EVERY GRAIN COUNTS

Herman Coello, Siemens, USA, discusses automation solutions that optimise the efficiency of utilising native Texas sand for fraccing.

Fracturing sand (i.e., frac sand or proppant) is a key component used in hydraulic fracturing operations that facilitates production by keeping fractures open so that oil and/or natural gas can flow freely from the formation into the casing and up to the surface.

Over the past decade, the explosion of unconventional resource development in the US, coupled with the implementation of larger pads and longer multi-laterals, has resulted in a significant increase in the demand for fracturing sand nationwide. In 2017, for instance, the Permian Basin saw a two-fold increase in sand usage compared to 2016 and it is predicted that figure will double again through 2018.[1] Similarly, in the mid-continental region, the average amount of sand being used per well has increased by nearly 30% over the past year.

As is the case with any commodity, growth in demand for frac sand over the past decade has been accompanied by a corresponding increase in price. In fact, just prior to the industry-wide downturn, it was not uncommon for proppant to represent more than 20% of drilling costs. With crude prices at more than US$100/bbl, this was palatable. However, as oil prices declined, producers in West Texas could no longer justify the expense of hauling in sand from places like Wisconsin, Minnesota, and Illinois and they began taking a hard look at how they could improve processes to become more efficient.

This resulted in a wave of investments aimed at moving sand processing infrastructure closer to shale plays, which drove down costs by effectively eliminating long-haul transport from the equation. And while it has been successful in helping Permian producers remain profitable amid the low price environment, it has also introduced new challenges that necessitate advanced measurement solutions and digital oilfield capabilities.

Pushing the envelope for efficiency

The feasibility of utilising native Texas sand for fraccing instead of costly white sands from mid-western states, coupled with the reduction of transport costs and improved fracturing technologies is bringing stability to the US oil industry. However, the need to improve efficiencies and drive out costs has not diminished.

The situation in the Permian Basin, as it pertains to frac sand level inventory monitoring, is similar to what was seen in the Bakken with crude oil level inventory monitoring five years ago. Leading up to the downturn, when prices exceeded US$100/bbl, many operators in the Bakken were so busy producing that monitoring the level and interface of oil and water in produced water tanks was not immediately addressed. It was not until production began to slow down that accountability for residual crude oil in water disposal tanks became more relevant and interface and level measurement technologies were implemented.

Figure 1. *Frac sand consumption is on the rise.*

Figure 2. *Digitalisation and instrumentation go hand-in-hand with the SITRANS LR560.*

Unlike the Bakken, crude oil production in the Permian Basin does not have the luxury of high prices and the window for profits is narrower. While Permian producers have achieved improvements and driven out costs in a number of different production areas, independent producers will continue to push the envelope for efficiency. As a result, room for waste is not an option and the need for accurate and transparent inventory monitoring of frac sand is of the utmost importance.

Process measurement – a key element in the digital oilfield

In recent years, an increasing number of sand processing and proppant plants have embraced level measurement and weighing solutions as part of their processes to ensure reliable inventory levels. Many, however, have taken it a step further by leveraging the data these solutions provide to drive operational efficiency.

In the oil and gas industry, as shale producers have sought new ways to improve production, well site data has become more valuable. While digital oilfield solutions based on the cloud and Internet of Things (IoT) have proven to be powerful tools, they can only be leveraged if instrumentation is in place to monitor process variables, such as pressure, temperature, flow, etc. In frac sand processing, without accurate data on the level of proppants that are stored, delivered and trans-loaded, a significant piece of the puzzle is missing.

Combining advanced level measurement with digital oilfield solutions provides transparency into well site operations. With continuous input from sensing devices, data from the field, such as sand frac levels in silos, can be closely monitored and analysed so that the health and effectiveness of processing and storage operations can be continuously improved.

Radar level transmitters for frac sand inventory monitoring

Interestingly enough, some operators still require convincing that reliable level measurement can be achieved in dusty environments with radar level transmitters. Much of this is due to the fact that prior to the advent of high frequency transmitting solutions and advanced signal processing algorithms, the only way to ensure the accuracy of mainstream (low frequency) through-air measurement technologies when measuring levels of silica sand, sugar or similar solids was through a highly arduous and painstaking installation and setup process.

When using low frequency transmitters, the spherical shape and steep angle of repose of silica sand tends to reflect the emitted signal, yielding a false reading. In 2011, Siemens addressed this challenge by introducing the SITRANS LR560, which is a two-wire, 78 GHz frequency modulated, continuous-wave radar (FMCW).

The high frequency enables the LR560 to emit a very short 4 mm wavelength, which provides enhanced signal reflection, even from solids with a steep angle of repose. Its unique lens-styled antenna has a 4˚ beam angle and a sensing range of up to 328 ft. This, coupled with the advanced signal processing capabilities of the transmitter, enabled clients in a wide range of industries to solve the problem of signal-skipping – the same problem that many operators are experiencing in their frac sand silos. Overall, the transmitter provides consistent and reliable level measurements, regardless of how much dust is in the air. It is also a plug-and-work solution that can be installed and brought into operation in a matter of minutes.

Reduced costs, improved safety, ensured compliance

Installation of a radar level transmitter for monitoring levels in frac sand silos provides a number of benefits with regards to safety, cost, and compliance.

