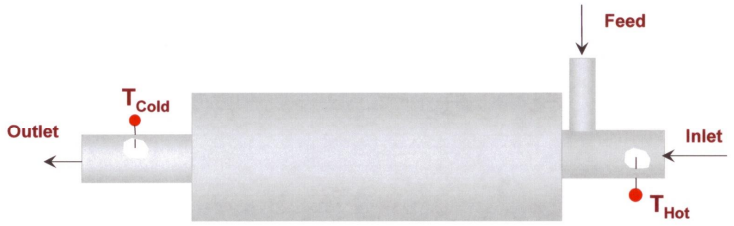
How The Delta T Works On Suspension Dryers

How the Delta T Works:

For suspension type dryers such as rotary, flash, ring, and spray dryers, the Delta T continuously measures the inlet hot air temperature (Thot) and the exhaust temperature (Tcold) and calculates the difference in the two to obtain (Thotï Tcold) = delta t = (æT). Since the air flow can be assumed to be essentially constant, the delta t value after processing by the model, is a measure of the evaporative load, the evaporative load change, the drying rate, relative humidity in the exhaust, and the product exit MC for a given set of operating conditions. Figure (1) shows the temperature measurements on a single-pass rotary dryer. It could as well represent a flash, ring, or spray dryer.

Figure (1) – Delta T Measurement on a Single-Pass Rotary Dryer



The Delta T Control System may be explained by assuming the dryer is running at steady-stateð everything is constant with no fluctuationsð then an increase in feed rate or moisture content (MC) disturbs the process. This causes the exhaust temperature (Tcold) to immediately drop, thus causing the delta t value to increase (an increase in delta t indicates an increase in evaporative load, drying rate, exit MC, and exhaust RH). The Delta T control compares this new delta t value to the delta t setpoint value that produces the target MC. The resultant difference in the two values (error signal) is used to increase the inlet air temperature sufficiently to evaporate the extra water. Additionally, the Delta T exclusive control algorithm re-calculates the setpoint to maintain the target MC with at least 30% reduction in MC variation below that achieved using currently used MC sensing and control technology. The control action also drives the exhaust relative humidity (RH) back down to near the original value before the disturbance occurred. If this higher water load disturbance to the dryer had not been immediately corrected by the increase in hot air temperature, the exiting product MC would have been wet

The Delta T is Simple to Operate:

The Delta T is quite simple to operate and requires 1 ï 2 days to adapt to the dryer and product. During operation, an occasional moisture sample can be taken and entered into the computer for verification purposes, but it is not needed for control purposes. After the initial to the dryer and the product being dried, the Delta T sensor does not require re-calibration and subsequent dryer startups are facilitated by use of the setpoint value previously determined. This reduces the time to get on MC target. Operator input is minimal.

Delta T Exclusive Technology:

The Delta T moisture control system enjoys at least a **30% advantage over the use of:** (1) the non-theoretical exhaust temperature control method which has no method for accurately re-calculating the setpoint following disturbances, and (2) the use of ñafter-the-factòmoisture meter data obtained either by lab samples or by an inline MC meter located downstream from the dryer which causes long dead times and large MC variaitons. The Delta T insures that no over or under-dried product is produced and that the MC variation is reduced by at least 30% below that offered by any other control method currently used.

Delta T technology is based on the first-principles-derived math model,

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

where (ΔT) is the temperature drop of hot air following contact with the wet product being dried, and (S) is the production rate or evaporative load to the dryer. Raw delta T data will not work, but proprietary means must be applied.

The MC Sensing & Control Solution:

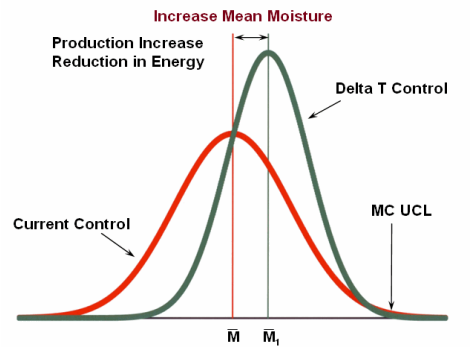
Delta T technology solved the two main problems associated with currently used moisture sensing and control systems by providing the following exclusive features: (1) a moisture sensor that can be installed ñinside-the-dryer,òthus reducing the dead time, which decreases the moisture variation at least 30%; and (2) a control algorithm that continuously re-calculates and adjusts the delta T setpoint for changes in evaporative load, thus maintaining the target MC.

Delta T Economics:

Normally, the DeltaT reduces the standard deviation of the product MC exiting the dryer by at least 30% and sometimes as much as 45%. This enables, where applicable, the mean MC to be increased by 0.5% to as much as 1.0%, thus allowing more water to be safely left in the product, lower unit energy consumption, and improved quality since over and under-dried product is eliminated.

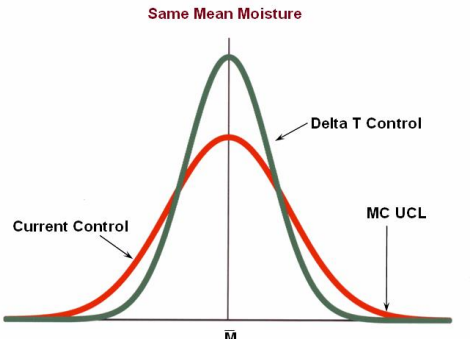
This normally gives a simple investment payback of f 3 ï 4 months. Figure (2) demonstrates graphically how these significant improvements are achieved:

Figure (2) ï Delta T Sensing & Control Vs Currently Used Control



For products that are controlled to less than 1% MC, or where additional production is not needed, the Delta T eliminate over drying dried products for substantial improvements in energy conservation and improved product quality. Figure (3) demonstrates these savings:

Figure (4) ï Delta T Vs Currently Used Control Systems



Conclusions:

The Delta T Moisture Sensing & Conrol has been validated by over 400 successful applications on a variety of products and dryer types. It may also be applied to belt, fluidized-bed, and batch dryers using direct or indirect drying if a suitable delta t can be measured.