisfactory and 2 were poor; one candidate's dissertation was exceptionally good.

Candidates obtaining good marks produced clear, well thought through answers with good descriptions of potential risks for all parameters. The better candidates provided excellent discussions of current performance and possible improvements. The poor submissions merely described the operating procedures for beer transfers and the filling process without addressing the topics required.

The examiner was looking for a good summary of how the design and operation of filling plant and associated equipment (buffer tanks, pumps, valves and pipe work) had been optimized to ensure that the risks to product quality were minimized, plus operational details designed to achieve adequate pasteurization (either tunnel or flash).

Individual answers should also have indicated how any improvements in specific applications could be implemented.

(b) Short Answer Questions
Five of the nine candidates attempting this paper achieved more than 50%.
In the main, questions on filling procedures, including dissolved oxygen control were well answered, but, somewhat disturbingly, several candidates struggled to answer adequately the questions relating to pasteurization theory and operational details of pasteurizers and sterile filtration.

(c) Long Answer Questions

Question 1 : Can Filling

Explain, with the aid of sketches, each stage of the can filling process from the exit of the rinser to the entrance to the seamer. [20]

Briefly explain the key differences between a gravity filler and a volumetric filler. [5]

List and briefly describe the online and offline checks that would be completed immediately after the seamer. [10]

Four candidates selected this question, with one providing a very good answer, 2 were satisfactory and one very poor answer.

The description of a can filler was generally well presented with relatively good use of diagrams, although in some cases these could have been labelled more precisely. Unfortunately, one candidate wasted time and marks by describing the entire canning line operation rather than sticking to the question asked. All candidates provided adequate descriptions of the need for and operational details designed to achieve good prevention of air pick up during the filling process and transfer to seamer.

The short second section was well answered, with all candidates explaining that gravity filling is the simplest form of barometric filling whereas volumetric filling produces a much cleaner fill, with volume control achieved via flow meters or filling heads provided with cylinders of given volumes. In addition, in modern volumetric fillers, the filling cycle does not depend on the rotation of the filler for the cycle to operate, meaning that if the filler stops with cans in place, the filling cycle finishes.

Finally, the better answers to the last section, included checks on packages (correct materials, best before dates, batch codes, etc) in addition to in package checks on product quality (such as volumes, CO_2 contents, total O_2 levels, ABV, flavour, microbiological checks, etc.).

Question 2 : Pasteurization

Describe in detail the theoretical basis of beer pasteurization. [15]

Outline the design principles and practical features of operation and control of a beer flash (plate/bulk) pasteurizer. [10]

Discuss the advantages and disadvantages of sterile filtration in comparison with flash pasteurization. [10]

It was extremely disappointing to the examiner that the 5 candidates attempting this question all fell short of providing satisfactory answers, particularly on the theory of pasteurization; one candidate completely failed to provide an answer.

It is fundamentally important that all beer packagers understand the basic principles of pasteurization and sterile filtration and there is plenty of information in text books and the course revision notes on these topics to provide all candidates with sufficient knowledge to answer such questions.

In the main, there was some knowledge displayed relating to the design and operation and control of a flash pasteurizer, but with no candidate being entirely convincing about their level of understanding, nor in explaining the advantages and disadvantages of sterile filtration.

Since there was a similar lack of understanding of the basic principles of pasteurization, sterile filtration and sterile filling displayed in the Short Answer Paper, the examiner strongly urges all potential candidates for the qualification of Diploma in Beer Packaging to ensure that they concentrate on these basic principles. It is hard to contemplate that the IBD could qualify candidates to Dipl. Pack. standard, without the ability to demonstrate such basic knowledge.

David Taylor
July 2011

Module 1 :
Unit 4 – Quality and Hygiene

A total of nine candidates completed the assignment and examination this year.

(a) Assignment
This assignment was designed to show that the candidate understood the importance of hygiene.

For a bottling or canning line of your choice, identify the most likely types and sources of microbial contamination.

Outline methods of prevention of infection and identify the appropriate key performance indicators to maintain control.

Summarize the procedures used to clean the filler, the beer feed line to it and the container closure (capper, crowner and seamer).

Identify any potential improvements that could be introduced and indicate how these might be implemented.

Of the 10 submissions, 5 achieved a rating of good, 3 were satisfactory and 2 were poor.

The overall objective of this assignment was to ensure candidates understood the importance of good plant hygiene and how effective sanitation can influence the overall quality and flavour of beer.

The majority of candidates produced clear, well written answers with a good overall structure and plan. The better candidates displayed good knowledge of beer spoilage organisms, although there were some erroneous thoughts on potential beer contaminating micro-organisms (like *Salmonella*!).

The examiner was looking for a good systematic approach to the layout of the dissertation, with well thought through descriptions of appropriate factors relevant to micro control and hygiene systems. Most candidates provided the appropriate descriptions of factors relevant to hygiene control, cleaning systems and procedures, and KPIs. However, some needed more information on the types of potential contaminating micro-organisms, their control and the potential sources of infection. Unfortunately, one candidate's submission was completely off-beam and, essentially, just presented a microbiology methods manual.

Most candidates presented good or, at least, adequate discussion of possible improvements and their implementation, although the suggestion of one candidate to install a supplementary packaging line might prove to be somewhat impractical!

Several candidates commented (quite rightly) that the worst case scenario for poor hygiene control in and around any packaging line may result in consumer complaints, with the concomitant potential loss of future sales and company reputation.

(b) Short Answer Questions
In contrast to the results for units 2 and 3, most candidates answered this paper well, with only 2 of the nine candidates failing to achieve more than 50%. The strongest candidate scored 26 marks out of 35.

In the main, all categories of questions were answered well, although questions on Quality Management Systems and data handling seemed to cause most concern; most candidates displayed good knowledge of cleaning systems and hygiene.

(c) Long Answer Questions

Question 1 : Quality & Food Safety

Describe briefly the basic concepts relating to collation of analytical data required to establish a beer product specification. [10]

Explain in outline the procedures available to establish "Due Diligence" conformity to food safety legislation for packaged beer. [15]

Discuss the significance and relevance to beer production of the principles of Total Quality Management. [10]

Both of the 2 candidates who selected this question presented satisfactory answers.

The examiner was expecting discussion on the key factors used in the establishment of, and the measurement for comparison to, product specifications. These include a number of measurements to be taken during processing and at the completion of the process which indicate whether the process is in control and whether the beer is of the right quality.

The principle of controlling quality is based on setting specifications for each of these measurements, measuring the process and taking corrective action if the product or process is 'out of specification'. However, in setting specifications, there are various factors to be taken into consideration, in addition to relevant statistical analysis:

- all measuring instruments have a degree of tolerance.
- the raw materials used in the brewing process are natural and therefore cannot be expected to always behave in exactly the same way.
- errors can be made in sampling.

Consequently, specifications are based on 'ranges' to reflect the normal expected variation in values.

In the second section, answers should have been based on HACCP analysis and identification of CCPs and implementation of control procedures to demonstrate due diligence, such as ensuring that empty and full package inspection and the reject systems are effective and that the relevant records are kept, a glass register is established, ensuring that package washing/rinsing and plant hygiene procedures are effective, with checks for residual detergent, and maintaining a system for handling customer complaints.

Finally a good TQM system should be based on principles such as a well motivated and well trained workforce, well maintained plant, ensuring adequate plant capacity for peak demand, maintaining good plant cleanliness and housekeeping, with inclusion of sufficient time for operations, cleaning and maintenance, plus establishing and maintaining good relationships between suppliers and customers (both external and internal).

Question 2 – Cleaning

Describe the underlying principles that determine the efficiency of detergent and sterilant action on process and packaging plant. [15]

Outline the range of cleaning and sterilizing materials available for beer process plant from bright beer tanks up to and including filling machines and the appropriate safety requirements. [20]

Somewhat surprisingly (given the apparent level of knowledge displayed by the answers to the Short Answer questions relating to cleaning systems), this question was answered poorly, with only 3 of the seven candidates attempting it, actually providing anything like satisfactory answers.

Good answers indicated that the key factors for effective cleaning include time, temperature, mechanical action and chemical action. The requirements of a good detergent are high solubility in water, strong cleaning power, high wetting power, little re-deposition of soil, easily rinsed, low corrosive properties, safe to use and little pollution potential.

Sterilants (including heat, as hot water or steam) should be effective at low concentrations on a wide spectrum of micro-organisms, with little or no adverse effect on beer quality (such as foam potential) and flavour taints, as well as being safe at working strengths to personnel.

The available text books and revision notes provide sufficient detail on the range of cleaning and sterilizing materials available and it was very disappointing that this section was glossed over by many candidates. Also few candidates actually discussed appropriate safety requirements adequately.

David Taylor
July 2011

Module 2 :
Unit 5 – Small Pack Handling Operations

(a) Assignment
This assignment was designed to show that the candidate understood the operation and layout of a small packaging line.

Selecting a small pack line of your choice, provide an overview of the operational and maintenance procedures which are in place to support line performance.

Selecting one of the key machines from the line, provide a detailed overview of the main causes of downtime and lost performance on this machine, explaining whether these are most impacted by operational or maintenance issues and the cost implications of these to the overall business.

Detail how any potential improvements could be made and indicate the financial benefits from each of these.

Of the 11 candidates who submitted assignments only 4 scored more than

50%, which was disappointing considering this assignment covered the actual packaging of small pack products. The better submissions clearly demonstrated the time that the candidates had spent on their chosen packaging line, as they were able to clearly articulate how the line was both operated and maintained, as well as what the key issues on the line were.

