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Moisture and Hardness Control Systems

Why is it so important to have Moisture and Hardness Control as a required part of your Making process?

The human operator can only keep track of a few things at a time. He can see the pug mill level change, he can take periodic penetrometer readings, and he can see when the dirt is getting hard or soft (within a window) so that he can make educated adjustments with his hand operated valves... if he happens to be at the pug when it occurs. However, today's economy has forced many other responsibilities on the operator which means he does not have the capability to baby sit the process any longer and hasn't had this ability for many years. All operators in a manual control state have to run the column softer than desired in case the column tries to harden quickly as a safety net. This allows them time to react without blowing o-rings, shear bolts and heads. Humans can not maintain 100% concentration nor do they have the necessary instantaneous data available to make the proper minute adjustments required to keep the column in a tight control window. Maintaining a column temper with 98% of production falling within a +/- 0.1 penetrometer deviation is humanly impossible. Our ***MCC Moisture and Hardness Control System*** has installations where 98% of production is within 0.05% of penetrometer target. Dimensions are held, frequency of wire breakage reduces and becomes predictable, and machine stops become infrequent. The whole making process turns from Led Zeppelin's discord to Beethoven's fifth in C minor. First Quality reports become career enhancers instead of anchors. Bottom line - these machines have a return on investment measured in months not years. Some installations produce a cost savings in excess of \$ 2700.00 per day. Ask us for details.

Why is the JEC MCC Moisture & Hardness Control so different?

Why do we call the MCC a Moisture & Hardness Control and not just Moisture Control? Are they not the same?

Tight Column temper control cannot be achieved by straight moisture control alone... **Period... End of Story!** The plasticity of a column changes with the size of the particles as well as changes in the recipe mix. Columns with larger particles require different overall final moisture content than do columns with smaller particle mixes. As silos and

feed hoppers empty, they do not empty evenly. Larger particles may have a tendency to fall easier than do smaller ones. Piles of stored mixes have a tendency to collect larger particles toward the bottom of the piles with finer particles at the top. Also, since the added water only has a few minutes to be absorbed by the mix, different materials absorb water at different rates and corrections for the types of materials in the mix must be profiled for their particular absorbability. For instance: sand and grog are poor absorbers of moisture where as kaolin and clay absorb at a faster rate than shale. The lubricity of the column materials must be determined and incorporated as part of the recipe curve. Also the curve must be continuously adjusted for time and % moisture through the pug mill and extruder through use of self teaching algorithms because not many things remain constants.

These continuous and dynamic inconsistencies in raw material supply have to be dealt with in a very dynamic manner; otherwise, keeping a consistent column temper as the material is finally extruded becomes unrealistic.

All companies use Front End Loaders. We have determined through analysis of the MCC Recorded Data Logs that the best performance we have ever seen from Front End Loader measuring and mixing has been 90% accuracy. Normal accuracy seems to be about 85% with some good days and some worse. Since all Moisture cameras follow a curve based on some recipe, inaccuracies in mixing today's recipe will vary the way all moisture sensing cameras see your desired recipe for any given batch. As the mix error varies, the curve would need to be modified proportionally for that error. The camera reading will never be completely correct and will always be off target by the constantly changing error caused by the industry standard of Front End Loader Science. Roughly, depending on the characteristics for a plotted curve, the error caused by the above inconsistencies can cause up to a 1% error in the moisture camera reading instantaneously as the mix changes instantaneously. Therefore a moisture only control system requires continuous operator adjustments in order to correct for these constant changes as mentioned above. The ***MCC Moisture and Hardness Control System is an automatic system. It addresses all of the above issues dynamically and therefore seldom, if ever, requires operator intervention.***

Why does the MCC Moisture and Hardness Control System not use a standard belt scale to measure flow rate?

The MCC System does integrate a standard load cell assembly (with out the control) to give us the mass on a section of belt as well as an encoder to give us its position on its way to the Pug mill or Pre-pug mill. Our system does not concern its self with flow rates. The difference here is that all standard belt scale amplifier outputs are rate based signals. The MCC does not listen to rate information. Our calculations are based on the position and mass in a moving data packet along the belt. The advantage of not using "rate" based signals is that we become independent of rate which is based on averages. Our System is able to calculate the required water mass for a particular data packet which can vary greatly. Mass Flow rates, foot to foot, can vary widely. This is evident when viewing the raw feed belt as differences in height and width of the clay can vary significantly over just a few feet. It may average out to x tons/hr but when you are able to meter in water additions based on a foot by foot requirement and not based on some averaged tons/hr.

flow rate signal, you obtain an acute ability to respond to the substantial changes in instantaneous mass addition into the pug mill. This assumes that the required water addition system is able to respond quickly, be independent of pressure changes in your water supply, and able to accurately meter differing water mass requirements foot by foot.

Why does the MCC Moisture and Hardness Control System not use a standard pneumatic valve to deliver the addition water?

