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# Tenke Fungurume looks to the future with second acid plant



By: April Kabbash, Editor, *Sulfuric Acid Today*

**T**he Democratic Republic of Congo (DRC), deep in the heart of Africa, is home to some of the world's largest known copper deposits. Tenke Fungurume Mining (TFM), located in the Lualaba Province, is one of the country's largest copper producers, as well as the world's premier producer of cobalt. The facility, which includes surface mining, leaching and SX/EW operations, currently produces 205,000 metric tons of copper and 16,000 metric tons of cobalt each year. As capacities increase, so do the demands for sulfuric acid, an important component in processing the ore. After the successful installation of the site's first sulfuric acid

plant in 2009, increasing capacities led to higher demands for acid. Always looking ahead, the company quickly realized the benefits of adding a second, larger acid plant, which came online in the first quarter of 2016. This addition brings the company's investment in the area to over \$3 billion so far, representing one of the largest private investments in the country's history.

## History

The Tenke Fungurume deposits are located within concessions totaling over approximately 600 square miles in the Lualaba Province of the DRC, about 110 miles northwest of Lubumbashi,

the republic's second-largest city. In the southeastern section of the country, the area was first explored in 1917 by Union Minière, a Belgian mining company that was later succeeded by La Generale des Carrieres et des Mines (Gecamines), with drilling beginning in 1919. The Mobutu government nationalized the project in 1969. A private/government consortium, Societe Miniere du Tenke Fungurume, then made an investment of \$280 million. In 1996, TF Holdings Ltd. (TFH), a subsidiary of Lundin Group, acquired majority interest in the project through a public tender process. Tenke Fungurume Mining was formed for the purpose of

developing the deposits of copper, cobalt and associated minerals.

Today, Freeport-McMoRan Inc. owns 56 percent of Tenke Fungurume Mining; Lundin Mining Corp holds 24 percent; and Gecamines, which is wholly owned by the government of the Democratic Republic of Congo, owns 20 percent.

The Tenke Fungurume deposits are sediment-hosted copper and cobalt deposits with oxide, mixed oxide-sulfide and sulfide mineralization. The dominant oxide minerals are malachite, pseudo malachite and heterogenite. Important sulfide minerals consist of bornite, carrolite, chalcocite and chalcopyrite.

Aggregate reserves total 99 million metric tons (mt) of ore at 3.19 percent copper and .37 percent cobalt with recoverable metal amounting to 7.2 billion pounds of copper and .9 billion pounds of cobalt.

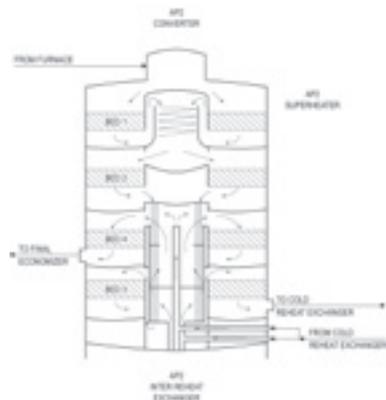
## Adding acid

The next logical step in streamlining production at TFM was the addition of on-site sulfuric acid manufacturing. The facility's first acid plant, AP1, was brought on-line in 2009 with a capacity of 600 metric tons per day. Before that, TFM was importing all of its acid from other locations. The original acid plant met some, but not all, of the facility's needs, even after a de-bottlenecking of AP1 in 2012, which increased annual acid production name plate capacity to 825 metric tons per day. While this was an improvement, it still didn't provide all the acid necessary for the facility. "TFM's acid requirements are constantly increasing with the mining of ores with higher copper content," said Daudet Zeka Songesa, acid plant superintendent at Tenke Fungurume. "Producing acid at the site to meet this increased demand is more economical than purchasing and transporting sulfuric acid to the site, with an improvement in acid availability. As an additional benefit of this project, the number of acid trucks on the road will be reduced, improving the safety and environmental impact risks in the region." So, planning began for a second, larger acid plant.