Starting with the operation and maintenance procedures candidates should have been able to provide a framework for the future sections of the assignment. Downtime and lost performance issues were not always well documented or understood, with some candidates choosing to completely ignore the section on cost implications. This continued into the improvement sections – with some candidates suggesting their line required no improvements, and others suggesting that all issues were materials based. Both suggestions showed a lack of understanding of the line operation – again with no financial evaluation being carried out on potential improvements.

(b) Short Answer Questions
In general this section was reasonably well answered, with the majority of candidates scoring over half marks. The calculation questions were generally well answered, with questions relating to the operation of the can rinser and filler selection factors being the ones attracting a weaker response.

(c) Long Answer Questions

Question 1 : Returnable Bottling

Draw and label the flow diagram for a returnable bottle line, including the nominal speeds for all main items of equipment. [10]

List the different checks that should be undertaken to ensure that all bottles are fit for purpose prior to filling. [10]

Using a tabular format, explain

- **the key loss areas on the returnable bottle line**
- **the type of loss (beer, materials, energy)**
- **how the loss is measured**
- **expected loss rates**
- **how the loss can be minimized[15]**

This question was answered by 5 of the 6 candidates and attracted mixed responses, with the scores ranging from 15 to 24.

For the flow diagram candidates were expected to include details for both the bottles and the chosen returnable packaging, as well as speeds. A number of candidates failed to provide any information for the returnable outer packaging, and some candidates only provided speed information for key machines. Better candidates also included a v-graph in their response.

In the second part of the question a number of candidates did not read the question clearly and provided a significant amount of detail on fill level and crowner check – none of which occur pre filling. Better answers detailed all of the checks at the bottle washer and also at the EBI.

The final section of the question was best addressed by considering each loss potential at each machine stage. These losses should have included packaging materials, beer, water and energy, however some candidates focussed on only one of these aspects.

Question 2 : Bottle Labelling

Draw and label a diagram of a bottle labeller which is used for applying paper labels to the front, back and neck of the bottle. Show all ancillary materials and equipment used in this process. [15]

Explain the different checks and equipment that are in place to ensure that all labels are both correctly applied and are the right labels for the pack. [10]

Briefly compare and contrast the paper labelling application with other methods used to provide branding information and decoration on the bottle and provide examples of where these would be used. [10]

Only one candidate chose to answer this question – however they provided a very good answer which demonstrated their clear knowledge & operation of a bottle labeller.

In order to best provide a clear diagram this should be done in plan view with all ancilliary equipment detailed e.g. glue system, brushes, coding equipment etc.

For the label checks, candidates would have been advised to work through a check list which should include correct material (work instructions), correct application (hourly check sheets), changeover management, routine checks and also how these were recorded for traceability purposes.

The comparison of paper labelling with other branded methods should have included items such as the use of PSL, crown graphics, bottle embossing, neck collars and sleeving to name some of the options available. Each option should have then been considered for the impact on line speed, rationale for use (promotion or standard), cost, image, space available etc.

Ruth Bromley
July 2011

Module 2 :
Unit 6a – Large Container Packaging Operations for Kegs

(a) Assignment
This assignment was designed to show that the candidate understood the operation of a large container keg packaging line of your choice and how it provides a product suitable for both customer and consumer.

Having studied the operation of a keg line of your choice, provide a detailed overview of the design and operation of the beer supply and keg filling systems which are in use on the line. Identify the key design criteria which are directly related to ensuring the quality of the final packaged beer.

By monitoring the performance of this equipment, highlight any areas of loss on the line and make recommendations for potential improvements. Detail how each of these can be reduced or minimized and indicate the potential financial savings from each of these.

In this assignment the submissions ranged from three poor submissions, three satisfactory ones and four good ones.

The key to this assignment was to structure and lay out the assignment with the use of diagrams to support the text explanation. A good description of the line layout, design and filling operations were then best supported with references to planning, housekeeping and maintenance regimes.

The list of loss areas could have included areas such as water re-use on the external washer, filling level controls (to prevent over and under filling), gas regulation, pasteuriser control, energy management and detergent recirculation.

(b) Short Answer Questions
In general this section of the exam was reasonably well answered with all candidates gaining more than half marks, with a maximum score of 26. Again candidates scored well on the calculation questions, but were weaker on keg palletization methods, cycle timings and general keg line design.

(c) Long Answer Questions

Question 1 :

Compare and contrast different methods used for container identification and explain how each of these is replaced when a keg arrives back at the brewery for refilling. [15]

Using a table format detail the various methods employed for both empty and full container inspection. Explain where and why each is used on the line and the potential risks if the inspection system fails. [20]

Only one candidate attempted this question and they provided a reasonable response.

The first part of the question was looking for candidates to first identify the different methods of container identification which included labelling, inkjet

coding, use of barcodes, use of transponders and tamper evident caps. The comparison of these methods gave the candidate the opportunity to consider a variety of factors including costs (material, investment, maintenance), manning, line impact, inspection methods, H&S, environmental factors and the ease of removal to name the main points.

The second part of the question was looking for the candidate to demonstrate an overview of the different inspection methods for both full and empty containers.

Checks on the empty containers should have included the following checks:- cap free, pressure check, contaminants, label/code removal, spear torque, leak detection, height (size change.) Each of these should then have been paired with the potential impact if the checks had failed. On empty kegs there main points expected here were based around container contamination (which could lead to potential line contamination,) machine damage and product loss or contamination on future fillings.

Checks on the full containers should have covered coding, capping, leaking containers, weight check, visual check for brand, data, legibility of label and container cleanliness. However here the main risks are increased as this is one of the last points of inspection prior to delivery to the customer – therefore there is less chance of being able to recover from an issue should the checks prove to be flawed.

Question 2 :

Explain the different operations used for the external and internal cleaning of kegs. [25]

List the different checks which are in place to ensure that the kegs are fully clean for each of the above operations. [10]

The rest of the candidates chose to answer the second question and whilst the marks ranged from 16 to 27, the majority of the scores were in the low 20's. Throughout the question there was a lack of detail provided – especially in terms of times, temperatures and detergent strengths.

For the first part of the question the candidates needed to cover the different operations on both the external and internal cleaning of kegs. Description of the external cleaning stages should have referenced the external washer operation and how this ensured that the keg completed with the process ready for filling. Areas which should have been covered here would have been a brief summary of machine operation and how each stage contributed to appearance, code removal, external cleaning, control of legionella temperatures applied and details of the debris removal process. For the internal process the description should have included an explanation of the different steps within the cleaning cycle including detergent supply operation and recovery, times, temperatures and chemicals used. A number of candidates were only able to provide very high level explanations of the internal washing process which was unacceptable for this level of exam.

For the second part of the question the candidate was again required to explain the checking steps at this stage of the process. External checks should have included visual appearance, removal of coding, presence of graffiti, damage to the container, age of the container (to demonstrate likely risk of stale or contaminant product) as well as verifying that the external washer was also clear of debris at regular intervals. The internal keg check list should have included a variety of tests including micro plating, caustic checks, cycle times, steam & gas checks, use of a trace keg to verify machine parameters as well as machine housekeeping validation and verification of carbonate levels to ensure the effectiveness of the process.

Ruth Bromley
July 2011

Module 2 :
Unit 7 – Packaging Line Design and Performance with Capacity Planning

(a) Assignment
This assignment was designed to show that the candidate understood the importance of line design, performance and capacity planning.

For a packaging line of your choice, describe the line layout and identify any constraints or benefits which influence its operation.

Draw the 'V-graph' for the current operation of the line and compare it with its original design specification, accounting for any differences. What is the significance of the different output rates for the key components of the line?

From the work you have carried out, identify any potential improvements which could be made to current operations.

Again this assignment received a number of different approaches from candidates with the marks ranging from 9 to 23.

In the first part of this assignment it was very clear from the submissions which candidates had spent time on the packaging line they were describing, as the detail of the submission was much clearer and the explanations of the constraints and benefits were also much more detailed. Some candidates also chose to include diagrams and photographs of the line which helped support their description.

The line V-graphs were generally well completed – although some candidates ignored the comparison with the original design principles. This section was included to allow a candidate to explain how changes in the packaging requirements or line operation can impact on the required line output.

The final section again clearly showed where candidates had spent time on the line, as the detail in their improvement suggestions was much greater. However the majority of answers were missing any financial evaluation of the proposed improvements.

(b) Short Answer Questions
This exam section saw the majority of candidates scoring in the low 20's, with an overall mark range of between 16 and 26. Candidates demonstrated a lack of knowledge on conveyor types, uses and their design criteria. Knowledge of the planning systems in place in a brewery was also weak – and the majority of the candidates could not explain the different between primary and secondary distribution.

(c) Long Answer Questions

Question 1 :

List the key criteria which must be considered when designing a non-returnable (NRB) glass bottle line and explain the relevance and priority of each of these criteria along with the impact on the business if these are incorrectly calculated prior to installation. [15]

Draw a flow diagram of the NRB line layout which would be used to produce the bottle volumes provided below, stating any assumptions you make. Label all key machines with their expected rated speeds in units per hour. [20]

Total Annual Volume = 0.5 million hl
The line is available for 120 hours per week and for 45 weeks of the year
Overall line efficiency = 70% for each bottle size

	250ml	330ml	500ml	660ml
Bottles/case	24	24	12	8
Percentage of total volume	25%	25%	25%	25%
Format	4 x 6 pack in a case	4 x 6 pack in a case	Case	Case

The first part of this question was looking for the candidate to be able to explain the key design features of a non-returnable glass bottling line. The question produced a wide range of answers with marks varying from 11 to 20 – with the weakest area being in the detailed line design and calculations area.

