

Design of quality assurance systems for breweries – Part 1

SYSTEMATIC MONITORING | Quality control and quality assurance are defined as the systematic monitoring of processes and (intermediate) products which are used to consistently meet product specifications at all stages in the process, up until and including when the product reaches the customer. The considerations presented in this paper are guidelines for establishing successful operating Quality Management Systems in breweries.

THIS TWO-PART ARTICLE will provide a comprehensive overview of the following topics regarding quality control and quality assurance:

- brewery related pre-conditions;
- quality management systems;
- quality control manuals;
- extent of continuous monitoring;
- economical considerations;
- required personnel.

The VLB is involved with research regarding the current practices of Quality Assurance (QA) and how these can be developed to fit the future needs of the industry. In conjunction with their ongoing research,

VLB consults with clients in the beer and beverage industries regarding their QA systems and how they could develop their existing practices.

Quality control is defined by Bamforth as “a reactive approach, [...] in that it seeks to respond to measurements that are made and effect corrections if the values are out of specification.” Quality assurance is defined by Bamforth as “an approach in which systems are introduced that ensure that at every stage in its production, the product is within specification, the

emphasis is on prevention rather than detection” [1]. The monitoring process must reflect the current status of chosen chemical-technical, microbiological and sensory parameters of all production and packaging areas. In order to maintain a defined product quality, certain quality criteria and (internal) quality standards are applied. Therefore, the combination of QC and QA can be regarded as a management tool providing essential information for the decision makers.

In order to establish a target-oriented QC and QA system the following six points, which will be outlined, are of relevance:

- Evaluation of brewery-related pre-conditions;
- quality management system;
- quality control manual;
- extent of continuous monitoring closely related to production volumes, products and processing types;
- economical considerations;
- considerations towards required personnel.

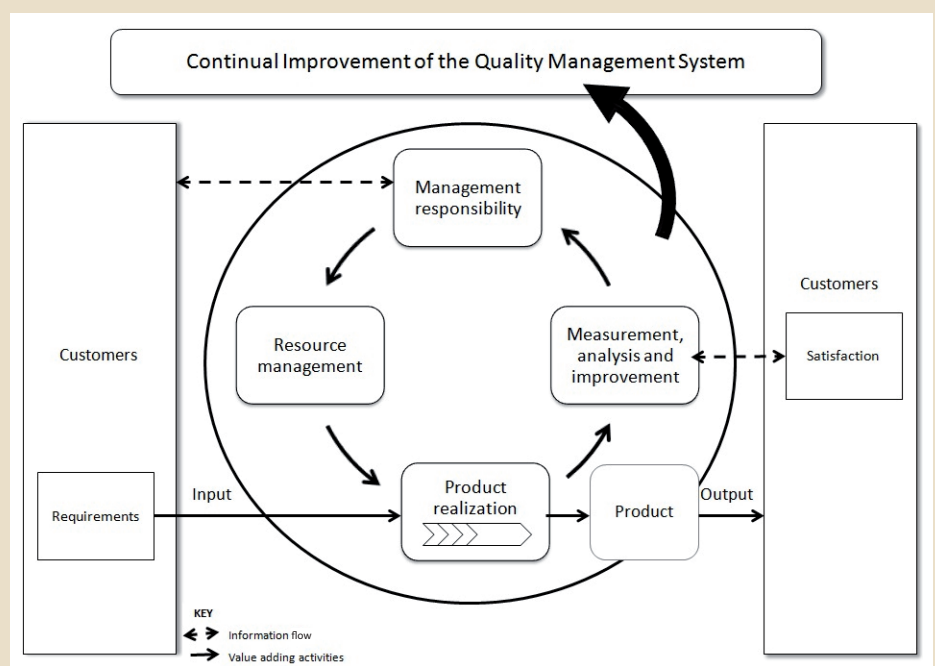


Fig. 1 Model of a process based Quality Management System [2]

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CONTINUOUS MODIFICATION OF THE QC PLAN

Topic(s)	Question(s) to be asked
Completeness	Is the security of the product given during each stage of production?
Relevance at a specific point in the process	Is there an appropriate possibility to react to findings in a certain (technological) way?
Information content of the result	Does the result provide significant information which is required at that stage of the process?
Plausibility of defined "target" and "critical" values	Are the tolerated deviations from the target values plausible?
Intervals of sampling	Are the chosen rhythms of sampling sensible?
Detection methods	Are the chosen methods selected correctly and target-orientated to obtain the desired information?
Current findings	Is there a concrete challenge in a specific production section – must sampling be intensified in a specific area? Counter measures!

Table 1

ITEMS SUBJECT TO INTAKE- AND PROCESS ANALYSIS [9]

Item	Example	
Intake analysis	Unmalted cereals	Auxiliary material
	Malted cereals	Consumables
	Adjuncts	Packaging materials
	Hops and hop products	...
	Yeast	
Processes	Water treatment	Yeast treatment
	Milling	Aeration
	Mashing	Yeast dosage
	Acidification	Main fermentation
	Mashing-off	Maturation
	Lautering	Centrifugation
	Boiling	Filtration
	Clarification	Stabilization
	Casting out	Packaging
	Wort cooling	Cleaning and disinfection of pipelines and vessels
	Propagation	

Table 2

Evaluation of brewery-related pre-conditions

To implement a robust QC & QA system, it is necessary to consider and evaluate specific brewery-related circumstances/pre-conditions:

- Number and type of (intermediate) products and product streams;
- technological process stream(s) performed;
- work flow within the brewery;

- availability of appropriate facilities and necessary equipment;
- availability of qualified personnel.

