Where to put the yellow stuff?

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discusses increasing flexibility for disposing of excess sulfur.

Mega projects, mostly in the Middle East region, have dominated discussions involving sulfur recently. This is for good reason, considering the size and number of SRU trains and their associated elemental sulfur production are unprecedented. Massive sulfur recovery trains producing thousands of tpd of sulfur are certain to change the dynamics of the sulfur market, and they are certainly fascinating engineering projects as well. However, there are dynamics in the market, some related to these projects and some not, which are having a meaningful impact on oil and gas processors and their consideration of sulfur.

First, there is the expected impact on the global sulfur market of the new supply of large volumes of sulfur. In the GCC alone, current projects are projected to result in a sulfur supply increase of more than 5.5 million tpy in the next 2 years. With so much production from only one region, some marketers are anticipating larger price differentials in different parts of the world. This means that some sulfur consumers who have traditionally purchased from specific regions based on freight costs may desire to expand their sources of supply. For example, several North American phosphate fertiliser producers who have traditionally sourced their sulfur primarily or even entirely from the North American molten market are now considering adding the capability to import solid sulfur from the global market. The secondary effect of this is that many North American refiners and gas processors, especially smaller producers without significant sulfur market clout may find their long standing sulfur customers may no longer be interested in their sulfur. This is just one example of how increased production in one part of the world can have a meaningful impact in what have traditionally been isolated markets. Similar effects of altered trade flows can be expected in other parts of the world.

Secondly, beyond the large increases of sulfur supply at the mega producers, there are increases in sulfur production on the small end of the spectrum as well. This is due to both changes in feedstock sulfur content and ever tightening standards of allowable sulfur content in fuels. Although the ongoing increases in oil and gas production from shale formations are generally sweet, production from more sour sources, particularly Canadian oilsands and Venezuelan heavy crude continues to increase. Not only that, but governments around the world are steadily decreasing the quantity of sulfur they allow in end products. Changing allowable sulfur content in gasoline from 25 ppm to 10 ppm or even from 100 ppm to 10 ppm will not increase sulfur production at a refinery by thousands of tpd. However, it can have a meaningful impact, especially for those producers who rely on truck transportation of molten sulfur to nearby sulfur consumers to dispose of their sulfur. Molten sulfur trucks normally do not include their own heating medium, confining

their range to the distance the molten sulfur can reliably be transported without solidifying. If the one sulfuric acid plant down the road that takes all of a refinery's sulfur production does not need an additional one or two truckloads of sulfur/d, where will that extra truckload go?

When the combined effects of large increases of production in some corners of market and small, incremental increases in other corners are considered together, it becomes clear that the fairly balanced market that has existed for the past few years may shift in a meaningful way. As a result, forward thinking sulfur producers are preparing alternative means of moving their sulfur. Some of the things being employed by various producers around the world include adding sulfur forming when they have always moved only molten sulfur, gaining access to a blocking facility, and developing alternative markets.

First, many producers, especially smaller producers and those in markets like North America and Western Europe where there is significant transportation infrastructure for moving molten sulfur, only possess the capability to store and load out molten sulfur. They have never needed to form their sulfur. However, some are realising that the ability to solidify their sulfur into a high quality formed shape provides flexibility that serves as insurance against an unpredictable market. First of all, formed sulfur gives the producer access to markets outside the molten market in their region. This opens them up to literally thousands of customers around the world. Most solid sulfur is moved by bulk cargo ship, but there are many customers who can take sulfur in 50 kg bags, 1000 kg bags, or even loaded directly into containers. The other benefit of forming the sulfur into a solid product is that it increases the range of options of moving and storing sulfur. Molten sulfur must be kept in a tank or sump, and it must be kept hot. Once the sulfur is solid in a high quality form, it can be handled like any other bulk product. It can be put into bags, poured on a pad or in a warehouse, and moved in virtually any truck designed to handle solids.

What kind of equipment is required in order to form sulfur? The forming unit is the core piece of equipment required. There are two types of equipment commonly selected by smaller producers. The first is the pastillation unit. This piece of equipment consists of a stainless steel conveyor belt with a spray of cooling water applied to the bottom of the belt. Droplets of molten sulfur are deposited on the belt, which cool into flat bottomed pastilles as they travel along the length of the belt. They are scraped off the belt at the discharge end and drop into a conveyor for further handling. The unit is normally located inside a building along with the other ancillary equipment required to keep the unit running. The most common unit using this technology produces 100 - 120 tpd of product, although pastillation units are offered in capacity up to about 350 tpd.

The second piece of equipment available for smaller producers is the Enersul mini-WetPrill. This unit was developed specifically with the existing sulfur producer in mind. It has a very small footprint and does not require a separate shelter except in extremely cold climates. It is a completely self contained unit that requires only utilities and molten sulfur connection to the skid which measures only about 7 ft wide by 15 ft long. This makes it easier to fit into an existing facility and quick to install. It also does not have any specialised components requiring unique operations or maintenance skills in order to operate and maintain. The standard capacity of a mini-WetPrill is 100 tpd. In addition, it is designed to be able to deposit product into a conveyor or directly into 1 t 'supersacks', eliminating the need for any other equipment. Regardless of the technology chosen, formed sulfur opens up new markets and new storage and transport options which do not exist when handling molten sulfur.

The next action being taken by producers in preparation for possible market changes is to gain access to a blocking facility. For new facilities or those in the enviable position of having excess real estate, they can build the facility at the refinery or gas plant. A traditional pouring tower or the Enersul ProPivot pouring tower is installed in order to be able to pour large volumes to block for medium to long term storage. Although blocked sulfur is more difficult to bring to market, in the case of an extended disruption in market access, it is an excellent way to store large volumes of sulfur. In addition to building a block at the site, some producers are moving to gain access to blocks at other sites. This can be another facility owned by the same company, or it can be a third party site. The two need to be connected by a reliable molten sulfur transportation network, but otherwise do not require close geographic proximity. This is chosen as a sort of insurance policy against market disruption. A site does not have to build anything or consume space on the site, but they commit to a maintenance fee or other reservation commitment to ensure there is capacity available for their sulfur if they need it. Blocking offers the advantage of being able to accept sulfur at a much higher rate than a small forming facility with a comparable capital investment.

Lastly, some companies are actively developing their own alternative sulfur products. Much ink has been spilled on sulfur concrete, sulfur asphalt, new sulfur fertilisers, and a few other potential outlets for large volumes of sulfur. However, only a few major producers have invested significant time and effort into developing these technologies in order to be able to have such products be a realistic outlet for a large portion of their production. One major gas producer in the former Soviet Union has been moving forward with a plan to build their own sulfur concrete production facility. In addition, another major Western producer has invested significant time and effort into developing their own proprietary sulfur products in order to diversify their outlets for sulfur. If the sulfur market does in fact end up being significantly oversupplied in the near future, these producers are likely to find themselves in a much better position than those who must sell into the same market they have always sold to.

The bottom line is that despite meaningful increases in production of sweet crude and natural gas in some regions, global sulfur production is increasing. As a mandatory byproduct of producing essential energy products, sulfur supply is inflexible and will not decrease substantially just because the price drops. It is imperative that managers and engineers in refineries and gas plants know what their options are for keeping their plant operating if the sulfur market changes such that their current method of disposing of sulfur no longer suffices.