FEATURE

Profitable aquafeed moisture control

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Aquafeed producers are losing about $4 to $10 per ton of product produced in terms of lost production, higher energy consumption and lowered product quality. These losses can be recovered by substituting a more effective moisture (MC) sensing and control technology for currently used traditional MC sensing and control.

The control problem

Two main problems prevent traditional MC sensing and control technology from being effective. Firstly, the lack of timely and accurate MC data upon which to base control action (poor MC sensing). Secondly, the inability to correctly adjust for evaporative load changes entering with the feed.

Figure 1 shows a typical normal MC distribution curve produced by traditional MC sensing and control technology. The curve is relatively wide as a result of the effect of high MC standard deviation. It is obvious that the wider the MC variation the lower the target mean MC must be to prevent production of wet product. Consequently, use of currently available control technology forces manufacturers to over dry their products which causes significant costs in terms of lower production, higher energy usage, and poorer quality. Figure 1 illustrates the effect of poor MC sensing and control on MC variation.

The control solution

Losses caused by poor MC sensing and control may be recovered if the MC variation (standard deviation) is reduced such that the mean MC can be maximized without exceeding the upper specification limit (USL). Fortunately, a solution for poor MC sensing and control was supplied by the derivation of a MC sensing and control model from first principles. The Delta T model:

$$MC = K_1(\Delta T)^p - K_2/S^q$$

relates the product MC exiting a dryer to the temperature drop (ΔT) of hot air after contact with the wet product and the production rate or evaporative load (S). The model solved the two main problems with MC sensing and control by producing. Firstly, a rugged, reliable 'inside-the-dryer' moisture sensor; and secondly, a new and powerful control algorithm that precisely adjusts the set point for evaporative load changes.

A new type of MC sensor

Figure 2 describes how the Delta T MC sensor continuously measures the MC of aquafeed inside the harsh environment of a dryer while it is being dried with a belt dryer.

As illustrated by Figure 2, patented Delta T technology invented a new type MC sensor that can be installed 'inside-the-dryer' which reduces the dead time (time to detect a disturbance entering with the feed) by at least 30 percent. Since dead time is directly proportional to the product standard deviation, use of this 'inside-the-dryer' sensor reduces the