Fundamental to the line design is to ensure that the line can produce what the company require – therefore high priority must be given to this information within the first stages of the design. Key information at this stage would include product types, bottles, packs and expected annual volumes, as if any of these were incorrect then the site would not be able to meet its customer requirements.

Once the fundamental pack types have been determined, the next group of factors to consider would include space, layout, warehousing requirements, demand, labour / skill, capital, seasonality, shift patterns and machine efficiencies. Each of these factors must be looked at in conjunction with local safety and employment legislation in mind, and if incorrect assumptions are made these will impact both on the cost and operational capability and performance of the line.

The final main section of the design should consider machine and material leadtimes, maintenance planning, inclusion of support services (lab, offices) along with CIP and housekeeping requirements.

Whilst a number of candidates made a reasonable attempt at this part of the questions the prioritisation of the plan was missed by a number of candidates. Better answers also made mention of the building environment in which the line should be housed e.g. drainage, floor surfaces etc.

In the second part of the question the majority of candidates got the flow diagram correct – although some candidates missed out key items of equipment. In general lines speed ratings were poorly completed, with not all candidates recognising the need to operate the line at different speeds for large and small bottle sizes. One candidate mixed up bph and bpm and many did not show working – hence making it very difficult for the examiner to understand the logic which had been applied.

Question 2 :

Explain the key elements of productive and non-productive time and their impacts on line and capacity planning. [20]

List the main functions of a Management Information System (MIS) and explain how MIS can be used to influence line performance. [15]

Only two candidates answered this question, with one submitting a reasonable attempt whilst the other completely missed the point of the question.

It was expected that candidates should be able to clearly differentiate between productive time (where machines are operating at planned speeds and material supply is normal) and non productive time (which includes meetings, CIP, plant start up and shut down, changeovers, maintenance, data gathering and slow running to name but a few.) Each of these topics can significantly affect the capacity planning arrangements, leaving breweries either short of, or with excessive production capacities. The first of these will of course restrict sales opportunities for the business, and the second will cost the business in terms of depreciation and asset utilisation.

The final section of the question was not well answered – and should have included the main details around the main functions of an MIS to record and track data at various stages in the process, as well as how this could then be used to improve line performance if the data analysis was then used to its best effects.

Dave John
Ruth Bromley
July 2011

Module 3 :
Unit 8 – WCM, Maintenance, Safety, Utilities and Environment

(a) Assignment
This assignment was designed to show that the candidate understood the importance of Waste Minimisation in all its forms.

For a packaging line operation of your choice, identify the principal wastes and losses (materials, beer, water, energy etc). Explain the fate of each waste or loss.

By comparing with what you understand to be "best in class" performance draw conclusions on the wastes and losses you have identified.

Quantify one of the key wastes or losses on an annual basis (weight or volume as appropriate). Propose a strategy for the elimination or minimisation of this waste / loss with clear recommendations for its implementation.

Of the 6 submissions a pleasing 5 achieved a rating of good and 1 of satisfactory. Within the good category one candidate produced a truly excellent, near model submission.

Patently candidates are becoming used to the requirement for clear, well written answers with a good overall structure and plan. The candidates variously and skilfully used diagrams and / or photographs and screen shots to illustrate their submissions. For this assignment, pie-charts often assisted in supporting the text.

The candidates generally identified the principal wastes and losses well with the very best answers including extensive quantitative data. In addition to material losses, the examiner was, of course, seeking reference to energy and utilities. More than one candidate went further and explained the Lean Manufacturing approach to tackling all waste, including time.

Comparison with "best in class" was best done by use of a table and several candidates adopted this approach. One candidate failed to adequately address this section of the assignment and clearly had not investigated "best in class" performance at all.

A key waste or loss to be addressed produced a variety of choices including glass, beer loss (3 candidates), electricity and water. Although the candidates, in general, drew sound conclusions and made clear recommendations a number would have greatly helped their assertions by carrying out a cost-benefit analysis.

(b) Short Answer Questions
For the eleven multiple choice questions, the number of candidates' correct answers ranged from 0 to an excellent 6. The range was from 0 to just 3 for the nine short answer questions and it was clear that candidates struggled much more this year with these questions. Nevertheless two candidates produced a good overall score.

The multiple choice questions on the environment, maintenance and quality were generally answered correctly. Although health and safety questions are historically well answered, future candidates should be more confident in understanding and differentiating risk, hazard, harm, accident etc.

The examiner deliberately sets questions with varying degrees of difficulty to truly test candidates' ability and allow the grading structure to identify the very best individuals. A number of the multiple choice questions were clearly daunting to several candidates this year. Whilst no candidate recognised the precautionary principle in terms of preventing environmental degradation in Q5, the examiner was more disappointed that only two candidates identified the process of carbon foot-printing (Q4). Equally disappointing was that only half the candidates were able to list the stages in the refrigeration cycle in the correct sequence (this question is generally a "banker" when the stages are given in the form of multiple choice sequences). Worryingly, half the candidates failed to identify Quality System procedures for recording and auditing in order to monitor actual performance against what should be achieved (Q19).

(c) Long Answer Questions
Disappointingly, the standard of the long answers was not up to the level of previous years with the majority of answers being weak and just one meriting a good mark. This was in contrast to the majority of the same candidates' assignment submissions and short answer papers which were generally good. This may, perhaps, have reflected the areas of the syllabus chosen for the questions where candidates this year were apparently less than comfortable. In past examinations, for example, long answer questions on any aspect of health and safety tend to be very well answered reflecting undoubted competence in this field in the workplace.

Question 1 – Utilities

Explain the water treatments that may be necessary (and why) to meet the requirements of an entire small packaging facility which includes a tunnel pasteurizer. [20]

How may these treatments be achieved? [15]

This was the less popular of the two questions and, disappointingly, there was no good answer.

One candidate incorrectly interpreted the question very narrowly indeed and only addressed the requirements of a tunnel pasteurizer. The examiner was seeking a very broad range of water treatment requirements including but not limited to: raw water treated by a water company, private borehole or well, water entering the packaging facility from a water company, high gravity dilution water, general beer chasing, NRB and can rinsing, plant cleaning, bottle washing, keg and cask cleaning, crate washing, tunnel pasteurizers, general housekeeping, steam raising and cooling towers. The actual treatments for each may have included variously: screening, filtration, disinfection, desalination, de-ionization or softening, de-mineralization, de-aeration, pH adjustment, corrosion prevention, scale inhibition, biocide addition (to prevent the growth of slime bacteria and *Legionella*) and so on. This part of the answer would perhaps have best been laid out in the form of a table with the various water supplies / uses down the left hand side with the appropriate treatments for each detailed opposite on the right hand side. An excellent answer would have included some typical quantitative data where appropriate.

The means of achieving these treatments could have included (amongst others): sand and / or carbon filtration, membrane technology, reverse osmosis, ion exchange, water softening or de-alkalization, microbiological treatment (chlorine, chlorine dioxide, ozone, UV light, sterile filtration, silver ion, heat). The examiner was not seeking, within the time available, a detailed description of the plant for each of the treatments merely the principles involved. Whilst not anticipated, one candidate briefly included waste water treatment in his / her answer.

Question 2 – World Class Manufacturing

Discuss the advantages and disadvantages of combining Quality, Health and Safety and Environmental Management Systems. [20]

What are the advantages and disadvantages of achieving and maintaining accredited standards? [15]

This was the more popular of the two questions with one candidate producing a good answer.

In discussing the advantages of combining Quality, Health and Safety and Environmental Management Systems the better candidates pointed out common areas in such systems and the potential for rationalization such as: top management commitment, documentation and record control, definition of policy, planning objectives and targets, procedures for training of employees, communication procedures, audits, control of non-compliance, corrective and preventive actions and management review. Further advantages might have included: a stimulus for business improvement, a reduction in risk, the potential to expose more areas of waste and non value-added activity and to reduce or remove barriers across departments and functions and the potential to reduce "entropy" – disorder or randomness.

The disadvantages of combining systems, perhaps understandably less in the context of WCM, major on the potential for conflicting priorities, how to rank differing aspects and the potential to lose focus - for example, how can environmental concerns be satisfied when the environment is treated as a customer?

Advantages of maintaining accredited standards might have included: good image in the eyes of customers and the public at large, all employees being committed to improving company performance and working as one team, more systematic working, pride in working in a company with accredited standards, having employees clear about company policy and objectives and increased ease in handling customer complaints.

Disadvantages included: cost of auditing, lack of top management commitment leading to systems getting into disrepute, the requirement for intensive support and paperwork, the drain on management time / resource. Of course, advocates of accreditation would argue that many or most of these are necessary for the business benefits that can be expected to accrue.

Robin Cooper
July 2011

Module 3:
Unit 9 – Beer Preparation, Micro Stabilization For Packaging Including Small Pack Filling Operation

(a) Assignment
This assignment asks you to discuss carbon dioxide use in preparing beer for packaging.

Explain your company's specification for carbon dioxide quality (either purchased or recovered) and discuss why each of the identified quality parameters is important to beer quality. Include in your discussion the potential consequence of using carbon dioxide that is out of specification.

Describe in detail three different means of increasing the carbonation level of bright beer and discuss the advantages and disadvantages of each. Describe how the concentration of carbon dioxide can be reduced in beer that has been over carbonated.

Describe two different techniques for measuring carbon dioxide concentration in beer and include the underlying scientific principles of each method.

Examine how carbon dioxide adjustments and their validation are made in your brewery or packaging plant and make conclusions as to the appropriateness of these methods or offer recommendations for improved methods.

