Examiners Report: 2020: Master Distillers

INSTITUTE OF BREWING & DISTILLING

Master Distiller

Module 1

Paper 1: Short Answer Questions

A total of 6 candidates sat this exam with 3/6 achieving a pass mark in this part of the paper with an average score of 53/100 marks.

Paper 2: Long Answer Questions

Question 1

a) **Barley purchased is high in moisture, nitrogen, and split husks. Discuss the impact on your malted barley production plant and identify operational changes needed to gain the maximum benefit from this barley. [13]**
b) **Discuss the design and operation of different cooking equipment required to process corn (maize). [12]**

Question 2

Discuss the impact of a poor sugar cane harvest on molasses quality and its implications on processing in a distillery. [25]

Question 3

A new distillery has the option to use water from a small reservoir (dam) or a borehole (well). Discuss the impact of using both supply options on distillery operations. Discuss the equipment required for each option. [25]

Question 4

a) **As part of a distillery mashing system upgrade, control is being changed from manual to an automatic (e.g. SCADA) system. Outline the key aspects of this control system and explain the control points. Explain how these control points would be monitored and the impact on operations if outside the control limits. [12]**
b) **As part of the same upgrade, the cold water with solid caustic flushing system is being changed from a manual to an automated CIP system. State the advantages of this upgrade and explain what type of CIP equipment and operational considerations are required. [13]**

Question 5

The environmental protection agency have reviewed distillery liquid discharge allowance and are proposing a reduction of 10˚C in the temperature and a 20% reduction of the chemical oxygen demand (COD) load. Discuss the options available to achieve these new targets and the financial implications of each option. [25]

Question 6

a) **Discuss the key elements of a distillery budget, detailing what is included in standard, budgeted, and actual costs. Identify direct and indirect costs, and outline what financial controls and reporting systems should be employed to monitor performance against budget. [13]**
b) **Design a trial to compare fermentation performance of a new yeast strain against the existing strain. Discuss how the trial results would inform a decision on whether the new yeast was more efficient. [12]**

The general feedback from Examiners was that there appeared a difference in preparation between candidates especially in non whisky related areas. As papers are being more balanced to cover all spirits production this should be an area of focus for all candidates. As there is a small cohort of candidates there is no detailed feedback on performance as this would identify individual candidates and assessing trends is not possible.

Module 2

Paper 1: Short Answer Questions

All candidates showed a good understanding over the range of the topics in the syllabus. It was noted that there was a better level of understanding shown in the answers to the cereal questions than the molasses and grape.

Candidates showed good judgement by providing answers with content fitting the allocated marks.

Paper 2: Long Answer Questions

Question 1

a) **State five Quality parameters that are commonly included in a purchased yeast contract. [5]**
b) **Demonstrate how knowledge of these parameters can influence process considerations. [10]**
c) **For each parameter, explain how the impact of low and high levels can be mitigated. [10]**

Generally this question was answered by most candidates. The question was answered well however candidates should have noticed the marking scheme gave indication that 2 marks in b and c were allocated for each parameter. Indeed the question was split into 3 parts to help candidates allocate time and length of answer appropriately. The answers demonstrated a good understanding of the need to include the parameter and the mitigation steps if not within specification. What the parameters influence on the process was less well answered. Ranges and units of measurement were expected to be shown.

Question 2

The analysis of a fermented maize/malted barley mash indicates the presence of unusually high levels of glucose, maltose and maltotriose, and very low levels of unfermentable dextrins. Discuss

the possible causes for the above and formulate a plan to return to normal low levels of sugars. [25]

This was not a popular question but was answered at a satisfactory level. Some candidates used a table to make the explanations simpler to discuss. This question was designed to examine the potential Master Distillers capability to investigate a process issue and then use the knowledge they have to reduce or eliminate the severity of the issue. All candidates should be confident they can answer this type of question. Most marks were lost by not giving an indepth recovery plan. For weaker answers: [13 Marks] candidates correctly determined cause of high sugar and low dextrins with a general discussion on these causes and a basic plan to recover. For satisfactory answers: [14 or 20 Marks] an additional discussion on cause with reference to reactions that are being impacted. Clear comment on fermentation not mashing as the cause. Discussion on how ,though not given, the levels of the individual sugars can help pin-point the problem. More in-depth recovery plan. For strong answers: [21-25 Marks] additional marks were awarded if the plan included analysis and data collection needed to monitor improved performance.

Question 3

a) **For a two-pot batch distillation process, design a plant that allows two distinct products to be produced using the same equipment. Legal constraints require the products to be segregated. [12]**
b) **For the above, discuss the necessary cleaning requirements for the plant to ensure any cross-contamination of the two products is mitigated. [13]**

This question was answered by all candidates. The candidates assumed that the question only asked for distillation equipment but in fact it was the whole process that was required. Marks were lost by only discussing the stills and not other equipment in the stillhouse. Several candidates suggested changing the physical shape of the stills but this was precluded in the question. A drawing of the various ways of operation made the discussion easier to understand.