Since all flow control valves on the market today achieve a desired flow rate based on a known valve position at some constant input pressure, they are all subject to flow rate error unless a constant supply pressure is available. Since most plants do not have consistent supply let alone a consistent supply at some consistent water pressure, we would either have to create this condition or find a better mouse trap... we chose the latter. The MCC Water Control Center uses a standard API valve whose valve stem position is modified by a motorized actuator. The MCC delivers water independent of water pressure but modifies the positions the valve stem continuously, and in a dynamic way, in order to meter in the desired number of grams of water required for each data packet mentioned earlier. The MCC uses a water meter which produces a pulse for each 9 grams of water throughput. Each data packet of clay mentioned above requires a different mass of water and as such the water valve is in constant motion data packet to data packet. It also is changing during each packet to correct for, sometimes, significant changes in water pressure. The Water Control Center response time (slew Rate) is roughly 0 to 15 gal/min in 1 second.

So... Why is our unit different? Because only **JEC** offers the **MCC Moisture and Hardness Control System**. It is the only unit on the market which **even** addresses these very real issues. It is the only unit on the market which has the ability to control them. It is the only unit available which can learn and teach its self how to make a better brick with your process.

What else can the JEC MCC Moisture & Hardness Control do for your process?

Raw Feed Control and Additive Feeder Control

The **MCC Moisture and Hardness Control System** offers very operator friendly pop-up menu controls which allow the operator to adjust activate or deactivate, on the fly, any feeder at any time. The outputs and feed back loops are completely programmable. They can produce any voltage output range desired from 0 to 10 volts DC or can be easily reconfigured to any milliamp output range of 0 to 150ma with 4 to 20ma being the most common. Raw feed control can be accomplished from a panel potentiometer or from the pop-up menu control and can be changed at will. Adjustments to the Raw Feeders will automatically make the appropriate changes to all of the additive feeders' dry weight set

points. Additive feeder set points can also be incorporated as part of a recipe so that it can preset the feeders feed rate and turn them on for a particular brick. There is no limit to the number of recipes which can be stored on our unit. The unit will permit millions of recipes to be stored if desired.

Associated with each feeder control can be a level sensor which will alarm and display for instance “Barium feeder low” when it is time for the operator to service that particular feeder hopper. Each Feeder can be programmed as lbs./ton, %wt., %dry wt., gal./min., lbs./min., lbs./1000 lbs. individually.

What kinds of conditions are monitored which would alarm and shut the process down?

At present there are 125 different process alarms which are monitored and recorded with a date and time stamp for review at any time. These Alarm logs, as well as daily process data (which includes about 20 plotted parameters every 5 seconds) and all monitored system maintenance events are stored chronologically on the system hard drive by year, month, and day. With the use of our data viewing software, all can be printed for analysis at any time. These records are never destroyed and it is easy to evaluate today’s production against the same day last year.

However, there is some show stopping alarms as follows:

- 1) If the water supply drops below 20 psig. or below a pressure which will not allow our unit to add sufficient water for control purposes.
- 2) A programmable low dirt weight on the raw feed belt. (Programmable delay)
- 3) Excessive die lube pressure which is programmable. (Programmable delay)
- 4) Excessive extruder amperage which is programmable. (Programmable delay)
- 5) Excessive pug mill amperage which is programmable. (Programmable delay)
- 6) Excessive pre-pug mill amperage which is programmable. (Programmable delay)
- 7) **Vacuum chamber backup alarm (new)** where the operator has not stopped the pug within a programmable time limit. This condition can be handled automatically by our unit if desired. It can shut the feed to the chamber during the backup and then start the feed again when the detector is cleared. The alarm will still sound and the message center will still display the “Vacuum Chamber Backup Alarm” & “Handling the Backup”.
- 8) Gross instability of the raw weight feed. (Programmable limits)
- 9) Any critical system equipment failure detected.
- 10) Main power in alarm.
- 11) A critical motor cuts out or for example: the extruder is not running and the pug is running more than a programmable amount of time. Another case would be if the operator forgets to turn on the feed belt after running down the pug.

How will this system improve your process? What immediate expectations should you have?

The number of Machine stops will go way down. Wire breakage will be much more predictable. Dimensions and texture will be much more predictable. Problems (stops) from the setting department will decrease as the bricks will not be cracking or falling out. Penetrometer readings will be very consistent. After kiln scrap rates will decrease and in most cases be dramatically cut. If our Feed controls are used, then predictable colors will be sent to the kiln. Variations in firing can still cause color variations.

What is new or coming soon?

- 1) JEC now offers a continuous penetrometer which takes 30 readings per second. This will give a play by play plot of how well we did as well as provide feed back to our system in real time to obtain even tighter control.
- 2) JEC is developing an in line camera vision system which will quality assure the proper dimensions of your extruded slugs with a resolution to 0.001 inches. You will be able to view the wire wear on the screen. An alarm will sound if dimensions are out of tolerance. This vision system will also detect **and control** pigment additives to a predetermined set point as well as a texture set point. It will also detect common errors such as rocks caught in the wires or broken wires at the extruder. Up to 3 cameras can be installed per system so that coatings etc. can be quality checked as well. Our goal here is to insure that if we send a slug to the setter... it would have to make "A Perfect Brick!"