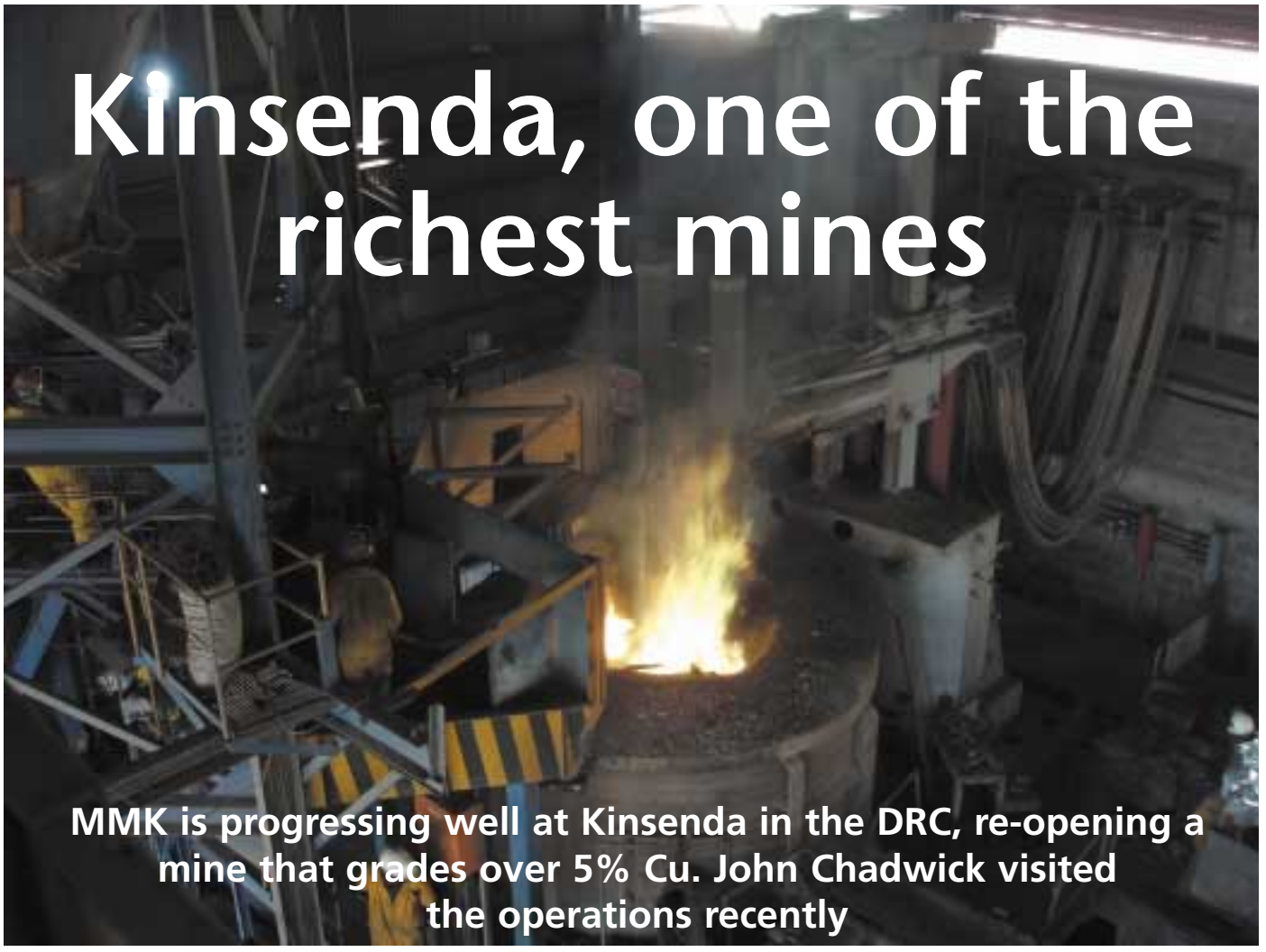


Kinsenda, one of the richest mines

MMK is progressing well at Kinsenda in the DRC, re-opening a mine that grades over 5% Cu. John Chadwick visited the operations recently

Immediately across the border from Konkola in Zambia is the concession area where Minière de Musoshi et Kinsenda (MMK) is dismantling half of the 5,000 t/d Musoshi mill and building a new concentrator at Kinsenda mine where MMK is dewatering one of the world's highest grade, currently known, copper mines – 5.1% Cu! By 2008, MMK should be treating around 1.2 Mt/y of ore, yielding 56,000 t/y of copper.