For part a) Weak answers only showed a rough design with no detail on how products would be segregated – only distillation covered [5 marks]. Satisfactory answers: [6 – 9 marks] the answer includes segregation of raw materials, and detail on how different streams are segregated and for Strong answers: [10- 12 Marks] they included discussion on storage of intermediate streams while processing the different products.

For part b) Weak answers only the liquid cleaning areas were mentioned and no detail on how cleaning to eliminate contamination would be achieved. [5 marks]. Satisfactory answer: [6 – 10 marks] detail of cleaning requirements after both products had been produced. Discussion on how cleaning reduced cross contamination. Covered not just liquid streams and strong answers: [11-13Marks] different cleaning techniques were mentioned. Cleaning of bins and tanks was discussed.

Question 4

a) **The analysis of a feed stock to a two-column continuous still indicates the levels of methanol, iso-amyl alcohol, and propanol are above the design specification. Describe the equipment required to ensure the specified spirit quality can be achieved. [15]**
b) **Describe the design requirements of a plate arrangement in a continuous still and explain how these requirements are met with reference to two different designs. [10]**

This question was answered very well. Some marks were lost by not referencing 2 different designs in part b.

For part a) Weak answer: [6 marks] Basic description of what columns are needed and basic comment on what impact each column. Satisfactory answers: [7 – 12 marks] gave detail on columns, how they interact with each other and a level of detail of operation and how this would bring the product back into the design specification. This requires 3rd additional column. Include feed and product ethanol concentrations. Strong answers: [13- 15 Marks] included information on relative volatility and how this changes with ethanol concentration. Comment on operational costs though not asked for can form part of the answer on why we need to design columns correctly.

For part b) Weak answer: only [5 marks] general reference to the 4 key requirements. Basic drawing or explanation of operation. A satisfactory answer: [6 – 8 marks] detailed design, usually with a diagram, of plate and how they exhibit the design requirements. Reference made to two types of plate and for Strong answers: [8- 10Marks] comment on other factors such as fouling and separation efficiency.

Question 5

For a distillery, state the key utilities and explain how these are generated. Describe what methods can be used to measure consumption and explain how the data obtained can be used to improve operational efficiency. [25]

Question was answered by all the candidates. Marks were lost by lack of detail, especially of metering systems. Further marks were lost by not discussing in sufficient detail how the data would be used to improve efficiency.

Weak answer [12] gave a list of utilities and short description of generation method. General comment on measurement and how data can drive improvement. Satisfactory answer [13- 20] description of at least 4 with what they are used for. Included how the method of generation allowed right specification and matched usage. Measuring equipment discussion included and why several measures are needed and how this can be used to build a monitoring system that can then be part of an improvement plan. For a strong answer [21-25] the need for consistent units, calibration and data recording. Comment on relative cost of each and how this would impact on level of metering and data collection.

Question 6

For a distillery, describe the key components of a management system and explain how these can be used to measure and optimise plant efficiency, utilisation, planning, stock management, and regulatory control. [25]

This question was not answered by many candidates but the key elements were included. Marks were lost by not covering all 5 topic areas and not commenting on the role of each component of the management system.

Weak answer [12] key components addressed and brief discussion on how used in the 5 areas mentioned in the question

Satisfactory answer [13-20] include more detail with examples of how the system drives optimisation and type and frequency of measurement.

Strong answer [21-25] impact on efficiency, cost, operator performance and need for regulatory control.

Candidates need to be careful they are answering the specific question not just writing down all they know on the subject. In addition when asked to compare two things then both need to feature in the answer. In general candidates gave enough to show knowledge of the subject, mainly from the teaching notes but to gain higher marks at this level you also need to show the interrelationship between different parts of the syllabus.

Module 3

Paper 1: Short Answer Questions

A total of 3 candidates sat this exam with 2/3 achieving a pass mark in this part of the paper with an average score of 67/100 marks.

