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Swifter sulfur

Peter Davy, Deputy Editor, Hydrocarbon Engineering, reports on recent trials of a new sulfur solidification solution in Sicily.

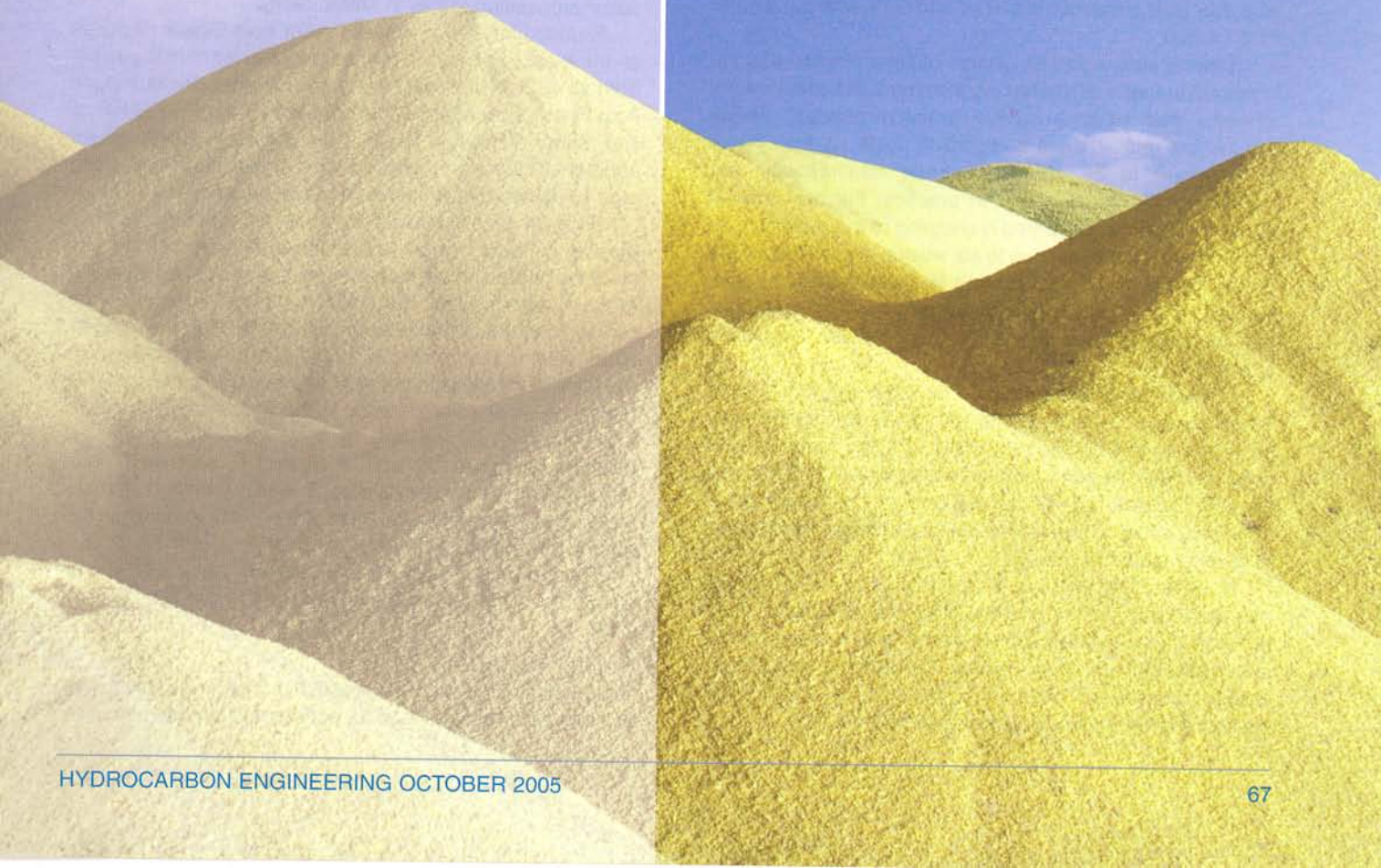
Sulfur has never been more common in oil and gas production, nor less popular in saleable end product. As efforts to meet world energy demands have led to processing sourer crudes and natural gas supplies, regulatory standards for the sulfur content of fuels have become increasingly stringent. The result, of course, is that refiners are key producers of sulfur, and their recovery of the chemical now accounts for more than 80% of the world's supply.

Sulfur handling companies such as Sandvik have been well placed to benefit from this. The liquid sulfur generally produced by oil and gas processors' desulfurisation systems is, at temperatures of 125 – 140 °C, awkward to transport. Solidification solutions have therefore become common, and demand for those that minimise environmentally unwelcome, and potentially dangerous, dust creation have seen steady growth over the last 25 years.

