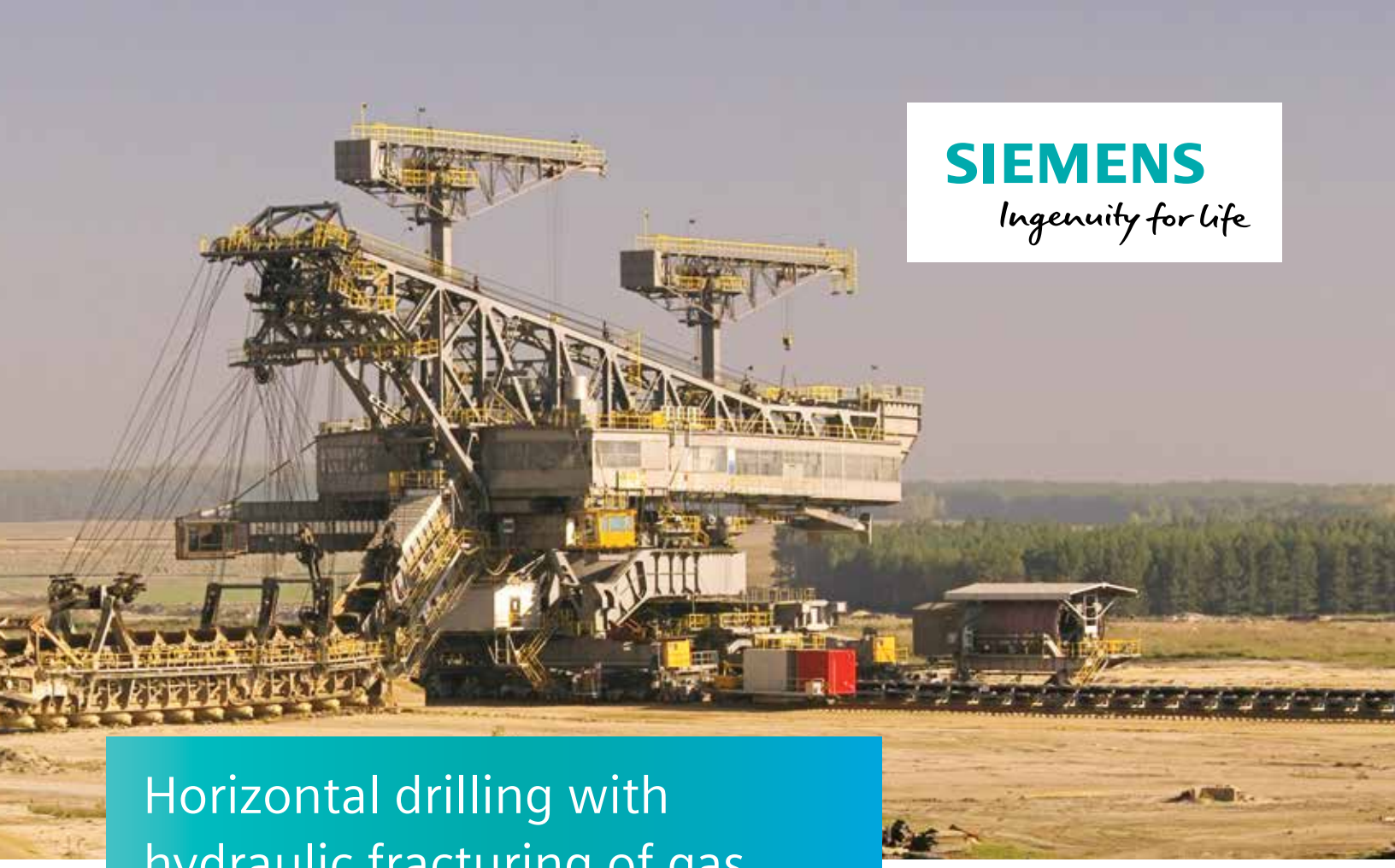

SIEMENS
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Horizontal drilling with hydraulic fracturing of gas wells

Turning sand into gold

Process Instrumentation

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Horizontal drilling started back in 1929 and hydraulic fracking began in 1949. However, it was not until 2003 that the horizontal drilling and hydraulic fracking processes were combined to extract gas from the Barnett Shale in north Texas. Since then, gas drilling has increased by 14 times in the United States. Given the vast shale formations throughout the United States, drilling will continue to increase for several more years.