Quality Management System

The design of a company's QMS is influenced by the following [2]:

- Its organizational environment, changes in that environment, and the risks associated with that environment;
- its varying needs;
- its particular objectives;

- the products it provides;
- the process it employs;
- its size and organizational structure.

A clearly defined QMS, which is customized towards the brewery's current requirements, forms the foundation and backbone of an appropriate QC & QA system, focusing on:

- Laws and ordinances to protect the consumer regarding health risks (laws of the own country and of the countries in which the brewery exports), e.g. HACCP system;
- intake control of all goods;
- manufacturing control (process and intermediate products);
- control of the final product quality and herewith the own brand(s).

Parts of a company's QMS are generally established according to formalized approaches available (international standards) such as ISO9001:2008. According to Bamforth, these standards "define activities for which the brewery must provide appropriate controls but [...they do] not define how they are to be controlled. [They] outline the key elements of a quality management system that should be in place to ensure the quality of the products produced" [3, 2]. All the international standards available follow a general guideline aiming to achieve the following principles [4]:

- Installation, implementation and care of a management system;
- liability of the leadership team;
- management of resources;
- realization of processes and product;
- measurement analysis and improvement.

International standards encourage companies to adopt a process approach when implementing a QMS. A process approach is the "application of a system of processes within an organization, together with the identification and interactions of these processes and their management, to produce the desired outcome" [2]. A process approach provides control over the connections between the individual processes within the system of processes. Being able to implement changes to processes is crucial because they are inherently dynamic and always susceptible to variation. A model of a process based quality management system commonly used is Plan-Do-Check-Act (PDCA). This model is popular because it can be applied to all pro-

cesses of interest. PDCA is described and illustrated below [2]:

- **Plan:** establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies;
- **Do:** implement the processes;
- **Check:** monitor and measure processes and intermediate products against policies, objectives and requirements for the product and report the results;
- **Act:** take actions to continually improve process performance.

A model of a process based Quality Management System is shown in figure 1.

Quality control manual

The evaluation of the brewery-related pre-conditions described above influence a number of strategic decisions which are used to define a quality manual which provides means for future continuous analytical monitoring.

Within this type of document all relevant information is issued regarding the intermediate product(s), e.g. specifications and key control points within the brewery. In order to maximize both the repeatability and reliability of results generated in the laboratories, it is necessary that all analyses are performed according to standardized operating procedures (SOPs) and international methods, as far as these are available.

Furthermore, the analysis results must be evaluated towards statistical considerations. There are many statistical methods available to assess each type of analysis performed. Specific statistical analyses for each type of laboratory analysis performed can be found in publications from EBC Analytica, MEBAK and ASBC [5 - 7].

A quality manual specifies which processes, procedures, and associated resources will be applied by whom and when, to meet the requirements of a specific project, product, process or contract [8]. A quality manual may include the following:

- Sample amount(s);
- sampling location(s);
- sampling cycle(s);
- responsibility and ownership of sampling and sample processing;
- analytical method(s);
- standard range(s) for specific analyses;
- critical value(s) for specific analyses;
- validation and statistical evaluation of the analytic results;

PRODUCTS SUBJECT TO ANALYSES [9]

Item	Example	
Intermediate products	raw water	wort used for propagation
	brewing water	yeast culture
	dry grist / wet grist	sterile air for aeration / activation
	mash	green beer
	lautering wort	harvested yeast
	first wort	unfiltered beer ready for filtration
	kettle-full wort	filtered beer
	last runnings	rinsing water
	spent grains	...
	cast-out wort	
	cold wort	
	propagated yeast	
Final products	packaged beer	...

Table 3

- how and by whom are the results assessed?
- Who is to be notified, if a parameter is out of specification (definition of information flow)?
- Counter measures to be taken, if product is out of specification;
- type of documentation.

In respect to the QC plan it must be stressed that the higher its degree of detail, the higher its flexibility to react specifically to current situations. Therefore, it is advisable to define several levels of priorities which complement a regular backbone of analyses (e.g. priority A) and only become effective depending on current circumstances/findings. This could involve zooming into a specific process section and increasing the number of samples collected from that stage to assist in pin-pointing the origin of the problem.

The QC plan should be subject to a continuous evolution and counter-check (see table 1).

Extent of continuous monitoring

For all means of continuous monitoring, defined and standardized methods originating from the above mentioned analytical fields are used. The extent of continuous monitoring is closely related to production volumes, products and processing types (tables 2 and 3).

A detailed overview of quality characteristics and quality control measures is published in *Praxishandbuch der Brauerei* [9]. The complete overview should serve as a

guideline for further considerations regarding the topic of staff planning and staff allocation. ■

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