Sandvik's Rotoform pastillating process is an example of the 'cooled belt' systems that dominate the solidification market among small and medium capacity sulfur producers of up to 1000 tpd. The concept (Figure 1) is relatively simple: a feeding system (the Rotoformer) deposits liquid sulfur droplets onto a running steel conveyor belt cooled by water sprayed on its underside, which speeds solidification of the sulfur. By the time the droplets reach the end of the conveyor belt, they have solidified and are discharged as regularly shaped pastilles.

This system offers sulfur handlers a number of benefits. Most importantly, the pastilles it produces have good impact and abrasion resistance. The Rotoformer (Figure 2) uses a uniformly perforated shell, dubbed the 'dropformer', turning around a heated cylindrical stator fed with liquid sulfur. By synchronising the speed of the shell's rotation with the speed of the conveyor belt, droplets are deposited without deformation, while at the feed end of the conveyor, a silicon based release agent applied to the belt by a roller ensures the pastilles are discharged without being damaged. The result is consistently shaped and sized pastilles without any sharp edges: features that reduce dust creation during transport and storage.

The droplets also solidify quickly on the belt. From deposit to discharge, the sulfur is on the belt for 8 - 10 s, but the droplets solidify within the first 3 - 4; the remaining time is used to cool the pastilles to below 70 °C. This reduces the opportunity for H_2S to escape into the



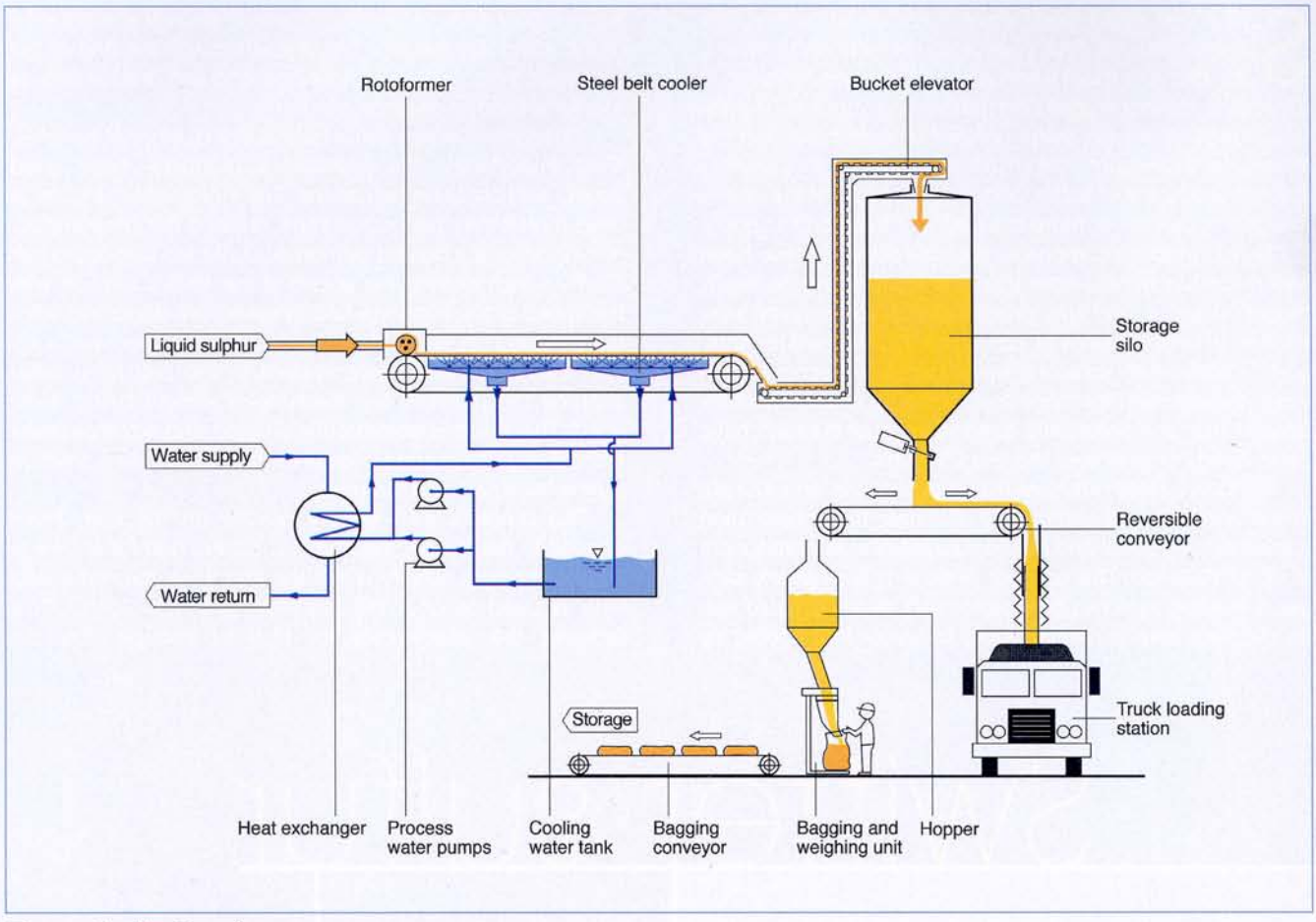


Figure 1. The Rotoform process concept.