This assignment was generally well answered with 4 out of the 5 submissions receiving a passing score. The examiner was looking for a discussion of CO_2 specifications with examples or explanation of what happens to beer when the gas is out of specification. With regard to methods of carbonation, the examiner wanted to see details on how CO_2 concentration is increased beyond a short statement that brewers can "apply top pressure". It was important to discuss advantages and disadvantages. Techniques for measuring CO_2 concentration should have had two parts – one part that discussed the technique for gas measurement (that is, how it is accomplished, in general) and another part that explained the underlying scientific principles. Use of Henry's law was helpful here. The part that was lacking in many of the submissions was an adequate conclusion. The examiner wanted to see some back conclusions about how gas levels are adjusted and measured and a critique, assessment (negative or positive) of the candidate's company's current practice in these two areas. It was this last part that was either missing or minimally touched on in all but one assignment.

(b) Short Answer Questions
Three candidates attempted but only one passed this section of the exam with 51% correct answers.

The candidates struggled with the short answer part of this exam. While they were able to correctly answer basic questions about gas solubility and ideal gas law relations (such as Dalton's law), all three were unable to perform simple calculations to determine the gas concentration in beer when expressed as mole fraction, mass/volume, and volume/volume. Carbon dioxide recovery details as well as gas exposure limits were also poorly answered.

(c) Long Answer Questions

Question 1: Gas calculations using Henry's law and ideal gas law

Carbon dioxide is used extensively during beer packaging. List where it is used in a packaging facility that performs both small pack and large pack operations and include a brief explanation of the purpose for each use. [10]

Consider the case where a single 50 litre keg is being filled with beer at 2°C and 2.4 vol./vol. of CO_2. Neglecting the amount of gas used to purge an empty key with CO_2, calculate how much CO_2 is needed (in kg) to fill an empty keg at 20°C to the equilibrium CO_2 pressure of the beer that will be introduced to the keg. If the keg line were filling 60 kegs per hour on average over an 8 hour shift, calculate the total amount of CO_2 needed for filling and counter-pressurizing the kegs during the shift. [20]

Finally, consider a 50 litre keg that is filled completely with beer at 2°C and 2.4 vol./vol. of CO_2. Calculate the total mass of CO_2 in the keg. [5]

Data
Universal gas constant, R = 8.314 kJ $kmol^{-1}$ K^{-1} [=] m^3 kPa $kmol^{-1}$ K^{-1}
CO_2 gas constant, R_{CO2} = 0.189 kJ kg^{-1} K^{-1} [=] m^3 kPa kg^{-1} K^{-1}
One more of an ideal gas occupies 22.4 L at STP.
Atomic weights: CO_2 = 44, H_2O = 18.
Henry's constant for CO_2 in beer at 2°C = 85.918 kPa (mole fraction)$^{-1}$
Lager beer density = 1.008 kg L^{-1}

No candidates attempted this question.

Question 2 : Factors affecting rate of carbonation

Discuss in detail the physical, environmental and chemical factors that influence the rate at which a fluid can be infused with gas. [14]

Explain three different modes of carbonation and then compare them based on
(a) the factors discussed above,
(b) time to achieve desired carbonation for an equivalent volume of beer,
(c) cost. [21]

Three candidates chose this question and two passed with scores averaging 69%.

This question asked the candidates to describe the various factors that influence the rate of carbonation. The examiner was expecting answers discussing gas pressure, fluid temperature, amount of interfacial area, fluid mixing, liquid composition, and gas type. The second and larger part of the question asked candidates to explain three different modes of carbonation (for example, top gas pressure, sparging tanks, inline venturi, sinters or nozzles) and then make comparisons using the factors outlined in the first part of the question. Significant point reductions were taken if the candidates could not identify and compare three distinctly different modes of carbonation as opposed to minor modifications of one technique.

Thomas Shellhammer
July 2011

Module 3 :
Unit 10 - Fluid Dynamics for Packaging and Materials of Construction

(a) Assignment
This assignment was designed to show that the candidate understands the use of valves in fluid flow applications.

For a complete packaging line of your choice, carry out a survey of all the differing valve types employed in the various fluid flow applications. Your survey should include an example of each of the differing valve types used in beer handling, all appropriate packaging plant, utilities, CIP and process gases. For each example describe:

a) the type of valve (not how it works)
b) the application
c) the criteria by which you believe the valve was selected
d) the means of actuation
e) any cleaning requirements
f) the maintenance requirements
g) any other distinguishing feature.

In addition for each example, comment on any issues relating to performance, maintenance, accessibility etc.

Draw conclusions and make recommendations for replacement strategy or for future projects.

Submissions ranged in quality from satisfactory to weak. The somewhat better answers were well planned, structured, of appropriate length and with sound conclusions and recommendations.

The range of valves was fairly well covered – however the examiner anticipated more detail and rigor in the discussion. A number of candidates made good use of photographs and diagrams. There was little mention of valve Standards, authority approval for food, pressure etc or regulatory requirements although design for pressure and temperature were sometimes inferred. The poorer answers had no real information about actual maintenance requirements (tasks, periodicity, costs, finding and solving leaks etc) or accessibility for maintenance.

Conclusions and recommendations were generally sound but extremely limited in scope. One candidate made welcome points around the benefits of valve standardization. The examiner anticipated a much broader view of actual performance with clear recommendations for future improvements in terms of valve selection, maintenance requirements etc.

Robin Cooper

(b) Short Answer Questions
Three candidates attempted this section and all passed with an average of 65% correct.

Candidates did fairly well on the short answer part of this exam. All correctly identified different types of pumps and understood their basic features and uses. All described water hammer as a phenomenon of condensate being blown along steam lines, which was acceptable, but the examiner was looking for phenomena associated with rapid valve closure. Surprisingly, none of the candidates could correctly describe or define a Newtonian fluid nor correctly identify different parts of the mechanical energy balance equation. The candidates had a poor understanding of stainless steel composition (the purpose of the individual components) and types of corrosion.

(c) Long Answer Questions

Question 1 : Net positive suction head problem

Discuss the Reynolds Number, (□ud/μ), explain what it describes and how it is used to characterize fluids flowing in circular pipes. [10]

Define laminar and turbulent fluid flow. For each type of flow, provide an example of where you would find it in a packaging operation and why the type of flow is required. [10]

A fluid of density 1000 kg·m^{-3} and viscosity of 10^{-3} N·s m^{-2} is flowing in a 50 mm diameter pipe at a volumetric flow rate of 8 x 10^{-5} m^3 s^{-1}. What effect will reducing the pipe diameter in half (to 25 mm) have on the flow conditions in the pipe? Justify your answer. [15]

Three candidates chose this question and all did quite well with one scoring a near perfect score. The average score for these three was 79%.

The first part asked the candidates to discuss the Reynolds number and the examiner was looking for an explanation of viscous forces vs. inertial forces. Re<2100 is cut off for laminar flow in pipes. The second part required a complete description and comparison of laminar and turbulent flow. Laminar flow is desired during small container filling, turbulent flow for cleaning and in-line carbonation. The final part of the question required the candidate to determine the linear velocity of the fluid in each of two different scenarios and then calculate a Reynolds number for each. The flow in the former (50 mm ID) was laminar and in the latter (25 mm ID) it was turbulent.

Question 2 : Stress corrosion cracking

Explain corrosion. What are three practical consequences of corrosion? [11]

Describe each of the following types of corrosion and explain how it is caused and how it can be prevented.
a. Galvanic corrosion
b. Intergranular corrosion
c. Stress crack corrosion[24]

None of the candidates attempted this question.

Thomas Shellhammer
July 2011

Module 3 :
Unit 11 - Thermal Energy Transfer For Packaging

(a) Assignment
This assignment was designed to show that the candidate understands the key issues in operating and maintaining an efficient steam distribution system.

Produce or reproduce a schematic diagram of the steam distribution system for a packaging line of your choice. The diagram should start and end at the boiler or steam generator (a schematic of the boiler or steam generator itself is not required). You should show and label all the devices in the system along with pipe and insulation sizes, pressures and temperatures.

Explain the purpose of each type of device and its maintenance requirements. Comment on any known performance issues.

Estimate how much condensate is returned to the boiler or steam generator (as a percentage of the steam generated) and explain where the losses occur. Produce proposals to reduce the avoidable condensate loss and estimate how much financial benefit could accrue.

Draw conclusions on the overall performance of the steam distribution system and make recommendations for improvements.

Of the four submissions, one was rated good, two satisfactory and one weak. Three of the submissions were well short of the expected length with one being very short indeed. The guideline length of 2500 words for these assignments was chosen with great care to ensure the tasks are rigorously addressed.

The one good answer featured an excellent diagram with all the symbols fully explained. The descriptions of the various system devices were very good indeed with basic maintenance being included. This candidate's focus on steam trap and insulation performance was well judged and his / her calculations on condensate recovery were very instructive!

The less good submissions had main diagrams which were too simplistic with symbols not explained. Two candidates made excellent and most welcome use of referenced photographs to support their text.

The examiner expected a much broader view and rigorous analysis of actual device performance issues – too often candidates produced a theoretical list of ways to optimize efficiency.

Two candidates made an assertion that 80% condensate is recovered but with no real explanation of where losses occur or proposals for improvement. One candidate chose to ignore the section on condensate recovery altogether!

Conclusions and recommendations ranged from very good to very poor. A cost / benefit justification is often helpful in making assertions about performance improvement.

Robin Cooper

(b) Short Answer Questions
Three candidates attempted this section and all but one passed. The average passing score was 57% correct.