With this increase in drilling, an industry has emerged almost overnight. The Frac Sand business falls into multiple categories, such as mining, distribution and service, and supply companies. With this mining expansion, the production of fracturing sand (also known as Proppant or Frac Sand) has noticeably grown since 2005. Currently, 30 companies are operating 1055 sand mines. Sand mines are expected to continue increasing over the next few years with the largest growth anticipated to be in Wisconsin, Arkansas and Michigan. Wisconsin alone expects to add 25 more mines, of which 14 should be almost completed. Although Frac sand is primarily a surface mining, there has been a growth in underground sand mining as well.

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Frac sand is the key component in this drilling process. Once a well is drilled horizontally, perforation guns are inserted at various points along the horizontal line. The explosive charges are set off to expand the natural fractures within the existing shale. Once perforation is completed, drillers inject a hydraulic gel, under high pressure, to open up the fractures. Then frac sand is added, allowing the fractures to remain open and permitting the natural gas to flow into the production casing and up to the surface.

One of these wells can be fracked more than 40 times, using 30,000 to 300,000 tons of frac sand, depending on the length of the lateral well and the number of times the well is fracked.

With the increased demand for frac sand, prices have risen from a value of $35.00 per metric ton in 2000 to costing somewhere between $50–$60 per metric ton in 2011. This represents an increase of almost 50% in just a 10-year period. The technology of fracking has also changed in recent years through the increased use of resin-coated frac sand.

The resin allows the sand to hold the shale fractures open better than conventional frac sand, once the hydraulic gel is removed. This increases the flow and volume of oil and gas released from the well. Resin coating the frac sand is more expensive which contributes the increased cost.

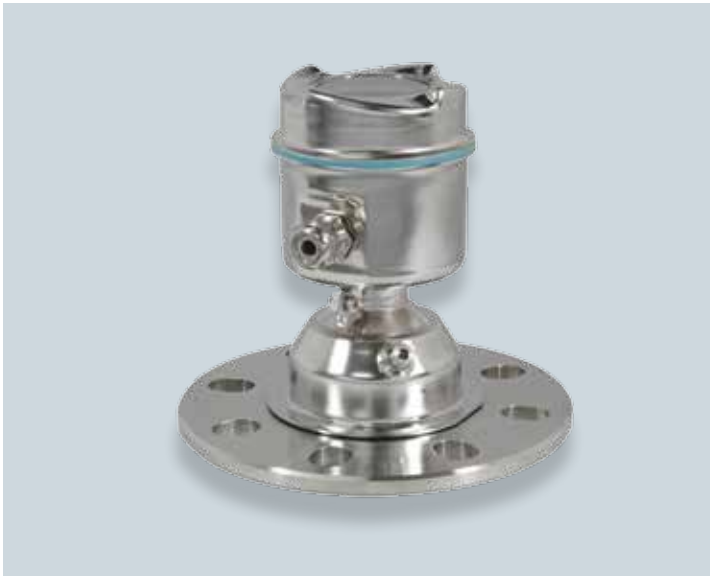
After being mined, the raw sand is then transported by a conveying system to a silica sand, process plant for crushing the sand and removing impurities. The next step is to separate the sand by size and washing it. Once washed, the sand is processed through dryers. The dried sand moves into holding silos to await transport to distributors and end users. For accurate inventory, mines use conveyors with belt scales to weigh the sand. Depending on the belt scale, a mine can achieve accuracies from 0.125% to 1%. For monitoring a continuous level measurement of the frac sand in the storage or holding silos, a non-contact continuous radar level transmitter with a back up high-level switch will provide reliable level measurement and good overfill protection, respectively. Mines that practice such procedures make both the mine and the silica-sand process plants more efficient.

Currently in the United States, there are 15 major distributors – and growing – that ship frac sand to a multitude of different service and supply companies. It is expected that more suppliers and service companies will incorporate frac sand into their portfolio of services.

Suppliers are installing small tank batteries with quantities of 12 or more in drilling areas. This industry is growing so fast that silos are mostly engineered with simple level instruments or no level instrument control or automation. Most measurements are done manually with Plum Bobs, Yo Yos and/or tape measures.

