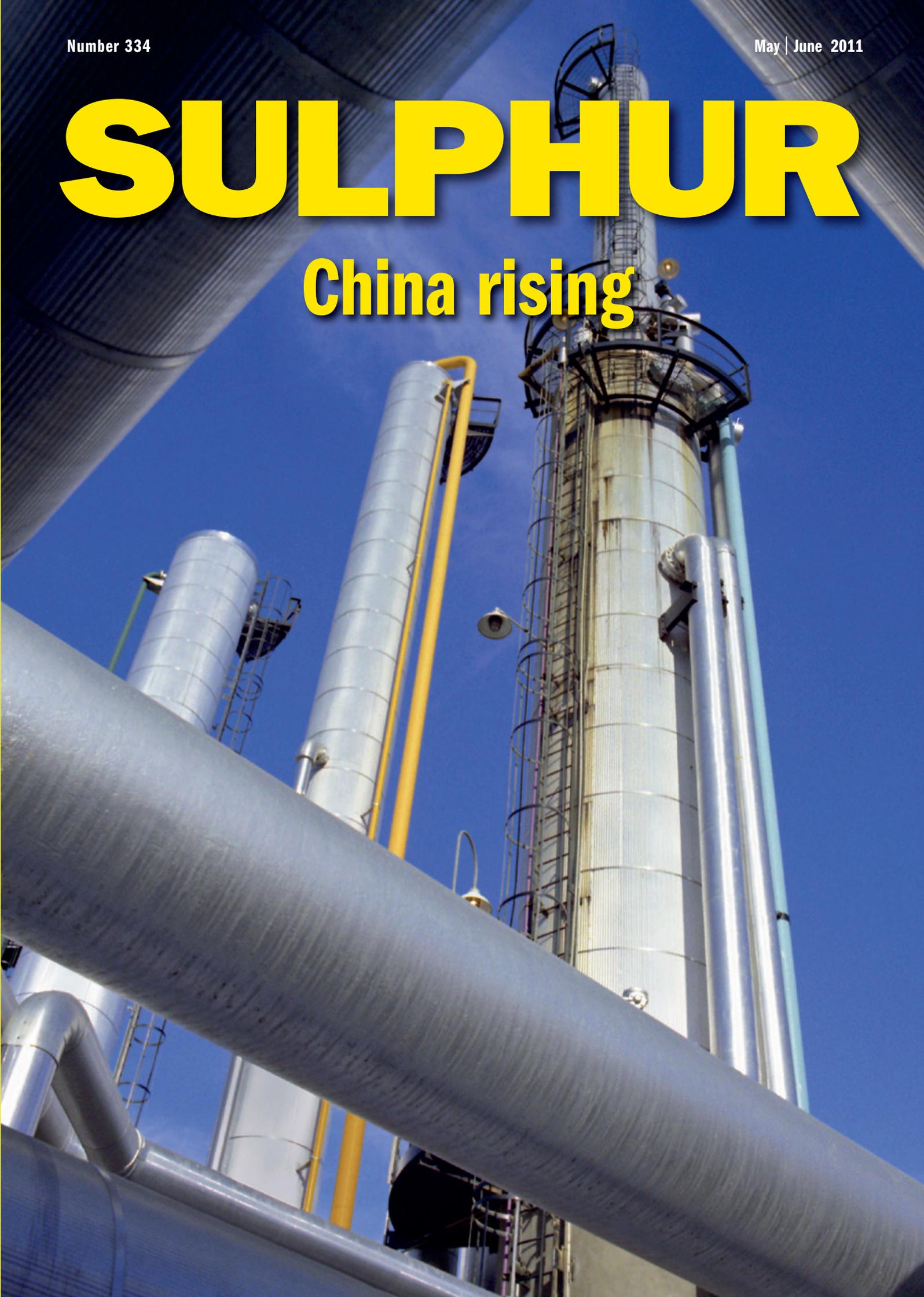


Number 334

May | June 2011

SULPHUR

China rising



Four Devco II units in Pugang,
China with a sulphur forming
capacity of 8,650 t/d.

China rising



PHOTO: DEVCO USA

The defining business story of the 2000s has been the rise of China on the world economy. Even the sulphur market has not been immune to this trend as China, already dominant in the world market as a consumer, entered the stage as a large-scale sulphur producer with Sinopec's Puguang Gas Plant.

In this article **Lan Huanqin** of Puguang Gas Purifying Plant, **Bai Yan** of Sinopec Engineering Incorporation, **Bevan Houston** and **David Savage** of Devco USA explore some key decision making factors for a large-scale forming facility, and how Devco II technology (and its upgrades) were the most optimal solution for Sinopec.

Sinopec's Puguang Gas Plant is located in Tuzhu Township, Xuanhan County, Dazhou City, Sichuan Prov., China and has a daily sulphur forming capacity of 8,650 t/d (4 Devco II units). The choice of technology for this large-scale sulphur production facility was critical, and through a competitive tender process Sinopec chose the Devco II wet forming process. Key areas of consideration were operational flexibility, product quality, capital savings and commercial benefits.

Operational flexibility

In general wet forming units perform very reliably, requiring very little downtime for maintenance. As the majority of the process is controlled by gravity, rather than multiple motors and pumps, there is less maintenance on moving equipment. Typical daily maintenance activities include visual inspection of forming trays and water sumps along with general housekeeping (all of which happen during operation). Yearly maintenance would include a more detailed inspection of rotating equipment, fixed equipment and instrumentation, which is carried out in less than two days at many Devco operations.