The candidates performed well on basic concepts of conductive heat transfer as well as thermodynamic definitions. Difficulties were encountered with multilayer heat transfer, such as correctly identifying the temperature profile across multiple layers. Mechanical refrigeration was another area that candidates struggled with. For example, many were unable to correctly draw the refrigerant flow path on a pressure-enthalpy diagram. Better performance was displayed in the area of steam distribution.

(c) Long Answer Questions

Question 1 – Heat transfer and tank cooling

Describe convective heat transfer and discuss the differences between natural (or free) and forced convection. [10]

Explain the challenges in chilling beer from 4°C to 1°C, and with the aid of a sketch indicate the most efficient placement of heat transfer media and temperature probe on a jacketed bright beer tank for this type of cooling scenario. [10]

Consider 200 hl of bright beer at 4°C that needs to be cooled to 1°C prior to packaging using only the cooling jackets on a bright beer tank. If the glycol in these jackets is at -4°C, calculate the initial heat flux (kW) from the tank at the beginning of cooling using the data presented below. [8]

Using the heat flux calculated above, estimate the time (hours) it will take to cool 200 hl of beer to 1°C. [7]

Data:
Density of beer = 1008 $kg \cdot m^{-3}$
Specific heat of beer = 4.2 $kJ \cdot kg^{-1} \cdot K^{-1}$
Specific heat of glycol = 3.0 $kJ \cdot kg^{-1} \cdot K^{-1}$
Overall heat transfer coefficient = 250 $W \cdot m^{-2} \cdot K^{-1}$
Cooling media area on tank = 4 m^2

All three candidates chose this question and none passed. This first part of the question asked students to discuss how density of fluids are a function of their temperature and how localized temperature differences can create free convective fluid movement. In contrast, forced convection would utilize some external means of fluid movement. The second part of the question required the candidate to recognize that in cooling beer from 4°C to 1°C causes the beer to decrease in density which in turn can create difficulties in cooling. For these instances it is best to have a temperature probe above the cooling jacket. The last part involved two calculations, the first requiring a heat flux estimation using q=UA□T, where the □T as between the beer and the glycol (8°C). The second part of the calculation required an estimation of the sensible heat change of the 200 hl of beer which would then be divided by the heat flux calculated earlier…the answer being 8.8 hours.

Question 2 – Refrigeration

Discuss how refrigerants are selected for use in the packaging plant. Include a comparison of primary and secondary refrigerants, giving examples of applications where each type is found. [15]

Glycol flowing at 1 $kg \cdot s^{-1}$ is being cooled from 0°C to -4°C using a single stage vapour-compression refrigeration system. Calculate the size of compressor necessary to accomplish this task if the system is operating with a coefficient of performance of 5.0 and the compressor is operating at 65% efficiency. [10]

If the evaporator of the refrigeration system is operating at -10°C, calculate how much heat transfer area (to one decimal place) is required to achieve this rate of cooling of the glycol. [10]

Data:
Specific heat of glycol = 3.0 $kJ \cdot kg^{-1} \cdot K^{-1}$
Overall heat transfer coefficient of evaporator = 1000 $W \cdot m^{-2} \cdot K^{-1}$

No candidates attempted this problem.

Thomas Shellhammer
July 2011

Module 3 :
Unit 12 - Process/ Line Control and Instrumentation

(a) Assignment
This assignment is designed to show that you understand the key sensors on a packaging line.

Prepare a simple schematic of the path beer follows in your packaging plant beginning with a bright beer tank and ending with the filler. Include in your diagram the basic vessels, piping and (most importantly) the sensors that exist on this path.

For each sensor on this path, explain in detail how the sensor works.

What is the underlying engineering/technical principle upon which the sensor operates? What is the accuracy of each sensor? How is each sensor calibrated or validated? And, how is information from the sensor fed to the control system in your packaging hall?

In your answer to this assignment you should include the following sensors: tank volume/fluid height, fluid flow rate, temperature, pressure and dissolved gas (oxygen or carbon dioxide). If all of these types of sensors are not present on your line, research the missing sensors to provide the necessary information requested by this assignment.

Draw conclusions on the choice of sensors used in your packaging hall and make recommendations for improvements where appropriate.

Five candidates submitted this assignment - two did poorly, two did modestly, and one submitted a perfect paper. The examiner wanted to see the various sensors identified on a diagram of the flow path from the bright beer tank to the container filler. For each sensor, the examiner wanted to see four key items: the fundamental principles upon which the sensor operated, how the sensor is calibrated and/or validated, the accuracy of the sensor, and how the information is fed from the sensor to the control system. The main point of deficiency in the assignment answers was insufficient detail on how the sensors worked. Additionally, the level of detail and completeness of the assignment varied from sensor to sensor.

(b) Short Answer Questions
Three candidates attempted this section of the exam but only one passed with a score of 60% correct.

The candidates did their best on some questions dealing with control theory, although several had difficulty distinguishing controller response for P, I, D control and their combinations. None of the candidates correctly answered questions about strain gauges and instrumentation for tank level measurement. Candidates had difficulty distinguishing thermocouples from thermistors and RTD's and were less certain about the operation of turbidity measurement.

(c) Long Answer Questions

Question 1 – Control theory and general systems

Describe the purpose of a control system and discuss, with the aid of schematics or sketches, the differences between feed forward and feedback control. [15]

List the advantages and disadvantages of both types of control systems. [10]

For each type of system, provide one example where it might be found in the packaging hall (or brewery), and include the purpose of the control system, what is being measured and what is being manipulated. [10]
Two candidates attempted this question but only one passed with a score of 60%.

The first part of this question was not asking for examples of feed forward and feedback control but rather an explanation of the differences between the two. Feed forward measures disturbances to the system and does not actually measure the output of the system (or the measured variable in a feedback system); therefore information moves through the system without further measurement. Feedback, on the other hand, does not focus on the disturbances directly and instead focuses on the variable being controlled in the system. Information that moves through the system is fed back into it. The second part was adequately answered using a table comparing the two types of systems. The last part was seeking specific examples in a packaging hall (or brewery). This examiner offers the repeated advice to candidates to read the question fully and then answer what is being asked of them.

Question 2 – Instrumentation for flow measurement

Describe in detail an orifice plate meter and a electromagnetic flow meter. [15 each]

Include in the answer:
principle of operation,
detailed figure including key functional components,
limitations of the device,
how the meter is calibrated, and an
example of where the meter is found in the packaging hall (or brewery).

In terms of information the meter provides about the fluid being measured what are the differences between these two types of flow meters? [5]

One candidate attempted this question and just barely passed (54%).

The first part asked the candidate to be specific in how an orifice plate meter and electromagnetic flow meter worked using 5 distinct points outlined in the question. The two meters were chosen because they utilize very different phenomena for gauging fluid flow rate. Similarly, the type of information they gather about the fluid is rather different – differential pressure in the former and induced current in the later.

Thomas Shellhammer
July 2011

GENERAL CERTIFICATE IN BREWING AND PACKAGING (BEER) EXAMINATIONS

November 2010 Report

The Autumn examinations for the General Certificates in Brewing and Packaging (GCB, GCP) was held on 12 November 2010 at 54 centres in 17 countries.

This was the 11th of the new multiple-choice examinations with specialist options for brewing and packaging variations, i.e. C&F, Cask, Keg, RB (Returnable Bottles), NRB (Non Returnable Bottles) and Can.

The examination was taken 'on-line' at 54 centres across the world, 41 of them being outside the UK and Ireland.

There were 279 entries, with an overall pass rate of 60%, which compares with a figure of 64% for the corresponding examination in May 2010.

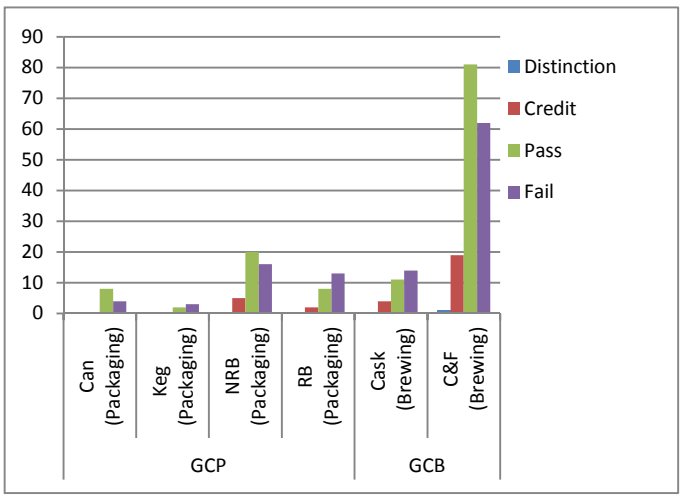
28% of all candidates sat the examinations on-line, and of these 53% achieved a pass mark.

The break-down between GCB and GCP results is shown below in table 1

Table 1Nov 2010

Exam	Option	Distinction	Credit	Pass	Fail	Total
GCP	Can (Packaging)	0	5	8	4	**17**
	Keg (Packaging)	0	1	2	3	**6**
	NRB (Packaging)	0	5	20	16	**41**
	RB (Packaging)	0	2	8	13	**23**
GCB	Cask (Brewing)	0	4	11	14	**29**
	C&F (Brewing)	1	19	81	62	**163**

Diagram 1 below is a graphical distribution of pass grade by option



COMMENTS

Overall the pass rate for GCB was 59% with 1 distinction (90%) and 23 credits (80%).

The pass rate for the 'C&F' paper was 60% with 1distinction and 19 credits.

For GCP the figure was 59%, with no distinctions and 13 credits being awarded.

May 2011 Report

The Spring examinations for the General Certificates in Brewing and Packaging (GCB, GCP) was held on 9 May '11 at 56 centres in 36 countries.