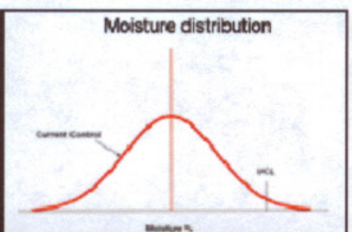


Figure 1: Typical MC distribution curve produced by poor MC sensing and control

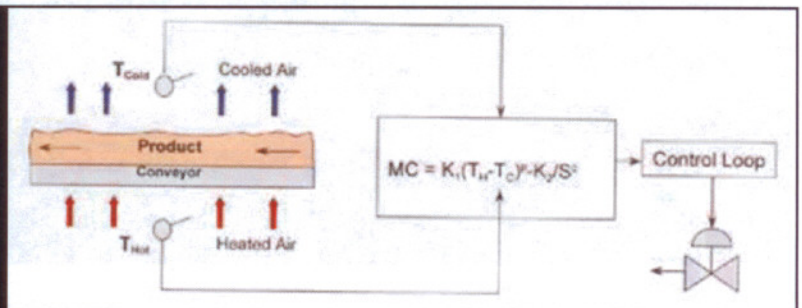


Figure 2: Delta T 'inside-the-dryer' MC sensor

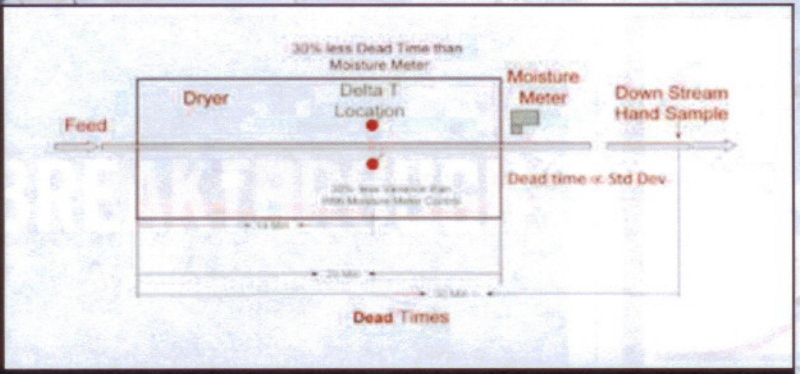
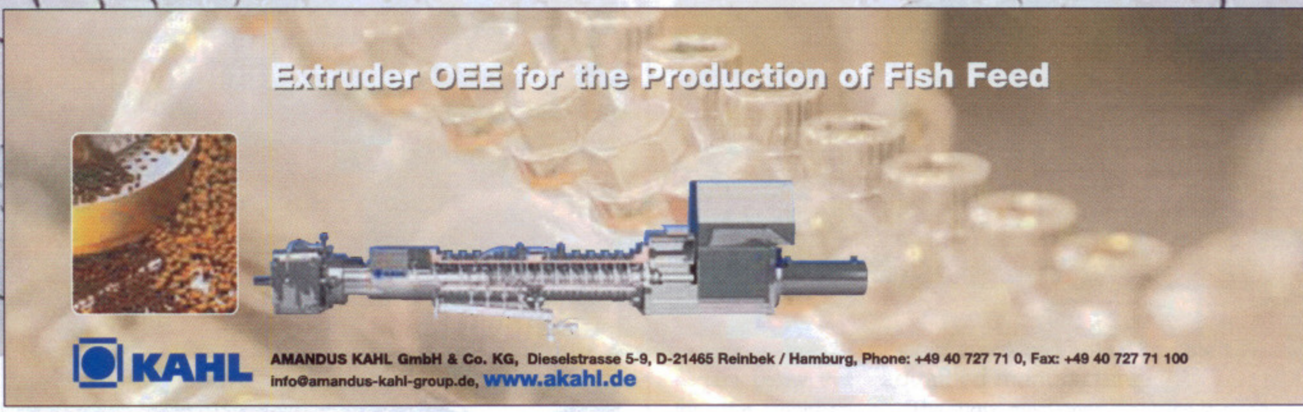


Figure 3: Delta T reduces dead time on belt dryer

standard deviation at least 30 percent below that achieved by use of currently used MC sensing methods. It should be noted that use of raw Delta T data will not work—it must be processed by the model before use. Figure 3 illustrates the advantage of reducing dead time for aquafeed drying.

Three possible locations are shown for installing the MC sensor. Dead time for each installation point is the time it takes for the individual MC method to detect a change in evaporative load entering with the feed. The lowest dead time is 14 minutes for the Delta T sensor inside the dryer; the next lowest dead time is 20 minutes for a MC meter located at the dryer exit; the longest dead time is 30 minutes for MC samples taken downstream of the dryer and analyzed by a laboratory instrument.

For the above conditions, the Delta T accomplishes dead time reductions of 30



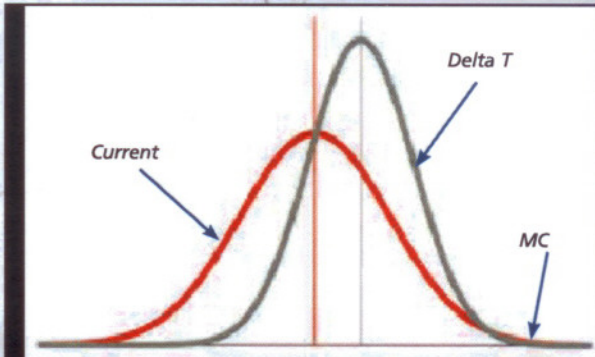


Figure 4: Delta T MC control allows mean MC to be maximized without exceeding USL

Figure 5: Outside view of Delta T MC system

percent and 53 percent below that for the moisture meter method and the laboratory MC sample method respectively. The standard deviation reductions would also be reduced 30 percent and 53 percent respectively.

A new MC control algorithm

As a result of its theoretical basis, the Delta T technology provides a new control algorithm that enables precise calculation of the set point necessary to maintain the target MC in spite of frequent changes in evaporative load entering the dryer with the feed. Proprietary methods are used in adapting the model to the dryer and product.

Application of Delta T to aquafeed manufacture

The above-mentioned reduction in standard deviation enables the target MC to be increased by 0.5 percent to as much as 1.25 percent without fear of producing wet product which might mold in transit or storage. Figure 4 shows schematically how reducing the standard deviation enables the mean MC to be increased by shifting the Delta T curve rightward until the upper + 3 standard deviation points (USL) of both curves coincide. The difference in mean MCs represents the economic gain from using Delta T technology.

Results and conclusions

From 10 to 25 lbs of additional water can be safely sold with the product per ton of product produced without exceeding the upper specification limit using this new technology. The return to the aquafeed manufacturer is $4 to $10 per ton of product for a wholesale product price of $800 per ton. In addition, energy savings of approximately four to seven percent possible. The Delta T has been successfully applied in the US for MC sensing and control of many products, including aquafeed using a Beltomatic conveyor dryer.

More Information:
Website: www.moisturecontrols.com