OSHA recently ruled on new limits regarding worker exposure to crystalline silica dust. As enforcement of these new regulations increases, users of frac sand will have to implement measures that minimise their workers' exposure to environments where silica dust is present. Installation of a radar level transmitter satisfies this requirement, as it removes the need for personnel to climb silos and open hatches to verify inventory levels. It also fulfills overfill prevention requirements, which is an area that will be closely regulated in order to prevent silica dust dispersion during filling and emptying of storage or holding silos.

When examining the benefits of reliable level measurement, one cannot discount the cost associated with improperly managed or incorrect readings of proppant inventory levels. This can come in many forms, including idling trucks, inefficient use of time, and in severe cases, lost production. The cost of instrumentation becomes miniscule when compared to the financial losses incurred when production falls behind. Considering this risk and the vast amount of proppant being used in hydraulic fracturing today, the lack of reliable level measurement solutions is a major inefficiency – especially for an industry that has managed to redefine success amid pressure from sustained low prices.

Overall, instrumentation solutions represent a minute fraction of the overall price tag to develop a sand processing plant. However, the impact they can have on production and efficiency is evident both during the plant development process and after it is in operation. For example, Siemens was recently performing work at a sand frac processing plant where radar transmitters were installed in narrow ports and protruded inside the silos. In this particular case, the pipes were too long and prevented the transmitters from being properly aimed to achieve consistent level measurement. This hindered the plant from obtaining reliable level measurements of frac sand for the entire range of the silo and will lead to future expenses to correct the situation.

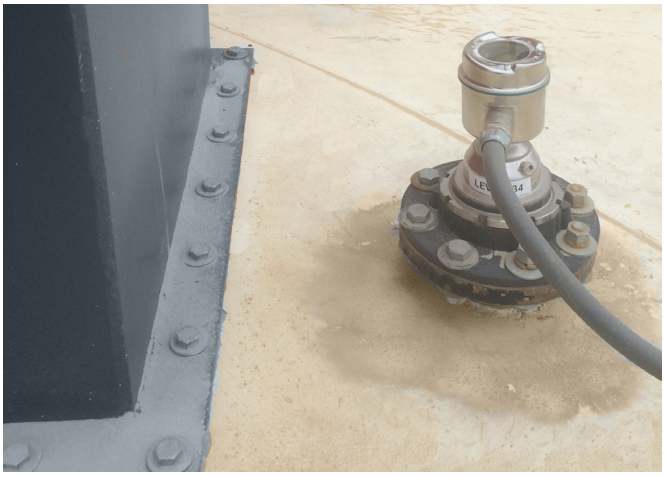

Figure 3. *Level measurement of irregular, granular, or spherical materials is made easier with the SITRANS LR560.*

Figure 4. *Simplicity, reliability, and verifiability are key features of this single belt scale.*

It is situations like this that highlight the importance of engaging early with a solutions provider during the design phase to decide what instruments should be utilised for inventory level monitoring. Optimal performance does not take place in a vacuum. There are many parts at play in any operation, and given the current economic environment, there is no margin to ignore what may ostensibly seem like a small detail.

The importance of accurate weighing

As previously mentioned, longer laterals and larger well pads require more sand and thus, more storage capacity. This inevitably increases trans-loading activity. Depending on the trans-loading system and area of distribution, accountability for what is being paid for and utilised – especially for high-end proppants – must be reconciled. The system's function, therefore, is not solely to convey sand or proppants from point A to point B, but also to validate asset management along key points in the process. Implementation of reliable and accurate belt scales play a key role in achieving this.

Utilisation of native Texas sands does not completely eliminate the need for more expensive white sands. Thus, accurately weighing how much proppant is being delivered by a rail cart is paramount. A single belt scale from Siemens can achieve +/- 0.5% accuracy. Doubling the number of belt scales further improves accuracy to +/- 0.25% and this can be readily verified via onsite material tests. Ultimately, the stage and price of the proppant being used will dictate the level of accuracy required by the belt scale.

One aspect of the company's belt scales that makes them particularly attractive for use in sand frac processing plants located in remote areas is that they are simple to install and require minimal maintenance. Furthermore, they are the same type of scales used with a National Type Evaluation Program (NTEP) certified custody transfer package. The latter should be considered with transactions involving more costly proppants. Additionally, the scales can be configured so that real time or totalised tonnage data is fed into the digital oilfield acquisition system for analysis and optimisation.

Leveraging instrumentation to drive safety and efficiency

Although silica dust remains a concern for shale producers, there are effective measures that can be put in place to minimise exposure by enclosing open areas where it is present and breathable. This includes using proppant coating technology as a dust suppressor and adding skirts to enclose conveying systems. While the primary purpose of level measurement instrumentation is to maintain dependable inventory levels, it is yet another means to mitigate dust levels and help producers remain compliant with current OSHA guidelines.

Automation solutions like radar level transmitters and belt scales can also generate significant economic value – particularly when one compares their relatively low cost with the significant financial losses that can occur as a result of inaccurate or improperly managed frac sand inventory levels. In the coming years, it will be solutions like these, which are inclusive of both the digital oilfield and essential well site processes, that help operators drive further efficiency and remain competitive in the 'lower for longer' environment.

Reference

1. Bush, T. 'The State of Frac Sand', Presentation. 6th Annual Frac Sand Supply & Logistics Conference, Houston, TX. (28 September, 2017).