MMK is held 75% by Copper Resources Corp (CRC), 20% by state-owned SODIMICO and 5% by the Forrest Group. In turn, Forrest owns 40% of CRC. Groupe George Forrest (GGF) is the largest private business in Katanga and one of the largest in DRC with extensive diversified operations in mining and mine contracting, engineering (it is building the new Kinsenda concentrator), construction and cement. GGF has operated for over 80 years in the DRC and has extensive local operational and management experience to support and facilitate the development of MMK's properties. It was a Forrest Group company, Enterprise Generale Malta Forrest (EGMF), back in 2002 that initiated this rebirth. MMK through its Forrest connections and its proximity to the Zambian border enjoys more stability than most other companies operating in the DRC.

The Kinsenda and Musoshi mines were started in 1968 by a Japanese mining consortium, operating to 1983, then by Canadian management on behalf of the government from 1983 to 1987, and subsequently by Sodimico, a Congolese state mining company. Historical production from Kinsenda totalled some 4.9 Mt at 5.12% Cu. Mining at Musoshi, in the Konkola dome, began in 1972, when the concentrator started up as well. Its peak was 1.67 Mt of ore grading 2.5% Cu in 1976. The average head grade from Musoshi, between 1972 and 2002 was 2.29%. It is 6 km long on strike and 550 m deep. Mining was by room and pillar, with some sub-level caving. Some 40 km away, mining at Kinsenda started in 1977. Its peak was 410,000 t of ore at 5.93% Cu in 1984 and it averaged 5.12% Cu between 1977 and 2002. ***IM*** went underground at Kinsenda and was very impressed by some of the huge stopes (cathedral like), left standing with little roof problem.

The geological reserves of Musoshi amount to 24 Mt at 2.4% Cu, while those of Kinsenda are 17.1 Mt at 5.1% Cu. MMK considers a recovery of 72% of these geological reserves to be a fair estimate to take account of the losses in the room and pillar mining method to be used. There is also the large (45.5 Mt of ore) Lubembe exploration project, which is a deposit similar in style to, and 24 km from, Kinsenda, grading 2.2% Cu. This project, southeast of Kinsenda and part of the Kafue dome, requires additional drilling.

The 4.5 MVA furnace at Musoshi is charged with 30% Cu concentrate, coke (100 kg/t of concentrate), limestone flux (500 kg/t) and iron ore (125 kg/t) used to melt and fluidize the slag.

Within the Musoshi concession there is also a very large and important iron ore deposit, 15 km in length. A reserve evaluation, that excluded areas of grades lower than 20-25% Fe, showed an average grade of 55-60% Fe (up to 65% in parts) and a total volume of over 176 Mt.

The MMK project area has extensive infrastructure including roads, water, staff accommodation and power. The power infrastructure includes a 110 kVA line to both Kinsenda and Musoshi. There are also substations at both, with back up

Musoshi was abandoned, but was kept in good condition

generators. This infrastructure was still in very good condition when MMK moved in; many of its employees having kept things well cared for even after Sodimico had basically abandoned the properties.

The first thing that MMK did was to install an arc furnace at Musoshi to treat ore stockpiles and purchased concentrates. This furnace produces some 230 t/month of copper matte (95% copper content). It was commissioned in 2005, before CRC became involved, and started generating cash flow for royalties to Sodimico so that a start could be made to recompense employees owed years of back pay. This task will continue with revenues from Kinsenda. The furnace also created worthwhile jobs at the deserted Musoshi site, and its early cash flows allowed the rehabilitation of drinking water and electricity to local villages and the employee's township, and provided subsidies for the local hospital at Muhona.

It was the President of the DRC, Joseph Kabila himself, who first asked George Forrest to help with the rehabilitation of Musoshi, as a social project to help the displaced workforce of the region. This job has now been done, but with the upturn in the copper market, so much more has come out of that early approach.

George Forrest has a strong social concern for the people of Katanga and he has done a great deal for them. Typical of the man, when he met with ***IM*** in Lubumbashi, he explained that one of his cement companies had been selling cement cheap to help with reconstruction. It was, he said, "a decision I took and my board was not happy." Similarly, he explained how he had been helping finance some small scale miners' projects through the International Labour Organization. He notes that "the group's technical expertise, economic know-how and socially responsible approach are the cornerstone

of its success and the best guarantee of its future."

Prioritizing Kinsenda

Fairly obviously, because of its high grade and relative ease of access, Kinsenda is the priority and last November dewatering of the mine reached the depth of 209 m. Thus CRC has completed the most difficult portion of the dewatering programme and work began on installing the permanent pumping station planned for this level. With the availability of this pump station and easy access, the next stage of dewatering to 285 m is substantially easier and was expected to be completed by February 2007. At 285 m, the level at which previous mining stopped, the dewatering programme will be complete, a second permanent pump station will be installed, and normal operational pumping and mine development will commence.

Chris Jordinson, CEO of CRC, stated, "With dewatering successfully reaching the 209 m level, the main dewatering risk on the Kinsenda mine has been removed, which is an important milestone for this project."

Construction of the 100,000 t/month Kinsenda processing plant involves the relocation and refurbishing of parts of existing concentrator equipment from Musoshi (here) and adding new equipment where required.