This was the 12th of the new multiple-choice examinations with specialist options for brewing and packaging variations, i.e. C&F, Cask, Keg, RB (Returnable Bottles), NRB (Non Returnable Bottles) and Can.

The examination was taken 'on-line' at 56 centres across the world, 47 of them being outside the UK and Ireland.

There were 252 entries, with an overall pass rate of 65%, which compares with a figure of 64% for the corresponding examination in May 2010.

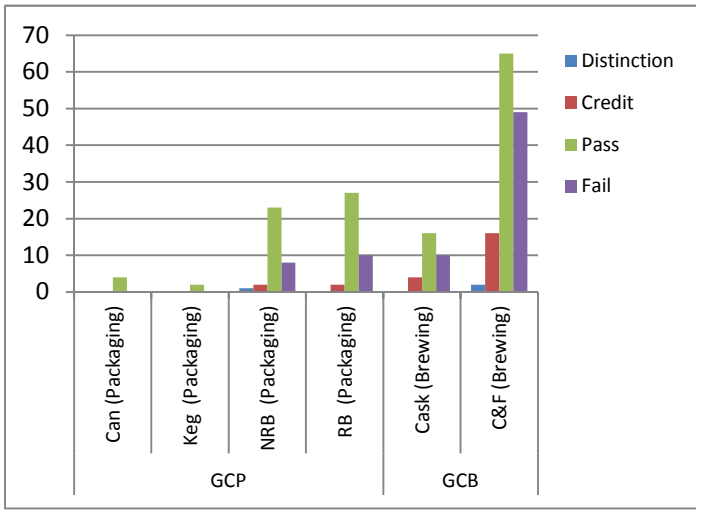
The proportion of candidates sitting the examinations on-line was 31%, of which 56% achieved the pass mark.

The break-down between GCB and GCP results is shown below in table 1

Table 1 May 2011

Exam	Option	Distinction	Credit	Pass	Fail	Total
GCP	Can (Packaging)	0	0	4	0	**4**
	Keg (Packaging)	0	1	2	0	**3**
	NRB (Packaging)	1	2	23	8	**34**
	RB (Packaging)	0	2	27	10	**39**
GCB	Cask (Brewing)	0	4	16	10	**30**
	C&F (Brewing)	2	16	65	49	**142**

Diagram 1 below is a graphical distribution of pass grade by option



COMMENTS

Overall the pass rate for GCB was 59.9% with 2 distinctions (90%) and 20 credits (80%).

The pass rate for the 'C&F' paper was 58.5% with 2 distinctions and 20 credits.

For GCP the figure was 75%, with 1 distinction and 5 credits being awarded.

Colin McCrorie
July 2011

GENERAL CERTIFICATE IN DISTILLING EXAMINATION

In November 2010, 26 candidates sat the GCD examination; 18 passed (69%) with 4 Credits; three candidates passes the Molasses option.

In May 2011, 83 candidates sat the GCD, with 72 following the Cereal option, 7 the Molasses option and, for the first time, 4 followed the Grape option. The overall pass rate was 56%, with 46 candidates passing, including 4 with Credits.

This number of candidates maintains the increasing interest in this qualification and it is particularly pleasing that increasing numbers of candidates are now electing to follow the options other than Cereal; it is hoped that the "Molasses" and "Grape" options for this qualification will become even more popular.

The continued success of candidates suggests that the candidates are steadily improving their examination technique, it is imperative that candidates read each question very carefully, plus any associated graph, sketch or table, to understand precisely what is required. It is also important that candidates ensure that all aspects of the syllabus are studied, since MCQ papers are designed to examine the full breadth of the syllabus.

Questions are designed to present a range of degree of difficulty, which are designed also to the depth of the candidates' knowledge, which may expose the level of candidates' preparation.

Dr David G Taylor
August 2011

Successful Candidates

The successful candidates from the 2011 Diploma and Master Brewer Examinations, who met all the IBD criteria, are listed as follows:

MASTER BREWER

MB1 Passes

Aaron	Allen	International
Michael	Badura	Irish
Michael Andrew	Benson	Great Northern
Miles Robert William	Chesterman	Southern
Richard	Clarke	Irish
Brendan	Coyle	International
Louis Richard	De Jager	Africa
Alan	Dempsey	Irish
Gregory S	Deuhs	International
Lawrence	Egan	Irish
Iyobosa	Erhabor	Africa
Oluwaseun	Faturiyele	Africa
Ganesh	Kumar	International
Kelvin Robert	Lamberti	Africa
Ndumiso Marius	Madlala	Africa
Lisa Marie	Marlow	Irish
Patrick Joseph	McGinty	Midland
Richard John	Moxom	Irish
Edward	Nsubuga	Africa
Apiwe Philela	Nxusani	Africa
John	O'Brien	Irish
Fearghal Patrick	O'Connor	Irish
Samuel	Oiko	Africa
Oyebode	Oloyede	Africa
Amy	Phizacklea	Scottish
Simon Andrew	Smith	Midland
Jonathan	Tillson	Southern
Robert	Whelan	Irish

MB2 Passes

Sharad	Bhardwaj	Asia Pacific
Lindsay Matthew	Crawford	Asia Pacific
Louis Richard	De Jager	Africa
Alan	Dempsey	Irish
Oluwaseun	Faturiyele	Africa
Tully Ceman Patrick	Hadley	Asia Pacific
Alexander Gregor	Hellenkamp	Midland
Peter	Hofmann	Africa
Kelvin Robert	Lamberti	Africa
Michael Mwaura	Muiruri	Africa
Naftaly Theuri	Ndungu	Africa
Apiwe Philela	Nxusani	Africa
Raj Kumar	Sharma	Asia Pacific
Christopher Alan John	Sheehan	Asia Pacific
Manoj Parameshwara	Thandel	Asia Pacific
Marna	Van Schalkwyk	Africa

MB3 Passes

Abiodun Bamidele	Ajayi	Africa
Sharad	Bhardwaj	Asia Pacific
Jonathan William	Elks	Midland
Alexander Gregor	Hellenkamp	Midland
Robert Patrick	Kelly	Asia Pacific
Edward	Kentish-Barnes	Southern
Dominika	Kwarciak	Great Northern
Michael Patrick	Leslie	International
John	O'Brien	Irish
Omololu Dada	Ogunkeye	Africa
Adeolu Babafemi	Ogunyinka	Africa
Patrick Roy	Parsons	International
Robert John	Topham	Southern

MB4

Nathan Garth	Calman	Asia Pacific
Gregory S	Deuhs	International
Rebecca Jean	Dickinson	International
Alexander Gregor	Hellenkamp	Midland
Edward	Kentish-Barnes	Southern
Omololu Dada	Ogunkeye	Africa
Adeolu Babafemi	Ogunyinka	Africa
Patrick Roy	Parsons	International
David	Rogers	Asia Pacific

MB5

Travis	Audet	International
Ching Fook	Chan	Asia Pacific
Gregory S	Deuhs	International
Rebecca Jean	Dickinson	International
Marco	Hacker	Midland
Graeme William	Hamilton	Midland
Alexander Gregor	Hellenkamp	Midland
Edward	Kentish-Barnes	Southern
Patrick Roy	Parsons	International
Raj Kumar	Sharma	Asia Pacific

AWARDED MASTER BREWER QUALIFICATION HAVING COMPLETED ALL 5 MODULES

Ching Fook	**Chan**	**Asia Pacific**
Rebecca Jean	**Dickinson**	**International**
Graeme William	**Hamilton**	**Midland**
Edward	**Kentish-Barnes**	**Southern**
Patrick Roy	**Parsons**	**International**

