Improved Moisture Sensing & Control of Biomass used for Pellet Production, Torrefaction, & Other Products

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Introduction

Moisture (MC) sensing and control is poorly conducted due to weaknesses in currently used MC sensing and control. Such weaknesses add *unnecessary costs* to densefied biomass products such as pellets, briquettes, bio-coal, fireplace logs, etc. In addition, industry MC standards such as PFI's pellet MC standards will be more difficult to meet using currently available controls. Also, it appears that improved moisture sensing and control will be crucial to successful operation of large torrefaction plants.

The Problem

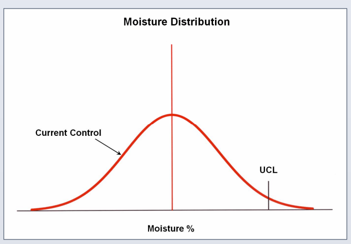
Two main problems prevent currently used MC sensing and control technology from being effective:

(1) Lack of timely & accurate MC data upon which to base control decisions.

(2) Inability of currently used technology to precisely adjust for evaporative load changes entering the dryer.

Figure (1) shows a typical MC distribution curve produced by currently available MC sensing and control technology. Notice the curve is wide indicating a large standard deviation. It is common knowledge that the larger the MC variation (standard deviation) the lower the mean MC must be to prevent exceeding the upper specification limit and producing wet product. Consequently, use of current MC control technology forces manufacturers to operate with a lower target MC which costs significantly in terms of lower production, higher energy costs, and poorer quality.

Figure (1) – Typical MC Distribution
Using Currently Available MC Sensing & Control Technology



The Solution

Losses from poor MC sensing and control can be recovered if the MC standard deviation is reduced such that the mean MC can be maximized without exceeding the upper specification limit. Fortunately, a solution for poor MC sensing and control is now available in the form of a unique, patented general dryer control model that has solved the two problems previously mentioned. The Delta T MC sensing and control model,

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

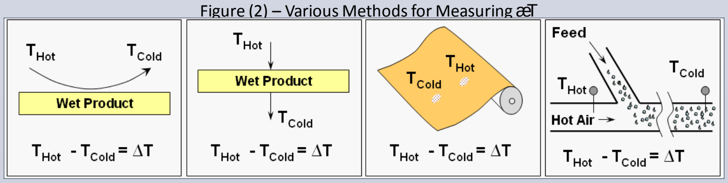
was mathematically derived from first principles. It relates the product MC exiting a dryer to the temperature drop (ΔT) of hot air after contact with the wet product and the production rate or evaporative load (S). The model solved the two main problems with MC sensing and control by providing the following exclusive technology:

An accurate and precise "inside-the-dryer" MC sensor.
A new powerful control algorithm that handles evaporative load changes.

A New MC Sensor

Delta T technology invented an *exclusive* 'inside-the-dryer" MC sensor that reduces the dead time (time to detect a disturbance entering the dryer) by at least 30%. Since standard deviation is directly proportional to dead time, use of this new sensor reduces the standard deviation at least 30% below that achieved using current control methods. Figure (2) illustrates various ways the MC is sensed using the Delta T parameter:

Figure (2) – Various Methods for Measuring æT



A New Control Algorithm

Delta T technology also provides a new control algorithm that enables precise re-calculation of the set point necessary to maintain the target MC, following evaporative load changes entering the dryer.

The Results

Delta T MC sensing & control technology has been validated by over 400 successful installations. Figure (3) illustrates the effectiveness in improving MC sensing and control by reducing the MC variation at least 30% to achieve tight, precise biomass MC control required for pellets destined for power plant use. Biomass for pellets destined for domestic heating use can be controlled such that the mean MC is shifted upward until the 3 + sigma limit points of each curve are superimposed at the upper MC specification limit (UCL). The difference in the two mean MC values represents the economic gain from improved control in terms of:

Production increase of at least 0.5 %
Unit energy conservation of 7%
Elimination of over and under-dried product
Moisture specifications more easily met.
Reduces moisture variance by at least 30%

Figure (3) – Power Plant Pellets

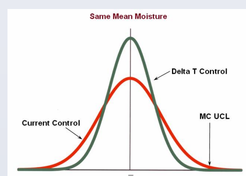
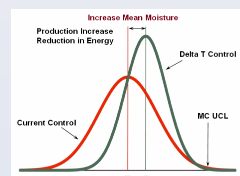


Figure (4) – Pellets for Domestic Heating

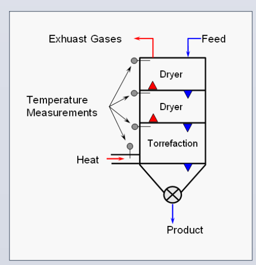


Improved Moisture for Torrefaction

Moisture control is important for proper torrefaction. Biomass for many torrefaction processes must be dried to a specific moisture target with as low a standard deviation as possible. It is possible that the use of improved MC sensing and control could be of significant benefit to this process.

Figure (5) depicts schematically one configuration of a vertical wood biomass torrefaction reactor that could be easily fitted with the Delta T 'inside-the-dryer" MC sensing and control by simply measuring the temperature of the gas entering and exiting the drying section.

Figure (5) – Simple Schematic of a Torrefaction Reactor
With Delta T MC Sensing & Control



Summary and Conclusions

Success in producing a good product at the lowest cost is highly contingent upon proper MC sensing and control. Use of improved MC sensing and control will eliminate losses in terms of production rate, excessive energy consumption, and in production of over and under-dried product. The technology described herein has been proven to reduce costs and improve ease of control on over 400 installations. Biomass products are excellent candidates for this improved control technology.

For a domestic pellet mill producing 150,,000 tons per year at a wholesale price per ton of $200, the net annual recovery would be approximately $150,000., or about $1 per ton. This does not include about 7% energy savings and savings from possible recall of poor quality pellets.

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