TopScan - A Glance into the Black Box Fermenting Tank

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ABSTRACT

TopScan from Steinecker is a new system for monitoring and regulating the fermenting process. At the same time, the cleaning of the closed cylindro-conical fermenting tank can be controlled to an extent that was not possible up to the present. This produces maximum possible safety and extensive savings with respect to cleaning. This represents an important contribution to the prevention of waste water. Furthermore, TopScan is an effective tool in achieving quality consistency, quality assurance and controllability.

A camera mounted on the tank supplies images of the inside of the tank that are displayed on a PC. Just as with open tuns, the individual phases of fermentation can be identified with the aid of TopScan, and visual evaluation of the course of the fermenting process is enabled.

During cleaning, the images are automatically evaluated and the course of the process correspondingly automated. When the image analysis shows no further dirt, a safety interval of several minutes is observed, and then the cleaning procedure ends. In this manner, the greatest possible safety is attained. Because the adjustment of the cleaning program is dependent upon the actual circumstances present, the process can be drastically shortened and the use of cleaning agents minimized.

Three pressure sensors are required in the tank for continuous measurements of the breakdown of the extract. The principle involved here is based on the measurement of the hydrostatic pressure caused by the breakdown of the extract during the course of the primary fermentation.

Keywords: Tank Cleaning, Cylindro-Conical Tanks, TopScan System, Fermentation Monitoring

SINTÉSIS

CominEl TopScan de la Steinecker es un nuevo sistema para monitorear y regular el proceso de fermentado. Al mismo tiempo, la limpieza del tanque cerrado de fermentación de forma cilindro cóncica puede ser controlado en cierta forma que no era posible sino hasta el presente. Esto produce la máxima seguridad posible así como grandes ahorros en lo que respecta a la limpieza. Esto representa una importante contribución a la prevención de agua de desecho. Es más, el TopScan es una herramienta efectiva para alcanzar la consistencia de calidad, y el control de calidad.

Una cámara montada en el interior del tanque provee imágenes del interior del tanque que son mostradas en una computadora personal. Tal como en los tinacos abiertos, las fases individuales de fermentación pueden ser identificadas con la ayuda del TopScan y se permite la evaluación visual del curso del proceso de fermentación.

Durante la limpieza, las imágenes son evaluadas automáticamente y el curso del proceso se automatiza. Cuando el análisis de imágenes ya no muestra mugre, un periodo de seguridad de varios minutos se observa y después el proceso de limpieza acaba. De esta manera, se obtiene la máxima seguridad posible. Por medio del ajuste del programa de limpieza dependiendo de las circunstancias presentes actuales, el proceso puede ser acortado drásticamente y se disminuye el uso de agentes de limpieza.

Se requieren tres sensores de presión en el tanque para la medida continua de la degradación del extracto. El principio aquí involucrado se basa en la medida de la presión hidrostática causada por la degradación del extracto durante el curso de la fermentación primaria.

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ADVANTAGES OF CYLINDRO-CONICAL TANKS

- Minimized danger of contamination
- Automatic cleaning process
- Easy handling of yeast crop
- Good connection to CO2 collecting plants

DISADVANTAGES OF CYLINDRO-CONICAL TANKS

- Insufficient possibilities for process monitoring
- With open fermenters or vessels you have the possibility to look at the fermenting surface. You can see the stage of fermentation and decide whether the process is running properly. With cylindro-conical tanks this possibility is missing.
- Monitoring of fermentation only with the help of non-continuous samples
- Insufficient monitoring of the cleaning process

THE PRINCIPLE

The principle of TopScan is based on the installation of a camera and suitable lighting on the top of the tank to enable observation of the processes taking place inside.

With the aid of data connection between the camera on the tank and a PC with a frame grabber card, the image acquired is displayed on a monitor that is located in the control room of the fermenting cellar. Based on this image, the brewer can make deductions about the course of the fermentation process and intervene in and regulate it. However, these images can also be automatically evaluated by corresponding image processing programs, as in the case with cleaning procedures, and the entire process can be automated. In order to accommodate the camera and the lighting fixture the top covers must merely be modified slightly. It is therefore important that these components do not project into the tank but function in a fashion similar to sight glasses, so that the cleaning procedures are in no way impaired and no contamination sources are created.