Paper 2: Long Answer Questions

Question 1

For a bottling facility that receives bulk mature whisk(e)y and produces cased bottles, filled into containers, describe and explain the main stages of processing and equipment that will be required. Discuss in your answer options relating to manning. [25]

Question 2

A spirits bottling plant is striving to become a 'net-zero' carbon business by 2030. Focussing only on the packaging and warehouse operations, describe and justify a programme to support this process in a packaging centre which includes multiple spirits products and RTDs (ready to drink). [25]

Question 3

Discuss the various factors and alternatives which will impact on the ultimate characteristics of a spirit due to it undergoing maturation. [25]

Question 4

a) **For cases (cartons) of twelve bottles, answer the question below for either:**
    i. **70cl bottles each of 40 %v/v or**
    ii. **75cl bottles each of 43 %v/v**

    Calculate the minimum number of casks required to complete an order of 10,000 cases of a blended whisk(e)y with the following recipe. 70% Grain (light) whisk(e)y 30% Malt (flavoured) whisk(e)y the grain whiskey is in American standard barrels. The strength after maturation is 65%v/v half the Malt is unpeated 5YO in Hogsheads at 60%v/v. The remainder of the Malt is peated 5YO in Butts also at 60%v/v. Assume 2% evaporation per annum and stating reasonable estimates for the various cask volumes in use. [20]
b) **Once the blend components had been brought together, several casks of one of the components were found to be empty. State what steps would require to be taken. [5]**

Question 5

When considering the packaging of spirits in glass explain how product risks to the consumer are assessed and controlled. [25]

Question 6

For a greenfield cask filling and maturation warehousing facility, supplied by tanker from various remote distilling locations, describe the various options which might be considered, drawing a layout diagram. Discuss the choices and business decisions involved. [25]

As there is a small cohort of candidates there is no detailed feedback on performance as this would identify individual candidates and assessing trends is not possible.

Module 4

Paper 1: Short Answer Questions

A total of 4 candidates sat this exam with 3/4 achieving a pass mark in this part of the paper with an average score of 64/100 marks.

Although there is a small cohort of candidates taking the Master Distiller Module 4 exam there were similar questions asked in the Master Brewer Module 4 exam and therefore I have included feedback from both these exams as it is applicable to the question asked.

Paper 2: Long Answer Questions

Question 1

a) **Explain the benefits of managing energy and utility consumption in real time. [10]**
b) **Discuss how this can be achieved and explain the practical difficulties which may be encountered. [15]**

The better candidates developed up to five benefits:

- Being able to measure / monitor energy and utilities instantaneously (as it is consumed).
- Being able to empower personnel to take immediate (generally corrective) action to address an abnormal consumption.
- To optimise energy and utility use.
- To benchmark more accurately.
- To allow departmental budgetary accountability (user pays principle).

The second point is one of the greatest benefits and is generally achieved by having control limits with alarms (visual on computer screens / phones and / or audible) to prompt immediate corrective action. This contrasts with the historic approach of investigating an abnormal use (often a spike on a chart) at some time after the event and trying to prevent reoccurrence.

The fifth point is a particularly important development – historically, there was rarely sufficient metering to provide user accountability. Attempts to do so by summation generally failed as the information lacked credibility and could easily be challenged.

For the second part of the question the examiner was seeking a discussion around four key issues on how real time management can be achieved:

- Requires installation of comprehensive metering and sub-metering for, as a minimum, the largest consumers of electricity, thermal energy and water.
- Need to set control and alarm levels for normal and abnormal conditions.
- Requires computer system to monitor consumptions and flag changing and alarm conditions.
- Need to empower operators and technicians to modify or even stop processes to reduce abnormal consumption.

Practicalities detailed by the best candidate included: High capital cost (although usually a good pay-back) plus some disruption during installation; Ongoing revenue costs (maintenance and calibration of instruments, training of operators and technicians); Prioritisation of metering (deciding between various energies and utilities); Implications for production planning and customer service of slowing or stopping processes; Handling very large quantities of data.

Question 2

a) **What considerations need to be addressed when setting up a Health and Safety Risk Assessment? [10]**
b) **With the aid of a diagram, explain the construction and calibration of a risk grid and how a risk grid is used as a management tool at either a distillery or bottling plant. [15]**

For part (a) the examiner was seeking considerations which should have included (but not confined to):

- Are the individuals / group competent to assess the risk – do they have the right knowledge and experience?
- Are the individuals who will be exposed to the risk represented?
- Is the risk assessment original or merely a copy of another which may not be identical?
- Is the assessment being rushed without all the correct information?
- Is the assessment being carried out in the area of the risk or remotely (are all the implications being considered)?
- Do the individuals / group have authority to put mitigation measures in place or would there be a delay in the process?
- What are the processes or procedures for ensuring that tasks are carried out safely, considering the results and requirements of the risk assessment?
- Is the risk assessment being adequately documented?
- How frequently are risk assessments reviewed?

A list of hazards present in the distilling industry was not being sought by the examiner which was the incorrect approach adopted by some candidates.

For part (b) of the question an explanation was required, not simply annotations to a diagram or sketch. In general, this part was answered well with good explanations of the key features including calibration of the grid in quantitative terms. As is found in working examples, there was some variation in "likelihood of occurrence" from the use of terms such as "very unlikely, somewhat unlikely, unlikely, etc" to numeric terms such as "1 in 1 year, 1 in 10 years, 1 in 100 years etc".