The MSHA, EPA and State Environmental Agencies have regulations in place to prevent the disbursement of silica dust naturally produced any time the product is moved. Silica dust is the main cause for Chronic Silicosis and Acute Silicosis. In order to enforce mines to minimize the silica dust, operating permits for mines and sand operators are contingent on the measures taken to suppress the dust. Overfill prevention in a silo is one area that will be closely regulated to prevent silica dust dispersion while the storage or holding silo is filled or emptied. Continuous level measurement and point level devices will be key for the mines to prevent overfill.

Distributors, service and supply companies not only have to meet regulations, but also meet the demands of their customers. It is very important for them to keep the various grades of frac sand separated. One drill site may require a completely different grade of frac sand than another site. One of their biggest challenges is to ensure the different grades do not become mixed. For example, if a silo or holding silo is not completely emptied with frac sand 20/40 and is then filled with frac sand 30/50, the entire contents of the silo is lost. When purchased at $60 a metric ton, 100 metric tons or more are lost due to not knowing if the silo is empty. There is also a substantial loss if the delivery to the drill site cannot be met.



SITRANS LR560 radar level transmitter

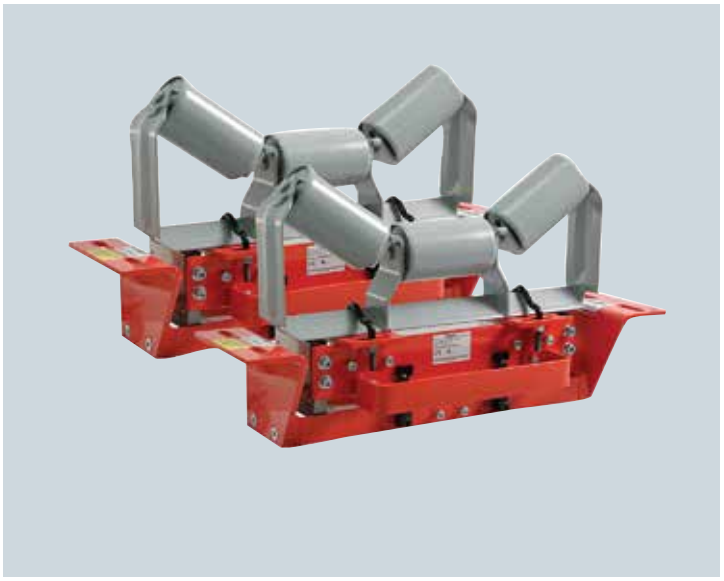
Siemens has a history of great success with measuring and weighing silica-based products. Some applications of silica sand continue to be a challenge when using radar level transmitters with a 24 GHz frequency. The spherical shape and steep angle of repose, typical in frac sand silos, deflects the emitted signal, yielding a false reading. Using the advanced process signaling of Siemens radar instruments, clients can to solve the majority of deflective or signal-skipping issues caused by silica at this frequency. Now, the reflective issue can be eliminated by using the advanced SITRANS LR560 two-wire, 78GHz frequency modulated, continuous-wave radar (FMCW). The high frequency enables the LR560 level transmitter to emit a very short 4mm wavelength, which provides exceptional signal reflection, even from solids with a steep angle of repose. LR560's newly developed lens-styled antenna has a 4° beam angle and a sensing range of up to 328 feet. Currently the SITRANS LR560 instrument is the only solids measuring radar transmitter on the market with these specific capabilities.

Last year, 18 Siemens' SITRANS LR560 radar level transmitter units were installed at a Texas sand process plant. All units were set up using the quick start menu, entering all required parameters in just a few minutes. The LR560 level transmitter permits easy installation because of the no visible horn and the tight beam angle, giving customers more flexibility in mounting the unit at the most available nozzle locations. The smaller beam angle and higher frequency allows the LR560 transmitter to read the level of the sand into the cone, unlike lower frequency and wider beam units. Other radar level transmitter units with a 4° beam angle are only available with a parabolic dish that can range from sizes of 10 to 18 inches and priced at double or triple the cost of the LR560 unit.

