Beverage Plant Application
420-15-057

Level Measurement with Beer Foam

There are two possible measurements available using RF probes when beer foam is involved:

1) **Level of the entire beer liquid/foam height**
2) **Level of the beer liquid, ignoring the foam phase**

The key item in either measurement is the conductivity of the particular phase. All of the beer (and wort) that we have tested over the last 20 years runs in the area of 1,000 micro mhos/cm.

The presence of the large quantity of gas in foam drops that conductivity substantially, to the area of 20-50 micro mhos/cm. This large reduction in conductivity allows an electrical differentiation to be made.

RF level transmitters operate by connecting a small, radio frequency voltage between an insulated metal rod and the wall of the tank (ground). Any current that flows from that rod to the tank wall becomes the signal on which the measurement is based. The current will depend on the number of feet of probe that are covered, and the impedance it encounters between the probe rod and the tank wall. The impedance consists of the probe insulation and the resistance of the liquid in the tank. If the probe insulation has very high impedance compared to the resistance of the liquid, that resistance can vary widely without affecting the RF current or the instrument calibration. This is an important condition called “saturation”, since no matter how much the conductivity increases (resistance decreases) no more RF current can flow, because it is limited by the probe insulation. The liquid is a “short circuit” between the probe insulation and the tank wall. The RF current will increase an identical amount for each foot of insulation that is “shorted” to the tank wall by the liquid. These increases produce a linear increase of RF current (and instrument output) with increasing level.

SATURATION: A condition where RF current from a probe-to-ground is determined solely by the impedance of the probe insulation. Increased conductivity in the saturating medium, even to infinity, will not cause a noticeable change in that current, nor in the transmitter output.

AMETEK Drexelbrook can vary the conductivity at which saturation will occur, over a significant range, by adjusting the impedance of the probe insulation. This is accomplished by changing the insulation capacitance (thickness or composition) or the frequency of the RF voltage. Practically, the conductivity at which the probe saturates can be adjusted between 1.0 and 1500 micro mhos/cm, but there are no theoretical limits. In order to "saturate" on low conductivity material such as beer foam, it is necessary to increase the insulation impedance by using thicker insulation and a lower frequency. By doing so, the instrument will produce an output that represents the total feet of beer and foam on the probe.

To measure the liquid and ignore the foam, the thinnest insulation, and the highest frequency that allow the liquid to saturate the probe are used. In this condition, the high resistance of the foam blocks most of the RF current, therefore contributing a negligible quantity to the instrument output. This is the type of measurement used in storage or aging tanks, where foam level is not of interest. In processing tanks that require both liquid and foam measurements, two separate probes are used, one optimized for the low conductivity foam, and the other optimized for the liquid. If foam thickness is desired, the liquid level may be subtracted from the total level signal produced by the "foam" probe.

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