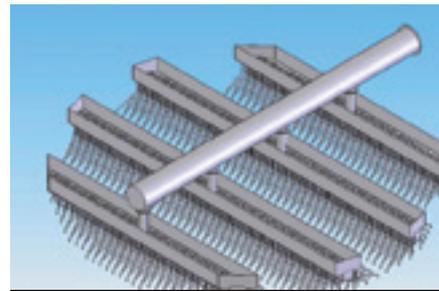
After the successful integration and operation of AP1, there was no need to reinvent the wheel when planning AP2. "We built on our success with the first acid plant, creating the second on a larger scale," said John Wellington, Tenke Fungurume's acid plant manager. A formal and systematic "lessons learned" session was conducted during the feasibility study phase of AP2. Key project team members met to review all aspects of the design and generate ideas on what could be done to make AP2 better than AP1. "While AP1 was a very successful project, improvements can always be made," said Wellington. "Several beneficial changes came out of the sessions, including changes to the plant layout to incorporate recommendations from the operators and an upgrade in the DCS system with an improved interface."



As with AP1, Saramet alloy acid towers were prefabricated, trucked in and lifted into position.



This schematic of the AP2 converter shows the inter-reheat exchanger.



In the ISO-FLUX trough distributor, acid flows from the main header to the bottom of the trough. It then flows up via a series of calming plates which also filter out debris. Choking of flow orifices through the downcomers is virtually eliminated.



The Tenke Fungurume facility will produce all the sulfuric acid it needs onsite, with the addition of AP2.

Layout changes included increasing the size of platforms around the front end of the sulfur furnace, in the area where sulfur guns are changed, to allow for better access. The DCS interface upgrade helped simplify things, while still providing all the vital information. "The DCS screens were revamped to enable operators to see the "core" of the acid plant in only two screens," said Chemetics Sales Manager for Sulfuric

Acid, Herbert Lee. "This means it is easier to keep track of all the critical operating parameters at a quick glance."

One new feature for AP2 is a continuously operating caustic scrubber that increases recovery of SO<sub>2</sub>, reducing emissions to less than 20 ppm. AP2 will also include a power cogeneration plant, with a nameplate capacity of 20 MW, which is expected to come online in



The prefabrication of the acid towers saved the TFM team time and money.

March. The power produced will be used to reduce the overall power demand from the grid and greatly improve reliability.

Chemetics, with their depth of knowledge and cutting edge technology, was brought on board in the early days of the project. As with AP1, Chemetics provided the core detail engineering for the acid plant and supplied key proprietary equipment.

"Our project team focused on leveraging proven experience from the first acid plant project and developing new innovations to improve reliability and capital costs for the second plant, which has twice the capacity," said Songesa.

The Chemetics-patented, all-stainless converter featured a modularized design, instead of the conventional "field erection" approach. The converter was shipped to the site in prefabricated modules after being trial fit in the shop, significantly reducing cost and improving the overall quality of the fabrication. "Site assembly was significantly simplified using a small crew compared to the traditional "field erection," said Lee. "The final quality of the converter is also better as most of the welding is done in a controlled shop environment." An internal steam superheater and inter-reheat exchanger are located inside the core of the converter to eliminate hot gas ducting between beds 1 and 2 and beds 2 and 3.

The acid towers, acid distributors, and strong acid piping incorporated proven Chemetics' Saramet™ sulfuric acid alloy. To minimize welding on site and avoid the associated quality risk the acid towers were supplied to site completely shop fabricated. The acid distributors feature complete modular bolted assembly and the Saramet acid piping was supplied in prefabricated spools suitable for shipment to site in standard shipping containers, further minimizing installation costs and optimizing schedule. The newest generation of ISO-FLUX™ trough distributors was installed in the acid towers to minimize packing chips fouling while reducing the total number of parts, simplifying installation and maintenance.

The sulfur furnace was also completely prefabricated before being shipped to the site. Chemetics' design features individual combustion air control to each sulfur gun for optimal air-sulfur mixing. This design also requires no internal baffle walls.