MMK is purchasing jumbos, LHDs and trucks to mechanize the development of the Kinsenda mine. In mid December, the company ordered an Atlas Copco fleet for Kinsenda comprising six MT 2010 trucks to be loaded by two ST1030 Scooptrams. The order also includes two RB 281 face jumbos. The management has decided to continue with the previous conventional mining method of room and pillar extraction using scraper winches, considering them to be the best initial ore handling machines on this inclined orebody. An underground crusher and a conveyor system are to be installed, the latter bringing ore to surface. The mine is accessed by three inclined shafts, with rail conveyances, and a vertical shaft.

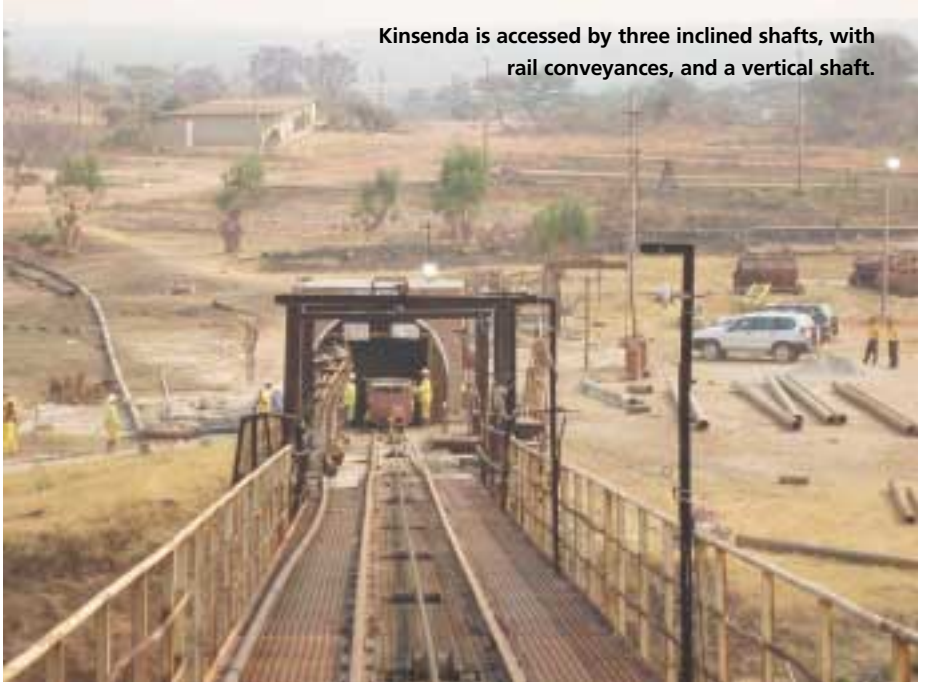
Construction of the 100,000 t/month Kinsenda processing plant began in July 2006. It will treat 1.2 Mt/y of ore at an anticipated head grade of 5.1% Cu to produce, at full capacity,

54,000 t/y of contained copper in the form of a rich, +40% concentrate. The estimated plant cost is low because it involves the relocation and refurbishing of parts of existing concentrator equipment from Musoshi and adding new equipment where required.

Mineral Engineering Technical Services (METS) completed the Kinsenda feasibility study, based on MMK's pre-feasibility study and on some of its own previous work. It concluded that operations at Kinsenda could be restarted within 18 months at an estimated capital cost of $36 million. Of that total, $23 million is for the concentrator.

The projected financial return to CRC is highly favourable with an estimated IRR of 95% and NPV of $143 million, at an assumed long-term copper price of $1.25/lb and a discount rate of 10%. The high financial rate of return reflects the extremely high grade of Kinsenda's reserves coupled with the project's low capital costs. The feasibility study assumes an average cash operating cost of $0.68/lb.

In the feasibility study METS developed a revised flowchart and recommended that the concentrator include SAG milling with process control as an alternative comminution circuit, which would have the benefit of simplifying the processing circuit and reducing the capital expenditure as well as operating costs. In fact, MMK elected to order an AG mill, 4.88 m in diameter and 9.14 m long. This is preceded by a Vecor crusher and followed by two ball mills for regrinding.



Kinsenda is accessed by three inclined shafts, with rail conveyances, and a vertical shaft.

MMK intends to develop and construct a metallurgical plant at Kinsenda as soon as possible, perhaps a year after the concentrator is commissioned. This will add value to the concentrate, create more employment and reduce export costs.

The known reserves of the Kinsenda deposit contain 840,000 t of copper, which will permit 13 years of operations at full capacity. However, the mine is open at depth and additional drilling is expected to yield more proven resources that will extend the life of the mine considerably. MMK has an exploration target at Kinsenda, offset to the current known orebody, that has the potential to double the mine life. ***IM***