PROCESS INSTRUMENTATION

Increasing efficiency in sand mine operations

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The rapid expansion of unconventional drilling that has occurred over the last 10 years has driven demand for industrial sand to levels higher than they have ever been. In unconventional drilling, cracks are created in shale rock formations, releasing the oil and gas that has been captured in the formations. In this process, sand is used as a proppant to hold these cracks open. To do this thousands of tons of frac sand are used on a single well, driving the high demand for industrial sand. An IHS Markit report entitled "IHS Markit ProppantIQ 2Q2018 Analysis" states the demand for frac sand in North America is expected to reach 81 million tons in 2018, and that number is expected to rise to over 115 million tons in the next 5 years. This increase in demand drives the need for increased efficiencies in industrial sand operations. Two areas in which many sand operations are looking to improve efficiency are inventory control and shipping costs.

In sand production and distribution, sand is stored at several places throughout the process. Whether in the wet plant, dry plant, loadout facility, transportation vehicles, or distribution centers, sand must be tracked for proper inventory control. The development of Internet-based technologies such as the "Internet of Things" (IoT) aided in tracking inventory levels; this is especially true when inventory is stored in multiple locations and at multiple sites. However, the proper tracking of inventory begins with the measurement. If the inventory is not properly measured, the best tracking systems available will not provide an accurate result.

There are many methods of measuring bulk solids available on the market ranging from pile surveys to level measurement to direct weight measurements. With each method there are multiple technologies.

Pile surveys measure the size of a pile; this measurement may be made using manual measurements, lasers, manned aircraft or drone technology. An algorithm is then used to calculate the total weight of the material on the pile, taking into account such things as bulk density, separation, and pile profile. The frequency of such a measurement can range from monthly to annually depending on the type and cost of measurement made.

Similarly, bin level measurement may be used to measure the amount of material in a bin or hopper. Although recent developments in level measurement technologies allow accurate measurement of sand in a bin or hopper, this may or may not be usable to calculate the weight of the material in the bin or hopper. Things such as changing product density and varying angles of repose can significantly affect the accuracy of the conversion from sand level to the weight of the sand.

A direct weight measurement will produce the highest accuracy. Continuous inline scales such as conveyor belt scales allow bulk material such as sand to be weighed as it is transported by conveyor. A scale can be used to measure the material as it goes into storage and as it is removed from storage, allowing the user to track the amount of material in storage. When sand is stored in a silo a direct weight measurement may also be taken by placing the silo on load cells. Each application should be evaluated to determine what measurement technology and method are best suited for the application.

Another way in which the industry is striving to increase efficiency is by reducing shipping costs. Shipping costs can be as much as 50% of the total cost of the proppant. To assure the transportation vehicle is filled to its maximum capacity, measurement of the material

as it is loaded is the most desirable. Common practice in loading bulk solids is to fill the vehicle, whether a rail car or a truck, to 90% of its capacity. The vehicle is then moved to a truck or rail scale and weighed, if the vehicle is not overloaded, it is shipped. In this practice, the additional 10% of the vehicle's capacity is shipped empty. To maximize shipping, the additional 10% of capacity can be more efficiency used by weighing the material as it is loaded into the vehicle. This can be done using a continuous inline weighing instrument such as a conveyor belt scale to measure the material as it is moved to the vehicle.

A key component to improving any process is measurement. When selecting the proper technology to measure a process, things like frequency of the measurement, location of the measurement, and desired accuracy should be considered. A direct measurement of the desired process variable is always most desirable.

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