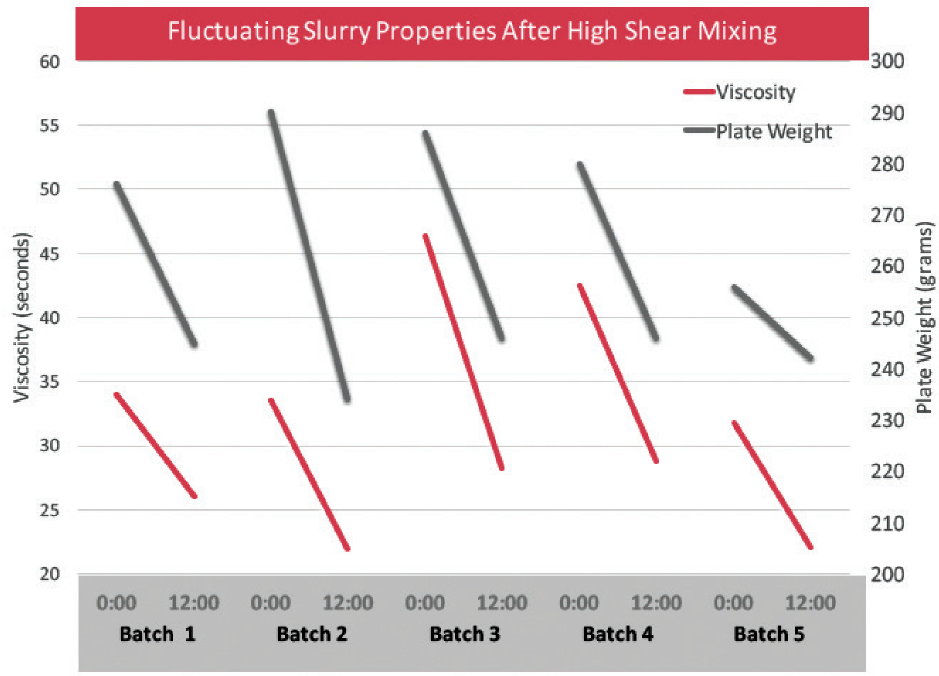
Tips to Protect and Improve the Process During Production Fluctuations

by Julie Markee, Key Process Innovations

Over the last year, the price of crude oil has dropped to lows not seen in nearly a decade. And without a doubt, there are consumers celebrating the lower cost to fill their gasoline tank. However, for those in the investment casting industry, the low cost of gasoline serves as a reminder of the challenging times facing this industry.

The impact of lower priced crude oil varies by industry served: oil and gas, pump and valve, and defense have been hit hardest while the medical industry has seen some growth. Regardless of whether foundry production is increasing or decreasing, there are variables within the process which are impacted by throughput fluctuations. And, without focusing on these variables, a plant may unknowingly experience variations in casting quality.



Slurry Health

Slurries, especially prime slurries have an expected life. This life is dependent on a number of factors including binder and flour composition and particle size, along with process variables such as addition frequency and type and slurry turnover. As throughput in the shell room changes, slurry turnover and required additions will also change. For example, as production decreases, changes in slurry viscosity may be due to water evaporation and not selective draining. Being aware of these subtle changes can help extend the life of your slurry while maintaining optimal shell strength.

Identifying these subtle changes requires performing the appropriate tests at a frequency which allows for adjustments prior to impacting casting quality. For more information on which slurry tests are good slurry health indicators, check out the April 2014 INCAST Magazine article titled, "Uncovering the Hidden Process Variables in Shell Building."

Slurry Conditioning

Slurries are typically mixed and then staged in a holding tank allowing the slurry to stabilize prior to being introduced into production. Slurry stabilization is measured by viscosity, plate weight and temperature. The amount of time required for stabilization is largely dependent on the slurry mixing method. For example, the stabilization time for a slurry which is mixed with a high shear disperser is much less than a slurry mixed with a Lightnin mixer.

The chart above illustrates changes in slurry properties in a holding tank. After high shear mixing, each slurry was transferred to a holding tank and properties measured every hour. As seen on the chart, the properties continued to change over the 12 hour holding time.

As production slows, increased stabilization time may result in lower plate weight and viscosity. As production increases, stabilization time may condense requiring additional liquids to achieve the desired viscosity. This, in turn, reduces the solids loading of a slurry which could reduce shell strength. Ideally, a slurry should be used once it has fully stabilized, however, it that isn't possible, be aware of additions to the slurry which could impact shell strength.

Shell Drying

Changing the number of shells being processed during a specified period of time may impact shell drying. Typically, intra-coat dry times are established based on robot or operator cycle time. However, these times rarely take into account severe increases or decreases in product throughput. Most parts have minimum dry times, but, these times are not typically tested to ensure acceptable casting quality. As throughput decreases, there are less molds to dip and as a result, intra-coat dry time will approach the established minimum. In addition, this change in dry time may also reduce the amount of time a mold is in front of a fan which can further reduce the rate of mold drying.

Ideally, the dip cycle should be based on a desired level of mold dryness and variables such as dry time, air flow, and in some cases, temperature and relative humidity should be adjusted in order to achieve the needed level of dryness. If measuring mold dryness isn't possible and a particular part (or parts) is experiencing drying related defects, it may be helpful to review dry times of previous lots processed during high production and use those dry times to establish minimum intra-coat dry times.

Operators

Changes in production levels also impact the operators. In some instances, the operators find they have excess time within their shift, or perhaps operators are moved into different departments to adjust to changes in workflow.

Utilizing a proactive approach to address these issues can help improve the efficiency of the operators, such as:

- Take advantage of downtime to train operators for different positions or departments.
- Develop a skills matrix for each department so management knows who is trained for each of the tasks while highlighting areas which need additional operators trained.
- Establish a competency test so operators can demonstrate a level of understanding prior to working in a particular department or performing a specific task.
- Institute clear operator responsibilities so everyone knows what is expected of them. This is especially true around shift changes.
- Utilize visual aids, including standard work, to ensure operators have reminders on how to do each of the specific tasks.

While it can be stressful managing a plant with declining throughput, this may be a good time to invest in some improvements to your plant and your employees. Are there potential cost savings ideas which need an investment of time? Are there operators who have shown promise in the organization who could benefit from training within another department?

Taking advantage of these downtimes to implement process improvements and further develop your work force will make the organization much stronger as the industry begins to grow again.

About the Author

Julie Markee's passion for the investment casting industry inspired her to start Key Process Innovations, a company focused on improving process efficiency through technical expertise, products and equipment. Throughout her 13 years in the industry, she has worked to reduce process variability across a wide range of foundries. She has presented numerous technical papers focused on helping PIC foundries remove variability from their process. She has Bachelor of Science in Chemical Engineering from the University of Washington.