atmosphere, improving the pastilles' purity and reducing their friability. Furthermore, because the cooling water never comes into contact with the pastilles, they contain very little moisture. The result is premium specification pastilles according to the Sulfur Development Institute of Canada (SUDIC) requirements, with less than 0.8% moisture, low dust creation properties and 95% with a diameter of 2 - 4 mm.

Sandvik also claims its system offers a number of additional advantages over other dry forming sulfur solidification systems that produce similar premium product. These include low maintenance and staffing costs, as the system is designed to be able to operate continuously and unmanned, 24 hours a day. In practice, the only regular maintenance that is required is cleaning of the metering bar in the Rotoformer every two to six weeks, depending on the quality of the sulfur. The solution is also relatively flexible. As well as quick startup and shut off times, multiple units can be operated independently to cope with fluctuating demand.

The number of units required for larger outputs has put off some larger capacity plants, though. Each Rotoform unit produces up to 6 tph, so producing 1000 tpd requires eight units, and despite some notable exceptions (Shell's Shantz plant in Canada has 46 installations and produces up to 6000 tpd), most of Sandvik's business remains in the small to medium capacity market.

However, later this month the company will launch its new sulfur solidification system, Rotoform HS (high speed) at the Sulfur Conference in Moscow. With an eye on the larger capacity end of the market, Sandvik has adapted its existing system and doubled its capacity to 12 tph, while maintaining the existing pastille specification.

Field testing

The new product is the result of over two years of development work, including several months' worth of testing to ensure the system could achieve the desired capacity while meeting SUDIC standards. Finally, a three month full production trial of the new system was conducted at Econova sulfur processing facility in Melilli, Sicily.

Founded in 1990 to process sulfur from Esso's refineries on the island, Econova is now responsible for handling sulfur from all of Sicily's six refineries, and its other clients include Agip Petroli, Exxon Mobil Chemical, Isab Energy, ERG Petroli and Saras Raffinerie Sarde. The company, which added another four Rotoform lines a couple of years ago, now operates 12 standard machines with a total capacity of 1300 tpd.

Econova receives sulfur from the refineries by truck or pipeline in liquid form at temperatures of up to 145 °C. It is stored in heated underground tanks, but prior to being piped to the Rotoform units, the sulfur is passed through a preconditioning unit with a heat exchanger to bring the temperature down to approximately 125 °C. This helps increase its viscosity, and results in better shaped pastilles. The sulfur is then pumped at 2 bar pressure to the Rotoform units, where it is solidified. At the end of the Rofoforms' conveyors, pastilles are released with a discharge knife and pass through a chute to collecting belts, which transport the sulfur to storage warehouses. Most of the sulfur ends up at the nearby commercial port of Augusta for shipping.

The new HS system was tested alongside other machines within one of Econova's plants from April to July 2005.

The new system

The original Rotoform used for sulfur was an adaptation of existing technology. Prior to adapting them for use with

