KOMBAT COPPER PROJECT, NAMIBIA
PLANT REFURBISHMENT FEASIBILITY

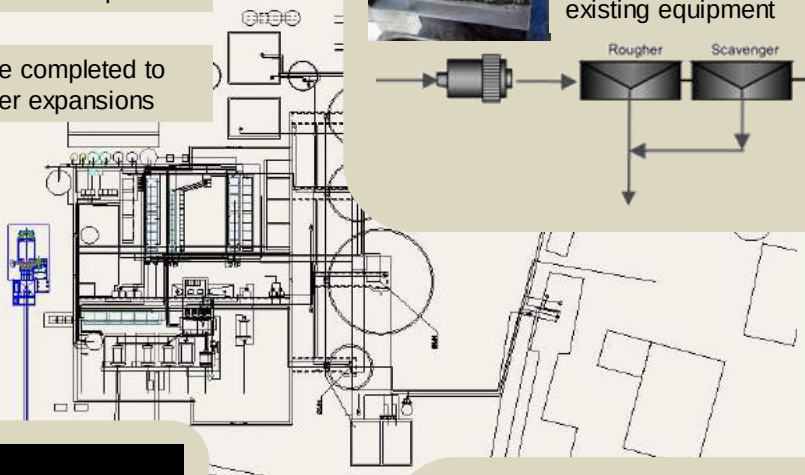
PROJECT DESCRIPTION

The Kombat Copper processing plant was commissioned in 1961 with a capacity of 35 ktpm consisting of a three-stage crushing, rod and ball milling, flotation, concentrate thickening and filtration circuits. The mine operated up to 2008 when it was placed on care and maintenance. Kombat is currently owned by Trigon Metals Inc. who are anticipating restarting operations.

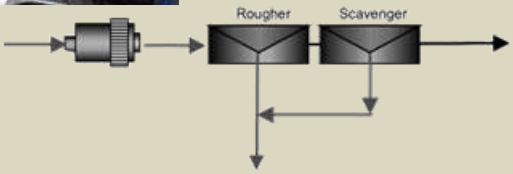
MINXCON INVOLVEMENT

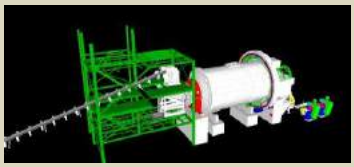
INFRASTRUCTURE drawings and designs were completed

Designs were completed to allow for later expansions



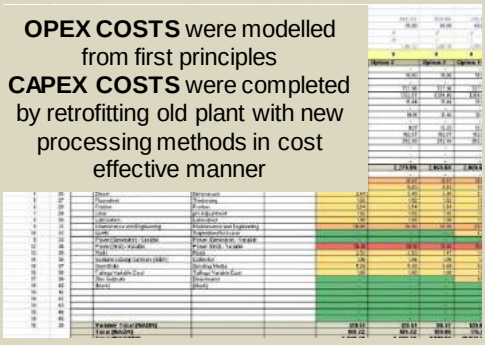
Established a **METALLURGICAL TEST** program. Results were used to optimise the flotation processing methods using existing equipment

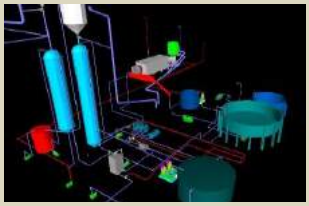




Mill Modelling and Design

OPEX COSTS were modelled from first principles
CAPEX COSTS were completed by retrofitting old plant with new processing methods in cost effective manner





Pump and Piping Designs

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Minxcon was mandated to complete a Technical Feasibility Study on the plant to determine the engineering requirements for recommissioning the plant. The envisaged plan was to initially treat open pit at throughputs of 35 ktpm followed by underground ore at 60 ktpm. The plant would therefore require two distinct stages of engineering works over the life, namely, refurbishment of the existing circuit to process the open pit material, followed by a capacity expansion prior to underground mining.

Together with determining the plant refurbishment requirements, Minxcon completed process and engineering designs for the expansion. The engineering design philosophy hinged on utilising as much of the existing infrastructure and equipment as possible to ensure optimised capital spend.

The first stage of the project entailed a review of the plant to determine equipment condition, capacities as well as suitability for the new Kombat operation. The availability of spares and second-hand equipment from nearby operations was also investigated. A conceptual flowsheet and process design criteria were developed as a baseline to identify any areas of concern.

With some minor upgrades and modifications, it was established that the existing crushing and milling circuits are suitable for recommissioning of the plant. Conversely, significant modifications would be required to the flotation circuit. Alternative or updated flotation methods were therefore sought.

Part of the challenge in reviewing the comminution circuit was determining the crushing and grinding aspects from historic production and metallurgical information. Determination of the bond work index was never completed.

Milling Circuit, Kombat Plant

As a result, Minxcon had to infer a range of work indexes in order to determine the capability of the existing comminution circuit as well as the requirements for the milling circuit expansion. Historical production information was used to verify the throughput capacities of the existing circuit as well as for design parameters for the mill expansion.

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Referring to the figure below, a fit-for-purpose stand-alone ball mill circuit was designed and retrofitted with the remainder of the plant.

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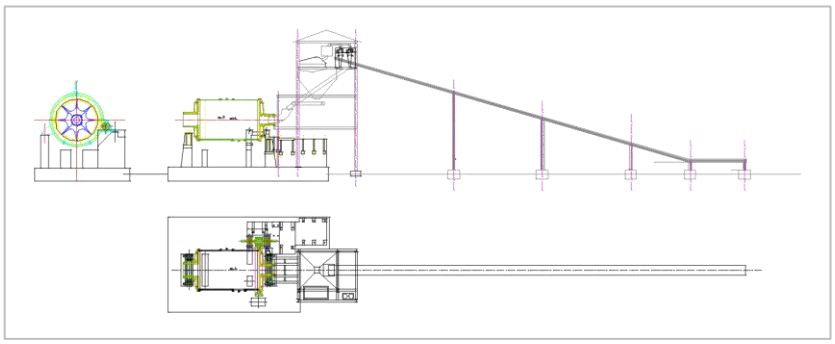

Additional Ball Mill as part of the Plant Expansion, Kombat Plant

All designs were completed in-house by Minxcon engineering personnel

The dated flotation circuit (figure below) was capable of producing separate copper and lead concentrates. The circuit was designed with two flotation circuits to first float the sulphides and then the oxides. More modern flotation methods and advancements in reagents now allows one to float the oxides and sulphides together. A successful laboratory testwork campaign was established by Minxcon which verified that the oxides and sulphides can be floated together to produce a sellable copper concentrate.

Testwork programme managed by Minxcon indicated that a sellable copper concentrate can be produced by floating the oxide and sulphides together

Flotation Circuit, Kombat Plant

Minxcon opted for a single flotation circuit consisting of roughers, scavengers, cleaners and recleaners. Detailed mass balancing was completed to assist in redesigning the pipe and pumping infrastructure for the milling, flotation and downstream processes.

Drawing from Minxcon's operational experience, another important aspect which was given focus was that of process control. Instrumentation was included to allow for automated control in critical areas. These included mill discharge cyclone feed control to assist in maintaining steady cyclone operation. Furthermore, basic float cell level control will be possible as Minxcon included level probes and float cell pneumatic dart valves. The instrumentation will be monitored and controlled by a central programmable logic controller over a simpler control network.

A sound solution was proposed based on process engineering and design principles that utilise well-proven and understood technology. The Feasibility Study outcome is a low-capital fit-for-purpose plant that is well suited for the Kombat Mine.