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SubCom® Case Study: Compania Minera Cerro Colorado - Heap Leaching Copper Project

bhpbilliton
Cerro Colorado

Year Completed: 1995

Deliverables: 10 MM BTU/hr raffinate solution heater

Project Overview

In 1995 Inproheat supplied a 10 MM BTU/hr raffinate solution heating system for a copper mine near Iquique, Chile operated by Compania Minera Cerro Colorado, a subsidiary of BHP Billiton Ltd. This copper mine is situated in a remote location at 2,500 meters elevation above sea level. A two hour drive east from Iquique takes a visitor deep into the mountainous barren landscape. Ore from the open pit mine is reduced in size by the crushing plant comprising of primary, secondary and tertiary crushers.

Crushed ore fines are sent to agglomeration where marble-size to golf-ball-size ore nodules are formed. Nodules and crushed ore are conveyed to heap leach pads where they are stacked in 50 foot lifts. Raffinate solution is continuously distributed over the heaps through piping systems and leaches copper and other minerals as it percolates down through the heap. The resultant Pregnant Leach Solution (PLS) is then collected at the bottom of the pads and pumped to the solvent extraction plant for copper recovery. The extracted copper is converted to high purity copper metal by an electrowinning process.

Acid leach solution from the solvent extraction process is heated from 15° to 35°C before it is recirculated to the heap leach pads. The primary source of energy for the mine is No. 2 diesel fuel. Propane is available in limited quantities.

The Challenge

CCMC wanted to provide some heat to the raffinate applied to the leach pads during winter to improve production. Low winter temperatures due to the high site elevation retards the leach kinetics.

Raffinate is the value-depleted solution from a solvent extraction process. In the copper SX-EW (solvent extraction – electrowinning) process, it is a mild solution of sulphuric acid and metals with a pH of between 1.2 and 2.0 and may contain chloride ions. An investigation of proper materials of construction for the system was required for the combustion chamber, solution tank, piping and valves.

Inproheat's experience with existing SubCom® installations was limited to gaseous fuels. The utilization of No. 2 diesel fuel had to be investigated.

The location of the site at 2,500 meters (8,250 ft) above sea level elevation had to be taken into consideration when specifying and designing the combustion system components.

The unit was to be located outdoors and capable of automated operation with remote start/stop from the control room.

The requirement for high efficiency is dictated not only by economics but also by the logistics of trucking diesel oil to a remote mine location high in the mountains.

The Solution

Inproheat designed and manufactured a 10 MM Btu/hr submerged combustion system for raffinate heating. Metallurgical studies were undertaken to establish best material for the combustion chamber. Carpenter 20Cb-3 alloy was selected for all combustion chamber components.

The tank, vent stack and piping was made of fiberglass using an acid resistant Derakane 411-45 resin.

To handle corrosive raffinate Inproheat selected Durco valves and a pump with CD4MCuN alloy wetted components. Propane was used as fuel for the burner pilot and #2 diesel oil as the main burner fuel.

The unit was skid-mounted, prepackaged and prewired including the heating tank, submerged combustion burner, combustion air blower, propane pilot fuel train, diesel oil main train, inlet water shutoff and control valves, discharge pump, and control panel. The fiberglass vent stack was shipped separately. CMCC provided raffinate inlet and outlet connection and fuel supply. Raffinate is fed by gravity from a large storage tank adjacent to the heating system. An inlet control valve maintains the liquid level inside the heater. On the discharge side, a centrifugal pump removes heated raffinate from the heater. To address the technical uncertainties of the project Inproheat decided to simulate system operation with water at the factory prior to shipment. The system was tested for approximately 2 weeks. A 50 Hz generator was rented to match the frequency of power supply in Chile. A cold water supply of approximately 130 USgpm was connected to the heater, and high altitude operation simulated by restricting the inlet to the combustion air blower.

Initially, a problem was developed with self-generation of waves in a round-domed fiberglass tank. This problem was quickly resolved by addition of wave attenuating baffles inside the tank. Performance of diesel oil burner exceeded expectations. Initial concerns of potential oil residue in the raffinate were alleviated by water discharge quality tests. All system functions and performance were tested before shipment to Chile.

Inproheat commissioned and started the system up In November 1995. A number of combustion tests were conducted.

The raffinate discharge temperature was set at 35° C, with stack temperature between 34° and 36° C. the resulting overall system efficiency was calculated at 93% of the diesel oil higher heating value, with US$ 12/hr savings compared to a conventional boiler / heat exchanger system. The successful system operations resulted in a repeat order. A second identical submerged combustion raffinate heater was installed at CMCC and commissioned in July 1996.

REQUEST INFORMATION:

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