110

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Effective does not always mean efficient – New approaches in cleaning of fermentation and storage tanks

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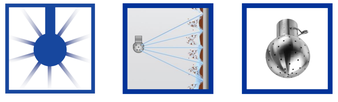
Introduction

Fermentation and storage tanks used in the brewing process have to be fully cleaned and automated on a regular basis. When producing bottling and packaging sensitive products, such as beer, there are strict hygienic requirements that need to be fulfilled in order to achieve consistent product quality. Cleaning in place (CIP) and industrial cleaning processes play an important role in maintaining a breweries reputation. Since breweries are driven by cost they have to keep a close eye on carefully handling their resources. Only when the four elements of the Sinner Circle - temperature, chemistry, time and mechanics - are cleverly combined, the hygienic requirements can be met. In order to save resources, the mechanical part of the Sinner Circle has to be maximized.

Over the last couple of years, only two different types of tank cleaning nozzles were recognized for using in fermentation and storage tanks:

Static Spray Ball

Principle Function: Static
Cleaning Method: Rinsing
Efficiency: Low
Costs: $



Tank Cleaning Machine

Principle Function: Gear controlled
Cleaning Method: Impact
Efficiency: High
Costs: $$$$$

Compared to the static spray ball, the gear controlled tank cleaning machine has much greater impact against the tank wall and with respect to the Sinner Circle, it provides more resourceful savings. In spite of these advantages, static spray balls are still the most common tank cleaning nozzles for cleaning fermentation and storage tanks due to the low costs. Lechler offers new innovative tank cleaning nozzles with a low rotational speed, which significantly improve the impact on the tank surface compared to static spray balls. The price level of these new nozzles are in between the price level of lower cost static spray balls and an expensive tank cleaning machine.

Controlled rotation

Function Principle: Gear Controlled
Cleaning Method: Impact
Efficiency: High
Costs: $$$

In cooperation with TUM Weihenstephan, the suitability of this new tank cleaning nozzle in fermentation and storage tanks was evaluated. The goal was to show that significant resource savings like fresh water, chemicals, temperature and cleaning cycle time of fermentation and storage tanks are now possible with new nozzle technology. Therefore a series of tests in the pilot brewery of the TUM Weihenstephan were completed.

Test Setup

Installation

Tank 1	
Tank Type	Cylindrical conical
Height	2.5 m / 11.8 ft
Diameter	0.84 m / 3.3 ft
Nozzle Type	Static spray ball
Operating Pressure	0.5 bar / 7.3 psi
Flow Rate	100 l/min / 25.3 US gal./min
Temperature	Unheated
Chemical	Finket FT 134SP - Alkaline

Tank 2	
Tank Type	Cylindrical conical
Height	2.5 m / 11.8 ft
Diameter	0.84 / 3.3 ft
Nozzle Type	Controlled rotation
	XactClean HP (Lechler)
Operating Pressure	0.5 bar / 7.3 psi
Flow Rate	73 l/min / 19.3 US gal./min
Temperature	Unheated
Chemical	Finket FT 134SP - Alkaline

The initial situation for both tanks were the same. Tank 1 and Tank 2 were filled with the same beer and the fermentation and storage time were the same. Above the filling level there was sticky yeast residue on the tank surface. This yeast residue is caused by dried yeast and foam during the fermentation process. The pictures above show the residues in Tank 1 and Tank 2. The cleaning effort to remove this soil is dependent on the beer type. In some cases you just receive a satisfactory result if you are increasing the chemical usage, the temperature of the cleaning process and the cleaning time. Besides these elements of the sinner circle you can also increase the mechanical impact of the cleaning liquid on the tank surface. To increase the impact, Tank 2 was equipped with the controlled rotation tank cleaning nozzle. Compared to the traditional static spray ball, the cleaning efficiency was greatly improved due to the controlled rotation, higher impact and overall spray coverage to the tank surface.

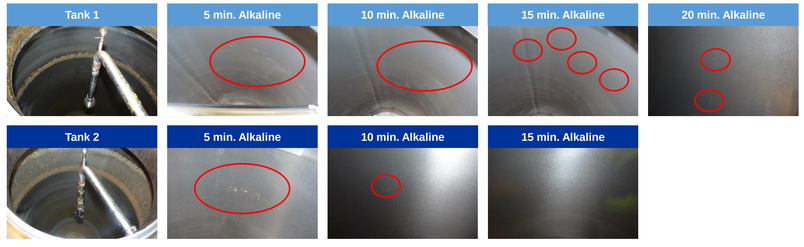
CIP Process

The CIP Process was divided into 3 steps. The first step was to clean the tank for 15 seconds with unheated fresh water to remove non sticky soil and carbon dioxide. This step has been the same for Tank 1 and Tank 2. In the second step a 2% alkaline solution was used. The process was stopped every 5 minutes to check if all yeast residues were removed. In the end, the tanks were cleaned two times with fresh water for 15 seconds each to remove all alkaline residues.

Fresh water 15 sec. → **Alkaline 2% solution** → **Fresh water 2 x 15 sec.**

Results

During the alkaline CIP process cleaning was stopped every 5 minutes to control the efficiency. The pictures were taken from the inner tank surface to document the cleaning progress.



The pictures above show the progress every 5 minutes during the alkaline cleaning for Tank 1 and Tank 2. The total cleaning time for Tank 1 was 25 minutes and 15 minutes for Tank 2. The cleaning with alkaline for Tank 1 was stopped after 25 minutes because it was not possible to remove all yeast residues. The red markers are highlight the yeast residues during every cleaning step. After the CIP process in Tank 1 an additional manual cleaning step (scrubbing) was necessary. In Tank 2 the alkaline cleaning was stopped after 15 minutes because it was completely clean. Both nozzles were operated at the same pressure. In spite of the low operating pressure, the controlled rotation nozzle outperformed the static spray ball.

Tank 1	
Fresh Water Consumption	75 l / 19 US gal.
Cleaning Time Alkaline	25 min.
Efficiency	Low
Manual Cleaning	Scrubbing

Tank 2	
Fresh Water Consumption	54 l / 14 US gal.
Cleaning Time Alkaline	15 min.
Efficiency	High
Manual Cleaning	No

Conclusion and Outlook

The test at TUM Weihenstephan showed that the new controlled rotation tank cleaning nozzle is a better option than the traditional static spray ball for cleaning of fermentation and storage tanks. The cleaning efficiency and the reliability of the process was increased due to the new innovative nozzle approach. **Water savings were increased by 30% and the cleaning time was reduced by 40%.**
Lechler and TUM will do further tests to analyze the influence of the operating pressure. It is to assume that the performance of the new nozzle will be even better at a higher pressure. The new cleaning approach will help breweries to save money by making their cleaning process more efficient.

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