A wet forming unit (or priller) has an easy start-up and shut down procedure. The unit can be started and stopped in less

than five minutes. The flow of sulphur is cut on and off in plants that run in batch operations during the day, as needed. The unit can be stopped and restarted throughout the day with no ill effect. The unit also is able to achieve a 4:1 turndown (or greater) by isolating the flow to individual forming trays in the unit. As a result of this operational flexibility, some Devco II units operate at a maximum capacity for a period of time then the unit is shutdown, when sulphur is available the unit is put back into operation. This enables the process facility to easily flow with production needs.

The Devco II system has innovations that have led to greater operational flexibility in field operations. Due to design innovations for the process water handling systems, there is no need to perform secondary chemical treatment for process water acidity. There is no significant residence time of sulphur in the process water, which also leads to finished product without high acidity (as is a problem for units that operate under old and outdated designs).

The Devco II unit also has the ability to operate through detailed PLC controls and monitoring which can greatly simplify operations for the facility operations staff. Finally, the Devco II unit has proven in the field that it can maintain operation, even in the presence of high H₂S in the molten sulphur.

Optimum product

Wet formed sulphur has always been the standard for safety and environmental quality. It is the only process technology which can meet the stringent Californian South Coast Air Quality Management District Rule 1159 (Storage, Handling, and Transport of Coke, Coal and Sulphur; c.20). This is easily understood in seeing that wet formed sulphur with a given moisture percentage would easily retain any dust particles produced during normal handling. Also, it is obvious that wet sulphur would be much more difficult to ignite.

Of course, there is a constant battle between safety and commercial considerations. While sulphur at 5% moisture would be extremely safe, it would also carry an unfavorable commercial impact (as one would be shipping and burning off excess water at the customer's acid production location). Devco (and its customers) feel that a 2% average level meets both safety needs, contractual requirements (typically set at 2% or higher) and China's national sulphur standards. The Devco II unit has the field proven ability to consistently produce the necessary moisture level for the unit's environment (Table 1).

An important consideration is that formed sulphur moisture percentage should always be viewed as loaded to vessel (the typical contract sales point) rather than at the end of the production line. If product is produced "dry" and then stored outside and covered in dust control surfactant and even sprayed with water while loaded – what benefit was there in making it dry in the first place?

Capital savings

Wet prilling units have long been understood to be the most capital friendly technology, even by parties who choose other methods to form sulphur. This comes from a variety of factors, including the aforementioned simple process design with minimal mechanical equipment. In most climates where sulphur production takes place, there is no need for a process building. The unit can operate outdoors, saving not



*Devco II sulphur forming tank
– simple process flow with
minimum moving parts.*

PHOTO: DEVCO USA

only on the building material but also the necessary safety equipment required for an indoor sulphur operation and increased maintenance cost.

Wet formed sulphur is stored outdoors, all over the world, from locations as diverse as Central Asia to desert climates, to rainy climates like Vancouver, BC. The low dust environment surrounding the product enables safe outdoor storage in environmental sensitive areas like Los Angeles, CA to the Puguang Gas Plant in Sichuan Province, China.

Devco technology utilises specific key design and engineering methodology that both lower cost and ensure ease of installation. During fabrication all equipment goes through a trial fit erection. This has proven to greatly reduce fit-up problems in the field, and lower installation costs.

The Devco II unit is a very low energy consumer, for a variety of reasons. Their unit has the highest throughput for any commercially available technology (2,300 t/d per unit) which means the maximum use from each sulphur and water pump online. Less moving parts also have a great impact in this area as well.

Another key factor which was important to the end user was the lack of need to precondition the temperature of the molten sulphur before forming. The Devco II unit can accept a temperature range of incoming sulphur from 125°C to 145°C and still meet all process and product guarantees.

This has a positive impact on both capital and operational expenses.

Other key utility savings are achieved by reduced steam consumption through PLC control and reduced power consumption with VFD pump control via PLC.

Commercial

Sulphur processing facilities that operate near the coast have an obvious advantage over facilities which need inland rail (or truck) transport to meet the world market. The Puguang facility requires inland transport to reach its customers, with this reality it was a key consideration to use a process technology which would have the lowest possible ongoing operational costs for the future.

In a market where prices have been as high as \$800/t and as low as \$5/t, there is a clear need to have a precise control on the operational costs of the production. With low OPEX costs, the ability to handle an environment with a negative net-back is much greater.

The Devco II equipment achieves this by requiring a very low level of operators per tonne of sulphur production. For a single tower with a 2,300 t/d capacity, Devco recommends one experienced operator and one general operator (for safety backup). Devco believes this clearly achieves the lowest operations costs per tonne of sulphur formed among any technology.

In conclusion the key considerations for the choice of a sulphur forming technology will include a thorough consideration of the possible operational flexibility, finished product quality (as loaded), capital costs and any commercial impact of the finished product.

Table 1: China National Standard for Sulphur for Industrial Use GB/T 2449-2006

| Mass fraction of water, % | Premium Class | First Class | Applicable Class |
|---------------------------|---------------|-------------|------------------|
| Solid Sulphur | 2.0 | 2.0 | 2.0 |
| Liquid Sulphur | 0.10 | 0.50 | 1.00 |



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