MONITORING THE STAGES OF FERMENTATION

The introduction of fermentation tanks to beer fermentation made way for improvements in the fermentation and maturation technology. The closed fermentation tank system enabled a secure and improved fermentation control. Although, in the former times of the open fermenter, the head brewer was able to judge the actual condition of the green beer and could control the fermentation process by regulating the temperature. Nowadays, no one knows exactly what happens inside the fermentation tank. The employment of closed tanks canceled this possibility, and the fermenting process must take place without visual control. The TopScan-System cracks the black-box fermentation tank and restores the head brewer’s eyesight. The application of TopScan enables intensive optical control of the fermentation. Images 1 to 6 show the various stages in order of time sequence.

![Figure 1](image-url)
** IMAGE 1**  
Creaming -  
begin of fermentation: 8 h fermentation time.

** IMAGE 2**  
Young heads -  
20 h fermentation time.

** IMAGE 3**  
Young heads -  
35 h fermentation time.

** IMAGE 4**  
High heads -  
80 h fermentation time.

** IMAGE 5**  
High heads start to collapse -  
130 h fermentation time.

** IMAGE 6**  
Collapsed surface -  
ready for tunnage: 160 h fermentation time.
**THE FUNCTION OF THE CONTINUOUS EXTRACT MEASUREMENT**

In order to be able to continually track the breakdown of the extract, a system based on three pressure transmitters is used. The principle of the extract determination is based on a measurement of the decrease of the hydrostatic pressure during the course of the primary fermentation.

**THE CONFIGURATION OF THE CLEANING PROGRAM TO FIT THE REQUIREMENTS**

The Configuration of the Cleaning Program to Fit the Requirements

With the assistance of TopScan, cleaning programs are configured in such a manner that they only run as long as is required by the respective degree of soiling of the tank.

The principle involved here is quite simple. During the pauses in the spraying operation, an image is made of the inside of the tank by the camera and sent to the PC where it is evaluated. Spent yeast has a characteristic colour that can be identified and marked with the aid of image processing programs. Images 8 to 12 show the progress of the cleaning process. On the left side, the original pictures are shown; on the right side, they are evaluated by the program and instances of soiling marked in yellow.

Even if the image analysis detects no soiling, a safety time period of several minutes duration is allowed before the cleaning process is terminated and disinfectants introduced. In conducting experimental runs in a brewery in southern Germany, it was discovered that the tank was already optically clean after the initial spraying, and cleaning with caustic would almost be superfluous. In total, it took 10 minutes until the tank was clean, whereas the conventional cleaning program was planned for 90 minutes.

With the aid of image evaluation programs, it was possible to reduce the time for the cleaning process to half the original time. On the other hand, in the event of particularly persistent soiling that has dried on, the caustic step can be lengthened until the image processing no longer recognizes spent yeast residues. Only then is the next step of the cleaning program initiated. In this manner it is possible to prevent, in case of insufficient cleaning, a portion of the dirt passing into the disinfectant solution which impairs its effectiveness.

![Continuous Extract Measurement and the Stages of Fermentation.](attachment:image_url)
SUMMARY

The TopScan System is a thoroughly new type of system for monitoring and regulating the fermentation process.

At the same time, the closed cylindro-conical fermenting tanks can now be cleaned to an extent that was not previously possible. This results in maximum safety and considerable savings with respect to the cleaning procedures and is a contribution to the avoidance of waste water production. Lastly, TopScan offers great assistance with regard to quality consistency, quality assurance and controllability.

- Visual control of cleaning results
- Problems in cleaning of tanks are recognized
- Cleaning depending on requirements
- Reducing the requirements of waste, detergents and time needed for cleaning
- Overfilling of the tanks can be prohibited
• Recognition of the suitability of the beer for transfer by the foam surface
• Problems during fermentation can be recognized without time delay
• Control of cold break discharge
• Prevention of mistakes