Spore removal of milk

Milk in the udder from healthy cows is free from micro-organisms but it will be contaminated with different types of micro-organisms when it leaves the udder. The usual way to kill these organisms is by means of heat-treatment. But, normal heat treatment does not kill all kinds of bacteria and heat sometimes has an adverse effect on milk for certain products.

Process

Due to their higher density micro-organisms may be separated from milk by means of centrifugation in a special centrifuge, a so called Bactofuge unit.

In the Bactofuge unit’s bowl (disc stack) the milk is separated into a light phase, with low concentration of micro-organisms, called “clean milk” and a heavy phase with spores and bacteria.

In the bowl, the clean milk is led all the way to the centre of the bowl, while the phase with spores and bacteria leaves the bowl over the top disc and/or are collected in the sediment space at the periphery of the bowl. The sediment space is emptied accurately and hydraulically at preset intervals. At the outlets, co-rotating pumps efficiently discharge the separated products from the centre.

The heavy phase with spores and bacteria may, depending on legality, after sterilisation be recycled, used in other dairy products or disposed as regular centrifuge sediment.

Factors influencing safety

A Bactofuge unit is a very efficient centrifuge and more sediment is taken out of the milk than in an ordinary clarifier. It is important that you set the sediment discharge size and the sediment discharge interval to match not only the sediment content in the milk but also the production schedule and the operating conditions.

Always follow the given recommendations. Check on discharge size and cleaning result now and then

Adjustments in spore removal process

The parameters described below will influence the performance of the Bactofuge unit. Normally they are set at start up and not changed during production.

Throughput

The throughput of the Bactofuge unit can be increased by increasing the feed pressure and vice versa. If the throughput is reduced below the nominal a certain improvement in efficiency is achieved. However, the relation between efficiency and capacity is not linear.
Temperature
The higher the temperature the lower is the viscosity of the milk that facilitates the separation of bacteria. On the other hand higher temperature gives higher content of protein in the heavy phase with spores and bacteria and increased viscosity. Normal spore removal temperature is 55-65 °C.

Decreasing the spore removal temperature from 65 to 45°C has a marginal effect on the reduction of spores.

Back pressure
It is important to maintain a back pressure on the outlet/outlets to avoid cavitation. Cavitation is a symptom on non optimal conditions, leading to poor efficiency.

Discharge interval
A too short discharge interval means larger amounts to take care of. A too long interval will eventually reduce the efficiency.

Poor milk quality, higher temperature or higher throughput may require shorter intervals because more sediment is separated from the milk.

Discharge volume
The discharged volume should be the same as the sediment space of the Bactofuge unit’s bowl. Smaller discharges might reduce the efficiency and make the cleaning more difficult. Checking of the discharged amount should be done by weighing.

Efficiency of spore removal process
The efficiency of the spore removal process is measured by determining how many percentages of the original number of micro-organisms that has been removed from the milk. The reduction in percentages can vary depending on which type of micro-organism that is investigated. The highest figure of reduction is usually achieved for anaerobic spore forming bacteria. The reduction of bacteria in general (total count) depends on what strains that are dominating.

The efficiency is influenced by throughput, temperature, back pressure and bactofugate discharge. In long production runs the disc stack will eventually foul to such a degree that the efficiency will be reduced. It is important that the CIP is efficient enough to clean the disk stack so dirt is not accumulating.
Product quality

The product quality in a milk separation process is most often measured in terms of free fat and air in the discharged products.

The temperature for crystallisation and melting of milk range from 17-38°C. Therefore it is important to heat the milk to about 45°C before separation, to be sure not to damage globules with partly melted fat. Free fat causes two serious faults, sticking and clumping. Rancid flavours may also develop as a result of lipolytic reactions.

If the incoming milk contains too much air there will primarily be a problem with foaming in product tanks. Secondarily, air is the major cause for destruction of fat globule membranes. The membranes may repair themselves again, but the globule is smaller and free fat has occurred.

Sampling and analysing methods

When sampling is done to determine the efficiency, the samples should be taken immediately before and after the Bactofuge unit. It is also necessary to take the samples in such a way that re-infection is avoided. For determination of total count and aerobic sporeformers IDF have standard methods. For determination of anaerobic sporeformers we recommend the NIZO’s modification of van Beynum & Pette.

Cleaning

Bactofuge units are very efficient centrifuges. In principle the more efficient the Bactofuge unit the more of the milk constituents will be separated together with the micro-organisms and the higher the demand on the CIP will be.

To make protein deposits swell which facilitates the subsequent cleaning, it is important that the CIP cycle start with cold, maximum 15 °C, water rinse until clear water is coming out of the system and the water coming out is below 20°C. The flushing should also take care of remaining milk in the system as milk residue will inactivate the detergents.

The flow over the Bactofuge unit during CIP should be at least the same as during production preferably 10% higher. If the Bactofuge unit in production is running below nominal capacity, then flow during CIP should be increased to at least the nominal capacity.

Our general CIP program is sufficient in most cases but depending on water quality and the degree of fouling modifications in the CIP program may be necessary.

Modification and tuning of the CIP programme for the Bactofuge unit should always be made at commissioning. It is therefore necessary to open the Bactofuge unit after the first production and CIP to check that the machine is clean. A new inspection of the cleaning should be made after a week of production at the latest.
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