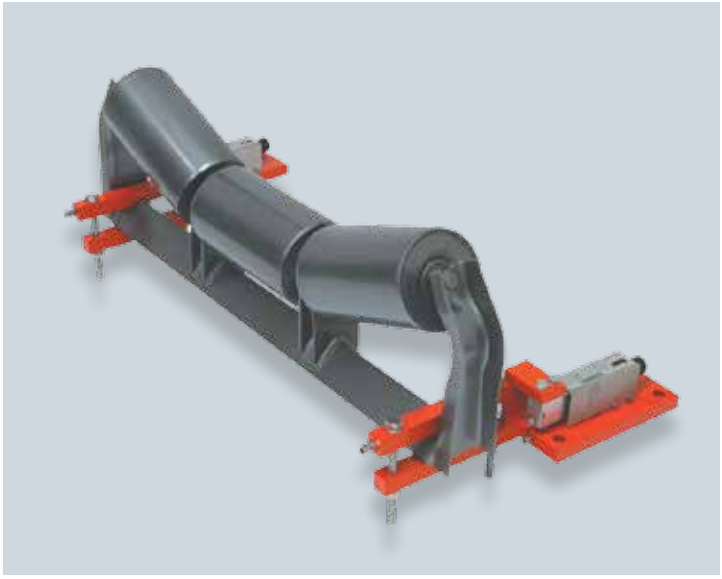
Conveyors handle transportation of the silica material at mines and by some distributors and suppliers. Scales are used to monitor how much material is moved. Not only is this a good way of moving a known amount of material, but it can be a very accurate measurement of inventory. With the price of frac sand doubling over the past ten years and demand growing, the price will most likely continue to increase. Inventory control becomes crucial for a company to be productive and remain competitive in such a growing market.

With over 30 years of experience in the mining industry and thousands of installations, Siemens' belt scales have proven to provide a high accuracy of inventory control while saving the end user on maintenance costs. Siemens has a full line of belt scales ranging from the 0.125% accurate MMI-3 model, to the economical MBS belt scale with 1% accuracy. Siemens has the belt scale that clients look for, regardless of the accuracy level, and at the same time offering the value of low cost ownership.

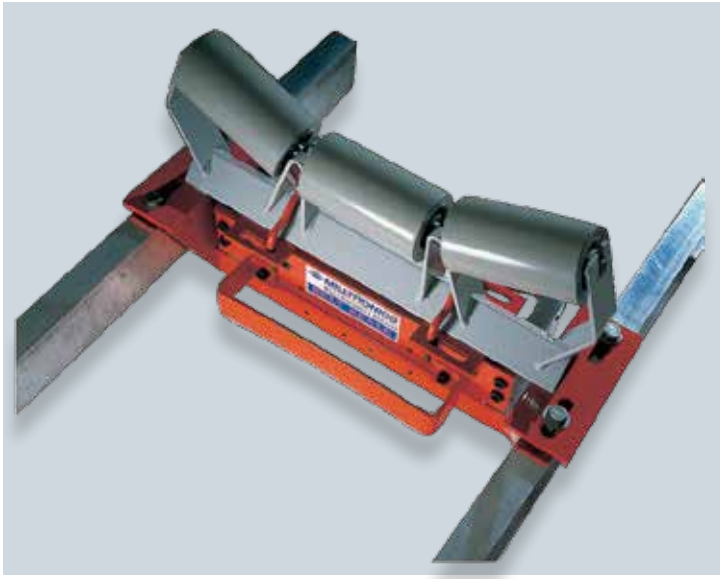
The drop-in installation of a Siemens belt scale allows for quick and easy setup. Two people can set the scale into place, with no need for



Siemens MMI belt scale



Siemens MBS belt scale



Siemens MSI belt scale

special heavy lifting equipment or costly moving expense. The less dynamic steel allows faster response to changing loads. Siemens scales measure within 0.25% using two weigh idlers (NTEP Certified for custody transfer). Other belts scales may require as many as six idlers, which can reduce the length of the weigh area by as much as 20 feet. A Siemens scale can be installed on conveyors, allowing for more available locations for the scales.

The Siemens MSI and MMI belt scale models use two parallelogram load cells per idler, one on each side. With this configuration and Siemens' patented technique of balancing these load cells the accuracy of the scale is not affected. Scale accuracy remains unchanged, regardless of where material is place, such as heavily load to one side of the belt. This makes the MSI and MMI weighbridges reliable, able to take abuse, have lower maintenance costs, and yet offer a low cost of ownership. Along with high accuracy and low maintenance costs, Siemens stands behind all their belt scales with no charge, 24/7 technical support. Over 160 US Siemens service partners provide installation, startup, and maintenance services.

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