SPX®

TECHNICAL BULLETIN

H.T.S.T. Systems

WITH DEODORIZERS AND HOMOGENIZERS

It is common practice in the milk industry to use a deodorizer in an H.T.S.T. system, particularly in areas where the milk supply is subject to weed or feed flavors. Extensive studies have shown that milk undergoes a dispersion change when subjected to steam injection followed by vacuum cooling. The fat/casein agglomerates in the milk are affected by the action of the rapid heating and violent action of steam injection. Further disturbance is caused by the vacuum cooling. The casein tends to band together to form agglomerates many times larger than in the natural state. In storage these agglomerates will rise to the top, giving the appearance of scum on the top of the bottle, referred to as “spaghetti ring”. The milk will have a flat, chalky taste. These undesirable effects can only be prevented by homogenizing after vacuum cooling.

In order to ensure the best homogenizing results and protect the homogenizer from mechanical damage, the position of the deodorizer in the system and the selection of the deodorizer auxiliary equipment is of utmost importance.

Poor homogenization and mechanical damage are usually caused by air in the product. When homogenized, air in milk is broken down into fine bubbles. These adhere to the small fat globules, causing them to rise to the top of the bottle, producing a fat ring. To understand the mechanical damage caused, there should be an understanding of tensile strength of metal. Homogenizer blocks are selected from stainless steel material with sufficient tensile strength to operate for the life of the machine at a calculated value above the maximum pressure specified. If the tensile strength is exceeded, even momentarily, the metal is overstressed. When such stress occurs, metal fatigue begins, and between eight and ten million cycles later a crack will occur.

All milk contains some dissolved air, probably in the range of one to three percent by volume. This amount will not have any appreciable effect on the operation. Air in larger quantities can contribute to overpressure conditions.

The clearance required between the homogenizing valve plug and valve seat is extremely small to give the desired homogenizing results. In a machine operating at 2000 gph and 2500 psig the gap is .0072. This gap is achieved by balancing the flow of liquid in the cylinder and the external pressure applied to the valve stem, either by handwheel or hydraulic actuator.

If excessive amounts of air are present, the liquid flow is reduced. The valve gap closes, because the pressure balance is disturbed. Meanwhile, the air is being compressed by the plunger, pressure in the cylinder rises, and the valve gap resumes its preset value. This action occurs very rapidly, measured in thousandths of a second, and can only be detected by electronic instruments.

The above deals with air, but any circumstances such as foreign substances blocking the suction line or entering the homogenizer and blocking the valve gap can cause the same conditions to occur.

Normal flow in an H.T.S.T. system is from the balance tank to the booster pump, to raw regenerator, to timing pump, to heater, to holder, to Flo-Diversion valve, to deodorizer, to extraction pump, to homogenizer with an open bypass around the homogenizer, to pasteurized regenerator, to cooler, to storage. Capacity is controlled by the timing pump and is generally somewhat less than the homogenizer capacity, the shortage being made up by circulation

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through the homogenizer bypass line. This type of installation provides no protection for the homogenizer.

The extraction pump is a centrifugal-type, sucking from a vacuum chamber usually under 16 to 18" hg. vacuum, handling a liquid at 165 to 175°F. Under these conditions, every centrifugal pump requires given NPSH. For the average milk pump this is between three and four feet, as measured from the center of the pump inlet to the top of the liquid level in the chamber. If this NPSH is not available, the pump is cavitating, meaning it cannot receive sufficient liquid. With the suction line under the vacuum and the pump head not flooded with liquid, air will enter through the pump seals, casing seal and pipeline fittings. This air will be forced into the homogenizer with the liquid.

With a manually adjusted timing pump there is no positive method of ensuring that the required NPSH will be maintained. To further complicate the problem, if the system goes into diverted flow, the vacuum chamber is pumped dry; the extraction pump continues to operate under vacuum, adding large quantities of air to the homogenizer, which keeps recirculating around the open bypass loop.

To ensure proper operating conditions it is imperative that an adequate liquid level control be installed on the vacuum chamber. A suggested method is shown on Figures 1 and 2. The liquid level sensor at the pump suction or, alternately, in the lower part of the chamber, senses the level in the chamber. An air signal is sent to the controller which compares it with the set point positioned to give the pump the required NPSH.

In turn, it sends a signal to the throttling valve to position it to bypass sufficient liquid to the chamber to maintain the desired level. Under these conditions, the extraction pump will always have the required liquid level head and should not suck air. This will permit proper homogenization and protect the machine from mechanical damage.

The 3A-approved liquid-level sensors, level controls and throttling valves are available from Foxboro Instruments and Taylor Instrument Co.

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