DIPLOMA IN BREWING

Module 1 Passes

Charlotte	Abeyie	Africa
Olajuyigbe Amos	Adebayo	Africa
Oluwatosin	Adetula	Africa
Peter	Agbo Gandee	Africa
Olalekan Fatai	Akinbowale	Africa
Ross	Allen	International
Ethan	Allured	International
Alvimar	Alves Lousada	International
Matthew	Anderson	Midland
Eric	Anzelc	International
Thomas	Ashton	Asia Pacific
Joseph Olanrewaju	Babalola	Africa
Maxime	Bedard	International
Sean	Bellew	Southern
Timothy John	Best	Asia Pacific
Jeffrey Alan	Booth	International
Alex	Brandon-Davies	Great Northern
Larissa	Burns	Asia Pacific
Owen	Cameron	Asia Pacific
Farai Jabulani	Chaibva	International
Ritesh Ramakant	Chiplunkar	Asia Pacific
Emma	Codyre	Irish
Jamie Harold	Cook	Great Northern
Nathan Robert	Crabbe	Asia Pacific
Matthew	Darrow	International
Jephthah Yaw	Datsomor	Africa
Thomas Cary Kwaku	Davis	Asia Pacific
Daniel	De Klerk	Africa
Andrew	Degnen	Southern
Anand V	Deshpande	Asia Pacific
Tyler	Downey	International
Oluwabusayo Atinuke	Egonmwan	Africa
Sarah	Engel	International
Luke	Erdody	International
Olaide	Fadahunsi	Africa
Josephine	Foley	Irish
Valerie	Fraser	International
Alejandra	Garcia	International
Nick	Gislason	International
James	Godman	Southern
Yogendra	Goundar	Asia Pacific
Thomas Vincent	Graham	International
Edward	Gross	International
Shantaveer N	Gudadinni	Asia Pacific
Scott Nathan	Hampton	Asia Pacific
Thomas	Hardy	International
John	Hart	International
William James	Henry	International
Brennan	Holmes	International
Marta	Horofker	International
Jeffrey	Hueneman	International
Aigbokhaode Mohammed	Ibrahim	Africa
Brian	Jackson	International
Brandon	Jacobs	International
Armachius	James	Africa
Karina Elisabeth	Jap a Joe	International
Jonathan	Jordan	International
Alieu Stephen	Kafoe	Africa
Michael	Kelly	International
Rachel	Kelly	Asia Pacific
Jane	Kershaw	Midland
Sandhea Devi	Kiran	Asia Pacific
Arvind	Kumar	Asia Pacific
Richard Morbe	Lado	Africa
Benjamin Robert	Landsberry	Asia Pacific
Ankie	Langerak	International
Caroline	Lanzoni	International
Xavier	Lapointe-Gagner	International
Jane Elizabeth	Lawton	Great Northern
Quynh	Le	International
Luyen	Le Thi Thanh	Asia Pacific
Andrew	Livingston	Scottish
Tran Thi Ngoc	Loan	Asia Pacific
Deb	Loch	International
Gavin	Lord	International
Juliette	Love	Southern
Andrew	Lowry	Irish
Barry James	McDougall	Irish
Louise	McGeorge	Southern
David Bruce	McKenzie	Asia Pacific
Nathan	McLaughlin	International
James	McSweeney	Irish
Garry	Menz	Asia Pacific
Ivan Stewart	Merida	International
Baldwin John	Mgendera	Africa
Jasper	Miller	International
Benjamin	Mills	International
Christopher	Mitchell	Africa
Rachel Refiloe	Moilwa	Africa
Brent Nathaniel	Morgan	International
Tumaini	Moses	Africa
Xolani	Mthembu	Africa
Ian	Mullican	International
Rita Nakanwagi	Muwonge	Africa
Simon Christopher	Nash	Southern
Robert George	Nicolle	Southern
Ntsapokazi	Ningiza	Africa
John Berchman Chinonye	Njoku	Africa
Andre	Nunes Ferraz	International
Esther Ntende	Odongol	Africa
Fearghal	O'Flaherty	Irish
Israel	Okere	Africa
Bolanle John	Oladokun	Africa
Fred Akoko	Oluoch	Africa
Abel Marco	Pallangyo	Africa
Ravi	Patel	International
Luke	Pestl	International
Hanh Duy	Phan	Asia Pacific
Jason	Pratt	International
Deroshan	Pullian	Africa
Buyankhishig	Purev	Asia Pacific
Gaolebalwe Timothy	Ramorula	Great Northern
Jacobus Pieter	Schoenmakers	International
Rebecca	Semoka	Africa
Anil Kumar	Sharma	Asia Pacific

Christopher	Shilubane	Africa
Victor	Sithole	Africa
Erik	Sohn	International
Kevin Foster	Somerville	International
Subramani	Srinivasan	Asia Pacific
Jonathan	Stewart	International
Louis	Steyn	Africa
Aaron	Taubman	International
Ui Ritoviko	Tavo	Asia Pacific
Mark	Toomey	Asia Pacific
Eno-obong	Udoh	Africa
Sanaz	Valizadeh	Asia Pacific
Mark Raymond	Vandergoot	International
Matheril Krishnan	Venugopalan	Asia Pacific
Carolanne	Watkins	Southern
Stephen Michael	Waygood	Southern
Daniel	Weber	International
Thomas David	Whitehouse	Asia Pacific
Geoffrey	Wiseman	International
Kenneth	Wood	International
Jacob	Zuchowski	International

Module 2 Passes

Oluwatosin	Adetula	Africa
Susheel Kumar	Agarawal	Asia Pacific
Ross	Allen	International
Ethan	Allured	International
Alvimar	Alves Lousada	International
Eric	Anzelc	International
Thomas	Ashton	Asia Pacific
Lasat Tanu	Basu	Asia Pacific
Maxime	Bedard	International
Trinh Thi Thanh	Binh	Asia Pacific
Craig	Brodie	Asia Pacific
Craig Matthew	Buddle	Asia Pacific
Niamh Eileen	Cashell	Irish
Farai Jabulani	Chaibva	International
Kay Mun	Chey	Asia Pacific
Joseph	Claffey	Irish
Ayodeji Peter	Dada	Africa
Matthew	Darrow	International
Daniel	De Klerk	Africa
Tomaso	Della Vedova	Irish
Sudha	Deo	Asia Pacific
Tyler	Downey	International
Daniel	Feist	Asia Pacific
Valerie	Fraser	International
Alejandra	Garcia	International
Nick	Gislason	International
James	Godman	Southern
Thomas Vincent	Graham	International
Mary	Groah	International
Edward	Gross	International
Shantaveer N	Gudadinni	Asia Pacific
Shamim T	Hamza	Asia Pacific
Thomas	Hardy	International
David	Hill	Midland
Paulien	Hollering	International
Jeffrey	Hueneman	International
Chung Ghee	Hum	Asia Pacific
Aigbokhaode Mohammed	Ibrahim	Africa
Enkhgerel	Jargalsaikhan	Asia Pacific
Alieu Stephen	Kafoe	Africa
Tendai	Kapambwe	Africa
Michael	Kelly	International
Jane	Kershaw	Midland
Neil	Kielly	International
Aeveen	Kirby	Irish
Rakesh	Koorapati	Asia Pacific
Peter Han Tung	Kuok	Asia Pacific
Caroline	Lanzoni	International
Xavier	Lapointe-Gagner	International
Jane Elizabeth	Lawton	Great Northern
Paul Kok Tiong	Lim	Asia Pacific
Deb	Loch	International
Gavin	Lord	International
Peter	Martin	International
Thomas	McEvoy	Irish
Jennifer Lynn	Merrick	Great Northern
Jasper	Miller	International
Benjamin	Mills	International
Chandrani	Mishra	Asia Pacific
Christopher Michael	Monahan	Asia Pacific
Ian Hardicker	Moon	Great Northern
Brent Nathaniel	Morgan	International
Rachel	Murphy	Asia Pacific
Rita Nakanwagi	Muwonge	Africa
Meshack Michael	Mwaluko	Africa
Anil	Nair	Asia Pacific
Simon Christopher	Nash	Southern
Wenyin	Ng	Asia Pacific
Georgine	Ngoumela Fokou	Africa
Vinod	Nikam	Asia Pacific
John Berchman Chinonye	Njoku	Africa
Andre	Nunes Ferraz	International
Rogatien	Nyada Nyada	Africa
Julius	Nyirenda	Africa
Cynthia Chineye	Obietoh	Africa
Tim	O'Donovan	Irish
Godfrey Osayande	Ogieva	Africa
Sylva Okechukwu	Okpara	Africa
Bolanle John	Oladokun	Africa
Lois Romaine	Oliver	International
Luis	Ortega	International
Dolapo	Oshiegbu	Africa
Kome Doris	Owhoruviowho	Africa
Ravi	Patel	International
Dirk	Penny	Asia Pacific
Sean	Peyton	Irish
Claire Marie	Prior	Irish
Deroshan	Pullian	Africa
Gaolebalwe Timothy	Ramorula	Great Northern
Dmytro	Revkov	International
Sarah Helen	Richardson	Great Northern
Andrew	Rusinas	International
Muthumalaichamy	Sakthivel	International
Milind Madhukar	Savaikar	Asia Pacific
Jacobus Pieter	Schoenmakers	International

Cameron Bowen	Shield	Asia Pacific
Christopher	Shilubane	Africa
Karli	Small	Asia Pacific
Michael John	Stonier	Asia Pacific
Harikrishna	Sudhakaran	Africa
Aaron	Taubman	International
Nathan Edward	Thomson	Asia Pacific
Pooi Mun	Tiong	Asia Pacific
Eno-obong	Udoh	Africa
Quinton	Van Adrichem	International
Ferdinand	Van Lingen	Africa
Veronica	Vega	International
Jerry	Vietz	International
Katrina	Vlahovich	International
Brendan	Watcham	Africa
Daniel	Weber	International
Tuck Loong	Wong	Asia Pacific
Kenneth	Wood	International
Seth	Wright	International