Chemetics also played vital roles in commissioning and start-up training services throughout the project. TFM currently employs approximately 3,400 people, a number that is not expected to change with the new plant. "We are not planning to hire any additional people to operate the acid plant," said Wellington, "but rather be more productive at the current manpower level." Ninety-eight percent of TFM's employees are DRC



The Chemetics-designed sulfur furnace was built offsite.



The furnace provides optimal air-sulfur mixing with no internal baffle walls.



AP2's stainless steel converter was assembled from prefabricated modules, simplifying installation.

citizens, making the company one of the largest employers in the region.

## On the fast track

The quick time frame of the project, along with the location, presented a unique set of obstacles for the team. The fast-paced project, which at \$245 million came in below the original budget, took approximately 24 months from feasibility to start up. Commissioning of AP2 was very successful due to a combination of an adaptable and flexible commissioning team made up of FMI, TFM, Chemetics and Hatch employees as well as the robust proven design of AP2 that allowed the TFM operators to easily transition to the new plant. First acid was made in early February and the plant had already exceeded nameplate capacity of 1,400 metric tons per day within less than three weeks.

"This was a fast-tracked project that involved coordination of project personnel from several different companies,

including Freeport-McMoRan, TFM, Chemetics and Hatch, who were located in very different time zones," said Songesa. "We had to find ways around that, to avoid slowing down the process."

Several members of the Freeport-McMoRan project team were moved to South Africa to reduce inefficiencies associated with extreme geographical and time zone differences, as well as to ensure purchasing, logistics and shipping issues could be dealt with quickly. Having them closer to the site avoided lag time and helped move the process along. All key project team members also attended frequent design review meetings to ensure all parties were on the same page.

Transportation of equipment within the DRC was another challenge. Ground transportation in the DRC has always been tricky. The terrain and climate of the Congo Basin present serious barriers to road and rail construction, making shipping of large, heavy equipment very difficult. These difficulties were overcome by ordering long-

lead equipment quickly and optimizing equipment design to fit within the shipping limitation, taking advantage of modular pieces whenever possible.

## Dedicated to environmental, community improvements

At Tenke Fungurume, safe production is the most important factor in the company's success, and everyone shares responsibility for safety, both in and out of the mine. "TFM is committed to managing the mine in a way that benefits the local community, promotes good governance, respects local culture, minimizes disruption to the ecosystem and supports the evolution of the country toward sound mineral development," said Songesa.

The company has also made significant investments in community development ranging from education and agriculture to healthcare and infrastructure development. Since 2006, TFM has funded a total of \$120.4 million in community development projects. Additionally, since the commencement of commercial production, TFM has set aside 0.3 percent of net metal sales revenue to fund the TFM Social Community Fund. Since the commencement of production, contributions committed to the fund have totaled \$23.6 million. Both TFM's direct community

development and TFM Social Community Fund projects are focused on supporting sustainable development of the concession communities by investing primarily in education, healthcare, infrastructure and agriculture.

TFM was the proud recipient of two significant awards at the 2015 iPAD DRC Mining & Infrastructure conference in Kinshasa, winning recognition as both Mining Company of the Year and Best Performer in Environmental Management. These just highlight the ongoing commitment the company has made, both to its employees and the region.

## Looking to the future

While Tenke is currently producing more copper and cobalt than ever before and serves as a major employer and

support for the entire region, the company refuses to simply rest on its laurels. The addition of the facility's second sulfuric acid plant should help it reach new heights in the coming years, while also cutting costs. "Production of acid from AP2 allows processing of higher acid-consuming ore, and it is anticipated to provide an improvement to copper and cobalt production due to the certainty of acid supply at an improved operating cost compared to importing acid," said Wellington. In addition, TFM continues to engage in exploration activities and metallurgical testing to evaluate the potential of the highly prospective minerals district at Tenke Fungurume. According to Songesa, "These analyses are being incorporated in future plans for potential expansions of production capacity, which could exceed 1 billion pounds of copper per year." □



Team members celebrate the first acid production from the new plant.



Tenke Fungurume is one of the largest copper producers in the Democratic Republic of Congo, producing 205,000 metric tons per year.