STEEL FROM COPPER SLAGS

A significant step toward the completion of plans for one of the largest steel mills in the Pacific Northwest was made with the initial prototype run at Strategic Materials Corp's pilot-plant at Niagara Falls, Ontario, Canada. The operation utilized a modification of the Strategic-Udy process to produce steel from waste copper slags.

by E. J. Fitzgerald

Utilizing a modification of the Strategic-Udy process, already applicable for low-grade manganese and iron ores, it is possible to produce steels from heretofore waste copper slags. This was demonstrated by a test run at the Niagara Falls, Ontario, pilot-plant of Strategic Materials Corp., which produced approx 200 tons of steel from 700 tons of Anaconda copper slag. Availability of copper slags should make the process significant, for besides the 40-million ton slag pile at Anaconda, Mont., and 30-million tons at Clarkdale, Ariz., there are two other major deposits in the US alone.

The pilot-plant is to be used as a prototype for a $30-million plant on which construction is expected to begin in the very near future. This plant, which will be located adjacent to the Anaconda smelter, is expected to produce 1000 tons of steel per day from hot slag, with fluctuations in demand to be met by the utilization of cold slag.

Webb & Knapp-Strategic Corp.—owned jointly by Webb & Knapp, Inc.* and Strategic Materials Corp.—has already contracted the Bonneville Power Administration to supply the necessary power starting July 1, 1963; the firm has also agreed with Anaconda to purchase the slag at 25 cents per ton. In addition, Webb & Knapp owns the 30-million ton slag dump at Clarkdale, and plans a similar operation there as described in the December 1959 issue of the JOURNAL OF METALS.

Slightly less than 3 tons of slag are required to produce a ton of steel. The Anaconda slag contains 33-37 pct Fe, 0.7 pct Cu, 2 pct Zn, with the remainder silica and traces of other metals, while the Clarkdale slag contains about 33 pct Fe, 0.5 pct Cu, and 2 pct Zn.

Considerable amounts of power are required for the operation; hence, the Aanconda site appears superior to Clarkdale from an economic point of view. Preliminary geological surveys have ascertained that adequate ground water and fluxing limestone are available near the Anaconda location. This is important because the process requires more than 2 tons of lime per ton of steel produced.

A feature of the process is that it is amenable to the utilization of a wide variety of coals as a reducing agent in the first electric furnace. Although the pilot test was run with a medium quality coal, lignites are expected to be used in subsequent tests.

Substantial amounts of iron pyrites are required for the process. Forecasts indicate that the Montana operation will require 50,000 tons of this material per year.

The 25-tpd pilot-plant flowsheet consists of a 20-ft gas fired rotary kiln and three 1000 kva electric furnaces. Processing the slag differs from Strategic-Udy's low-grade ore operation in that the kiln is used only to preheat and calcine the limestone rather than for pre-reducing the charged material. The kiln utilizes the CO-rich gas from the electric furnace to supply the necessary heat.

Preheated lime is charged with copper slag, pyrites, and coal into the electric matting furnace. During the operation, zinc volatilizes from the melt and is collected as zinc oxide. A majority of the copper and some iron form a copper-iron matte containing 16-17 pct Fe and 4-5 pct Cu at the bottom of the furnace. In addition, a copper-free iron-silica slag is formed. Copper-iron matte is tapped periodically through the lower tap hole. This matte can be either sold directly or given further treatment. If it is up-graded, the recovered iron can be fed directly into the smelting furnace.

In the second furnace, the smelting furnace, the iron-silica slag, containing 0.30-0.35 pct Cu, is refined to a *semi-steel* by the addition of coke and lime. Although this metal could be considered a pig iron, its 1.00-1.25 pct C would indicate that semi-steel is more descriptive. After refining, the semi-steel contains about 0.12 pct P, 0.3 pct S, and a nominal amount of silicon. The *slag-slag,* which forms during the smelting operation, is skimmed off, and then the metal is transferred to the 3-ton, 1000-kva steelmaking furnace.

The following table illustrates the amount of raw materials necessary to produce 1 ton of steel and the various by-products produced:

Raw Materials, lb	Products, lb
Slag, 5500	Steel, 2000
Limestone, 4700	Slag-Slag, 5000
Coal, 600	Zinc oxide, 150
Iron pyrite, 440	Sulfur, 150
	Copper, 25

While all economic considerations have not yet been completely resolved, it appears that the process could be an important development in the economic production of steel. A Strategic process plant, using waste slag or low grade ore could, it is claimed, be built for under $50-million and be economically feasible for a market area where economics and raw material conditions do not justify a major complex.

* It was announced later that Webb & Knapp, Inc. has transferred its interests in the project to its subsidiary, Gulf States Land & Industries, Inc., in a move that will substantially re-orient and expand the activities of Gulf States Land & Industries.