Module 3 Passes

Inalegwu	Adoga	Africa
Melissa Anne	Aistrope	Asia Pacific
Ross	Allen	International
Ethan	Allured	International
Alvimar	Alves Lousada	International
Eric	Anzelc	International
Jennifer Ovue	Bakene	Africa
Maxime	Bedard	International
Daniel	Bedford	International
Ailish	Bergin	Irish
Jan	Brestovansky	Irish
Donal	Comerford	Irish
Matthew	Darrow	International
Thomas Cary Kwaku	Davis	Asia Pacific
Suzanne	Davis	Irish
Daniel	De Klerk	Africa
Deirdre	Delaney	Irish
Tyler	Downey	International
Luke	Erdody	International
Lisa	Fahey	Irish
Valerie	Fraser	International
Darrin William	Gano	International
Alejandra	Garcia	International
Nick	Gislason	International
Edward	Gross	International
Thomas	Hardy	International
Ashley Graham	Hazell	Asia Pacific
Tamara	Hudson	International
Jeffrey	Hueneman	International
Aigbokhaode Mohammed	Ibrahim	Africa
Colin	Johnston	Scottish
Brian	Karemba	Africa
Michael	Kelly	International
Rachel	Kelly	Asia Pacific
Ross	Kidd	Irish
Neil	Kielly	International
Eliazah	Kihanya	Africa
Claude Henry	Korosso	Africa
Vipul	Kumar	Asia Pacific
Caroline	Lanzoni	International
Xavier	Lapointe-Gagner	International
Samuel Yao	Lefoneh	Africa
Matthew	Letki	International
Paul Kok Tiong	Lim	Asia Pacific
Deb	Loch	International
Gavin	Lord	International
Thomas Karl	Mace	International
Leighton Callistus	Madziwa	Africa
Cherubim	Makoni	Africa
Blessing	Makunzva	Africa
Joseph	Malibe	Africa
James	McSweeney	Irish
Jennifer Lynn	Merrick	Great Northern
Jasper	Miller	International
Benjamin	Mills	International
Jude Ikechukwu	Molokwu	Africa
Brent Nathaniel	Morgan	International
Takura M	Mugomba	Africa
Gail	Mullins	Irish
Eric Wilhelm	Ngoile	International
John Berchman Chinonye	Njoku	Africa
Andre	Nunes Ferraz	International
Israel	Okere	Africa
Fred Akoko	Oluoch	Africa
Robert James	Parker	International
Ravi	Patel	International
Sean	Peyton	Irish
Iain William	Price	Irish
Deroshan	Pullian	Africa
Gaolebalwe Timothy	Ramorula	Great Northern
Jason	Richard	International
Luke	Rutland	Asia Pacific
Martin	Ryan	Irish
Sushil	Savla	Asia Pacific
Daniel Lee	Scott Paul	Great Northern
Lewis	Seddon	Asia Pacific
Renesh	Sewnarian	Africa
Mathighatta Gopalakrishna	Shamsundar	Asia Pacific
Christopher	Shilubane	Africa
Marc	Smith	Great Northern
Mike	Spitere	Irish
Michael John	Stonier	Asia Pacific
Harikrishna	Sudhakaran	Africa
Rob Mathieu Johan	Tummers	International
Eno-obong	Udoh	Africa
Genevieve Corinne	Upton	Midland
Veronica	Vega	International
Daniel Christopher	Walker	Asia Pacific
Christopher John	Ward	Asia Pacific
Jonathan Christopher	Ward	Midland
Brendan	Watcham	Africa
Aaron	Weshnak	International
Samuel George	Williamson	Asia Pacific
Kenneth	Wood	International
Jacob	Zuchowski	International

AWARDED DIPLOMA IN BREWING QUALIFICATION HAVING COMPLETED ALL 3 MODULES

Inalegwu	Adoga	Africa
Melissa Anne	Aistrope	Asia Pacific
Ross	Allen	International
Ethan	Allured	International
Alvimar	Alves Lousada	International
Eric	Anzelc	International
Lasat Tanu	Basu	Asia Pacific
Maxime	Bedard	International
Daniel	Bedford	International
Ailish	Bergin	Irish
Jan	Brestovansky	Irish
Joseph	Claffey	Irish
Jamie Harold	Cook	Great Northern
Matthew	Darrow	International
Daniel	De Klerk	Africa
Deirdre	Delaney	Irish
Tomaso	Della Vedova	Irish
Tyler	Downey	International
Valerie	Fraser	International
Darrin William	Gano	International
Alejandra	Garcia	International
Nick	Gislason	International
Edward	Gross	International
Thomas	Hardy	International
Ashley Graham	Hazell	Asia Pacific
Tamara	Hudson	International
Jeffrey	Hueneman	International
Aigbokhaode Mohammed	Ibrahim	Africa
Tendai	Kapambwe	Africa
Brian	Karemba	Africa
Michael	Kelly	International
Rachel	Kelly	Asia Pacific
Ross	Kidd	Irish
Neil	Kielly	International
Eliazah	Kihanya	Africa
Aeveen	Kirby	Irish
Claude Henry	Korosso	Africa
Arvind	Kumar	Asia Pacific
Caroline	Lanzoni	International
Xavier	Lapointe-Gagner	International
Samuel Yao	Lefoneh	Africa
Matthew	Letki	International
Paul Kok Tiong	Lim	Asia Pacific
Deb	Loch	International
Gavin	Lord	International
Thomas Karl	Mace	International
Leighton Callistus	Madziwa	Africa
Cherubim	Makoni	Africa
Jennifer Lynn	Merrick	Great Northern
Jasper	Miller	International
Benjamin	Mills	International
Jude Ikechukwu	Molokwu	Africa
Brent Nathaniel	Morgan	International
Takura M	Mugomba	Africa
Gail	Mullins	Irish
Eric Wilhelm	Ngoile	International
Georgine	Ngoumela Fokou	Africa
John Berchman Chinonye	Njoku	Africa
Andre	Nunes Ferraz	International
Rogatien	Nyada Nyada	Africa
Julius	Nyirenda	Africa
Luis	Ortega	International
Robert James	Parker	International
Ravi	Patel	International
Dirk	Penny	Asia Pacific
Sean	Peyton	Irish
Iain William	Price	Irish
Claire Marie	Prior	Irish
Deroshan	Pullian	Africa
Gaolebalwe Timothy	Ramorula	Great Northern
Jason	Richard	International
Andrew	Rusinas	International
Luke	Rutland	Asia Pacific
Martin	Ryan	Irish
Sushil	Savla	Asia Pacific
Daniel Lee	Scott Paul	Great Northern
Lewis	Seddon	Asia Pacific
Mathighatta Gopalakrishna	Shamsundar	Asia Pacific
Christopher	Shilubane	Africa
Marc	Smith	Great Northern
Michael John	Stonier	Asia Pacific
Harikrishna	Sudhakaran	Africa
Nathan Edward	Thomson	Asia Pacific
Rob Mathieu Johan	Tummers	International
Eno-obong	Udoh	Africa
Genevieve Corinne	Upton	Midland
Quinton	Van Adrichem	International
Veronica	Vega	International
Daniel Christopher	Walker	Asia Pacific
Christopher John	Ward	Asia Pacific
Jonathan Christopher	Ward	Midland
Brendan	Watcham	Africa
Samuel George	Williamson	Asia Pacific
Geoffrey	Wiseman	International
Kenneth	Wood	International

DIPLOMA IN DISTILLING

Module 1 Passes

Debbie Sarah	Briody	Scottish
Ashok	Chokalingam	Great Northern
Leanne	Corner	Scottish
Marland Oneil	Davis	International
Flavien	Desoblin	International
Mncedisi Sisekelo	Gama	Africa
Richard Kevin	Guiseppi	International
Barry Macdonald	Harrison	Scottish
John	Mackenzie	Scottish
Mutondi Thomas	Makhubele	Africa
John	McCarthy	Southern
Barrington Calbert	Morgan	International
Michael	Riley	Scottish
Rohan	Robinson	International
Romesh	Singh	International
Christian Klaus	Von Der Heide	Irish
Craig	Wilson	Scottish

Module 2 Passes

Karen	Bell	Scottish
Alan T	Brown	Scottish
Marland Oneil	Davis	International
Rodney	Donnell	Irish
Shona	Glancy	Scottish
Richard Kevin	Guiseppi	International
Jaime	Jordan	Irish
Mark	Lancaster	Scottish
Jane	Loveland	Scottish
Stephen John	McHugh	Asia Pacific
Robert	McWilliam	Scottish
Alan	Rettie	Scottish
Ian Alexander	Russell	Irish
Shona	Schroeder	Asia Pacific
Romesh	Singh	International
Rosalind Priscilla Alexandra	Thomas	Irish
Ian John	Thorn	Southern
Craig	Wilson	Scottish
Murray Orr	Wiseman	Scottish

Module 3 Passes

Debbie Sarah	Briody	Scottish
Amanda Judith	Burke	Scottish
Daniel	Burke	Irish
Lisa Marie	Carr	Scottish
Susan	Cattanach	Scottish
Matthew	Crow	Scottish
Nikolas Stephen Lawrence	Fordham	Southern
Mncedisi Sisekelo	Gama	Africa
Caroline	Geddes	Scottish
Richard Kevin	Guiseppi	International
Andrew James	McCulloch	Scottish
Romesh	Singh	International
Jeremy Matthew	Stephens	Scottish
Duncan McNab	Stewart	Scottish
Ian John	Thorn	Southern

AWARDED DIPLOMA IN DISTILLING QUALIFICATION HAVING COMPLETED ALL 3 MODULES

Lisa Marie	Carr	Scottish
Susan	Cattanach	Scottish
Matthew	Crow	Scottish
Rodney	Donnell	Irish
Nikolas Stephen Lawrence	Fordham	Southern
Caroline	Geddes	Scottish
Richard Kevin	Guiseppi	International
Barry Macdonald	Harrison	Scottish
Andrew James	McCulloch	Scottish
Ian Alexander	Russell	Irish
Romesh	Singh	International
Jeremy Matthew	Stephens	Scottish
Ian John	Thorn	Southern

DIPLOMA IN BEVERAGE PACKAGING

Module 1 Passes

Gareth Michael	Annable	Midland
Geoffrey Keith	Davis	Asia Pacific
Brian	Penney	Midland
Anthony	Walton	Midland
Taw Han	Win	Asia Pacific

Module 2 Passes

Shun Chiun	Chong	Asia Pacific
Antony Ian	Duke	Great Northern
Patrick	Kerr	Irish
Wee Ann	See	Asia Pacific
Bruce	Turner	Southern

Module 3 Passes

James Frazer	Davies	Asia Pacific
Graeme Andrew	Gibson	Asia Pacific
Jack	Rattan	Asia Pacific
Samantha Kathryn	Schleyer	Asia Pacific

AWARDED DIPLOMA IN BEVERAGE PACKAGING QUALIFICATION HAVING COMPLETED ALL 3 MODULES

James Frazer	Davies	Asia Pacific
Jack	Rattan	Asia Pacific
Samantha Kathryn	Schleyer	Asia Pacific

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