The final part of the question produced variable responses. The best answer listed the following (not in any order of relative importance):

- Severity vs incidence can be evaluated.
- Relatively simple visual guide for overseeing multiple risks.
- Risks can be quantified relative to each other to allow identification of priorities.
- Use of risk grids is in line with regulatory authorities (same language).
- Allocation of resources – personnel and money.
- Guide for continuous improvement to reduce risks.
- Patterns of risk can be identified.

The third point is clearly one of the key benefits of using a risk grid.

Question 3

How would a commercial brand owner be assured about the integrity of their products which are produced at multiple international locations including by some external third parties? [25]

For this question, the examiner was seeking demonstration of a broad understanding of the importance of brands within an organisation including how technical, production and commercial teams work effectively together across international boundaries to support brand equity and integrity.

Most answers covered how to set up quality assurance approaches for this including appreciation of labelling requirements as well as audit protocols. However there generally were insufficient details highlighting what factors would be important to the commercial brand owner and how these would be covered.

More marks were available for answers covering working internationally as well as containing reporting, variance management and reporting. Marks were also available for details of effective collaborative working including management of complaints procedures and product recalls.

Question 4

One of a spirits company's large customers would like to set up a collaborative planning forum between both parties in order to improve shelf availability of spirits products in their retail outlets. Describe all factors that would need to be reviewed for the organisation to consider putting this in place and explain their importance. [25]

Most answers focused on planning aspects that were important to a production site and not on the possible benefits across the whole supply chain including to the most important aspect, the Customer ! Fuller answers would include preparation and evaluation of a business case.

Setting up of the forum including benefits resources, ways of working, alignment on metrics etc

Planning processes, forecasting, promotions, offers, new product development, time horizons, short and long term planning, prioritisation of own products vs order, order fulfilment.

Inventory management and responsibilities/accountabilities

Financial impact of all of the above including articulation on where there may be impacts for all parties.

Other factors and benefits including length of contract/partnership, points of contact including commercial teams, immediate insights, and Relationship development.

Question 5

a) **Discuss how a finished goods warehousing and logistics review should be set up and carried out. [10]**
b) **Explain how the following key outcomes might be achieved as a result of the review:**
    - **an improved company financial position**
    - **improved customer service [15]**

The examiner was looking for candidates to demonstrate application of their knowledge of three key areas : financial management, project management and supply chain.

Review of what is currently in place, key metrics, financial and operational performance,

Reference as to how to improve the two required metrics and demonstrating knowledge of which levers would move each and what 'good' would look like.

Articulation of how the review would be set up with key decision points.

Articulation of how the review would then be managed and implemented as well as ongoing key decision points and post project follow up.

Question 6

a) **Explain the term "inherent reliability" (in-built reliability) in relation to plant performance. [4]**
b) **How can inherent reliability be optimised? [16]**
c) **Describe the implications for capital and revenue expenditure in seeking a high level of inherent reliability. [5]**

For part (a) the examiner was seeking an explanation along these lines: The inherent reliability is a measure of the overall "robustness" of a system or piece of equipment. It provides an upper limit to the reliability and availability that can be achieved. In other words, no matter how much inspection or maintenance is performed, the inherent reliability will never be exceeded.

Inherent reliability of plant or equipment can be optimized by careful consideration during the design and build phases as well as operating phase. Reliability practices during the design phase might include:

- Zero failure design for key items – critical failures are entirely eliminated by design.
- Fault tolerance – redundant elements switch over to a backup or alternative mode.
- De-rating – a component is used much below its capability rating.
- Durability – a component is designed to have a longer "useful" life or damage tolerance.
- Safety margins – the design allows for all applicable worst-case stresses and margins.
- Fail safety design – failure effects function but no injury or additional damage.
- Provision of early warnings of failure – through fault diagnosis

Strategies during the manufacturing, build and installation phases might include:

- Process failure mode, effects, and criticality analysis
- Statistical process control
- Environmental stress screening tests
- Production reliability acceptance tests – used to detect any degradation in the inherent reliability of the plant over the course of production. Also used to assure that the plant meets the customer's reliability requirements and expectations.

During the operating phase, the inherent reliability of plant or equipment can be optimized by operating, inspecting, and maintaining as well as possible. On the other hand, if there are gaps in operating, inspection, or maintenance practices, only a lower level of the inherent reliability will be achieved. One method of maintain high levels of reliability is to have a system of failure reporting, analysis, and corrective action. Essentially this provides the data used to identify deficiencies for correction to ensure that inherent reliability is not degraded.

The implications for capital and revenue expenditure in seeking a high level of inherent reliability were not well described. In general, there will be a higher capital cost for the initial purchase of the plant or equipment with, over time, lower revenue cost for operating and maintaining. The very best answers explained the principles of life cycle costing which is highly relevant in this context.