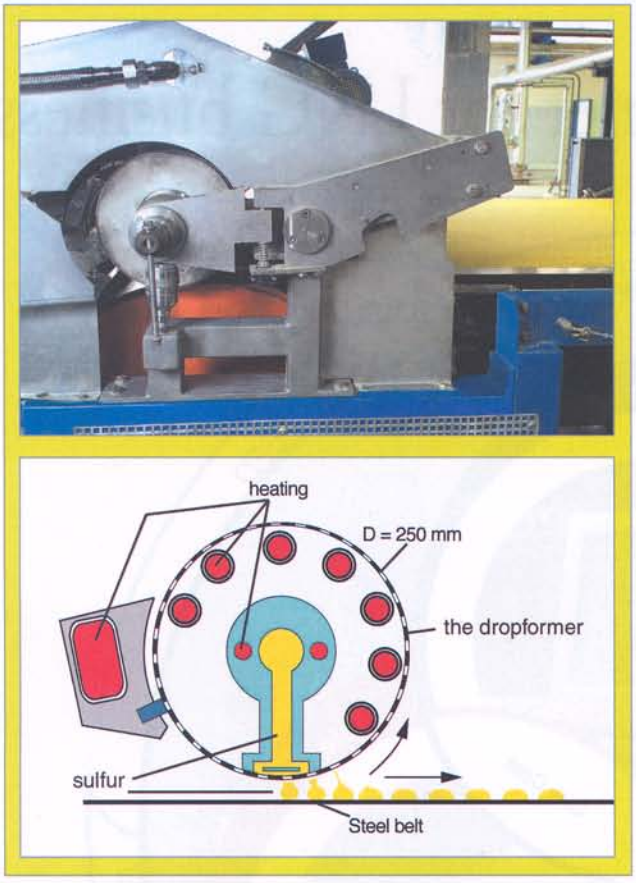


Figure 2. The Rotoformer (above) and concept.

Figure 3. The longer, 15 m, steel belt conveyor.

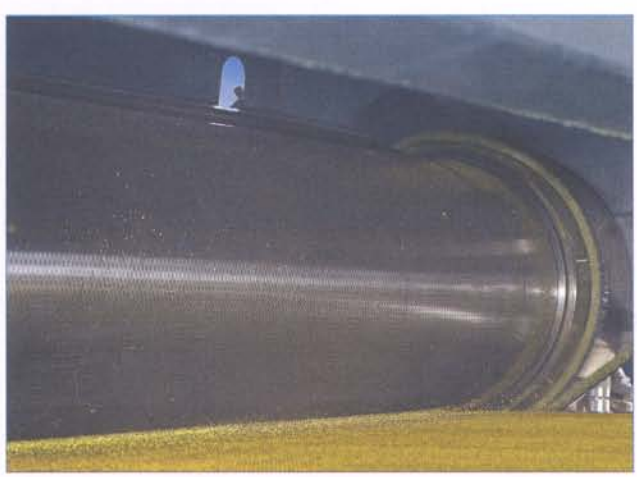


Figure 4. The larger diameter, 'dropformer' perforated shell, which deposits the sulfur droplets.

sulfur, Sandvik used similar Rotoform steel belt systems for a range of other chemicals, as well as in the food industry, to make chocolate chips for cookies, for example. In the same way, the HS system builds on, rather than overhauls the existing concept. 'The concept behind this belt technology is relatively simple,' says Ulrich Nanz, sales manager at Sandvik Process Systems. 'Whether you pastillate sulfur or cookies, there aren't so many parameters. Inside, the machine is similar to what we have supplied 1300 times before; the functional principle is identical.'

Yet, to double its capacity, significant changes have been made to the standard machine. The most immediately obvious is the length of the conveyor belt (Figure 3). The Rotoform HS achieves its increased capacity by running at twice the speed of the old machine, at 120 m/min. Since the sulfur needs the same amount of time cooling on the conveyor, this means the belt has to be twice as long, as Nanz exaplains: 'We cannot change the physical properties of chemical, so if we double the speed, we have to double the length of the machine.' The new belt is therefore 15 m long to ensure the sulfur still has 8 - 10 s cooling time. The new system also features an automatic tracking system to ensure the belt remains central on the conveyor as it turns at high speeds.

However, the most important change is found in the HS system's Rotoformer and, in particular, in the rotating dropformer (Figure 4) that deposits the sulfur droplets on the belt. In the new machine, its diameter is more than three times that of the standard system's.

The increased size is necessary because the speed of the dropformer's rotation has also doubled to remain synchronised with that of the belt, and the wider diameter offsets the increase in centrifugal force on the droplets that this would otherwise cause. 'The size enables the system to cope with the increase in speed, so that the drops are still deposited with a force that doesn't flatten them,' explains Nanz. As an engineering feat, the larger shell was significantly more difficult to achieve than the increase in belt length. It takes more than 15 hrs with an NC machine to perforate the new part with more than 30 000 holes.

Sandvik has also taken the opportunity to update the existing design. Other improvements include easier access for servicing, with fewer components, a swing out bearing unit and a new pneumatic lifting system to put the dropformer into its service position. This latter feature also improves the system's safety by automatically lifting the shell if anything is caught between it and the belt.

To market

With the production run at Econonova meeting its 12 tph and SUDIC targets by the second month of production, Sandvik is now starting to market the HS product to new and existing customers, and already has one order.

The company currently supplies approximately 50 Rotoformers a year, and sulfur machines make up about a quarter of this business. Within the last year, Nanz reckons that the company had four or five orders where high speed machines would have been appropriate, but the company hopes to sell significantly more than this by using the new system to build its business among high capacity producers. Whether it will succeed remains to be seen. However, as the world chases after decreasing supplies of oil and gas, and environmental restrictions continue to tighten, the HS system should not have too much trouble finding a market. ■