Progress Report on Roasting Copper-Cobalt Concentrates

by L. F. Theys

A previous paper[1] dealt with early experimental data gathered during the start-up of the 14 ft diam FluoSolids reactor at the Jadotville plant of the Union Miniere Du Haut Katanga, Belgian Congo. Several months of continuous operation have elapsed since then and major improvements have been brought to the operating conditions.

Concentrates, with low copper and sulfur content, and which were unable to yield a self-sustaining reaction, are now successfully roasted. It might be worthwhile to quote the results which have been obtained in several fields:

Slurry make-up: A very unpleasant feature of the chalcosite concentrates treated is their tendency to agglomerate by weathering. Such a concentrate, laying outside for 6 to 8 mo, can only be reclaimed in large and hard blocks, which are very difficult to turn into a slurry. A tube mill filled with 3 and 4 in. balls suited the purpose best.

Low sulfur content of the concentrates 12 to 13 pct accounts for the very high density of the slurry thus prepared. In order to pump the slurry, centrifugal pumps had to be ruled out and diaphragm types used; these operate satisfactorily. Slurry is now made up on a 6 to 8 tons per hr basis in a 6 x 12 ft tube mill and partially recycled from a storage tank. Density is automatically controlled.

Reactor: The slurry is fed through the roof of the reactor by a Mono pump which has very good volumetric characteristics. A home made feed gun is used, consisting of a vitalium screw sprayer backed up by a 2 in. pipe. Slurry and compressed air enter the feed gun and emerge as a conical dispersion of small droplets. Drop size is kept between 0.02 and 0.25 in., to prevent defluidization and to limit carry-over. This is done by control of the air pressure.

Fluidizing air: Air is provided by a Roots type blower. Flow is kept constant in order to ensure a 1.2 ft per sec space rate, which gives both a good fluidization and a low carry-over.

Calcined products discharge: Overflow calcine is discharged through a vitalium rotary feeder, which takes care of the backpressure of the reactor. Dust from the reactor in the exit gases are collected into a single mild steel cyclone with stainless steel vortex finder, followed up by a Peabody scrubber using spent electrolyte as washing liquor. The cyclone has been insulated externally; this provision raised the internal temperature and lowered the amount of unburnt sulfur in the cyclone dust.

Improved results

From 1957 on, several new features have been added to the operation in order to improve metal recoveries: 1) The diameter of the bed section of the reactor has been brought from 14 to 12.5 ft, while the freeboard diameter remained unaltered. A reduction of carry-over was thus contemplated. 2) Top feeding of the slurry provides a better dispersion on the surface of the bed, and better control of the compressed air flow regulates the size of the slurry droplets. 3) Bed height was cut from 5 to 4 ft. 4) The space rate is now down to the minimum value allowed to keep efficient fluidization going. This sets the excess air at 20 pct and the oxygen content of the exit gases at 5 to 6 pct.

Which of these measures contributed most to the improved results is hard to tell, but it is clear that the metal recoveries have been improved, as can be seen by Table I.

Treatment of low sulfur concentrates

Operations of March, 1958, were on a concentrate containing not more than 40.58 pct Cu and 11.95 pct S. Actually, concentrates running less than 35 to 37 pct Cu and 11 pct S are frequently met; they make a self-sustaining reaction impossible. Adding fuel-oil to the slurry is not practical as it increases viscosity beyond reasonable limits. Feeding dry coal to the reactor looked more promising. The coal that is now used has a high content of volatile matter and is crushed below ⅛ in. It is fed into a sloping 3 in. pipe by a screw conveyor and is then pushed into the furnace by compressed air.

Extensive automation has been achieved and the reactor now operates according to the following principles: Fluidized air is constant and depends upon the minimum space rate chosen. An Arnold Beekman analyzer records the oxygen content of the gases and controls its value around 6 pct by regulating the speed of revolution of the Mono pump. The bed pyrometer records the temperature and controls it by regulating either the flow of cooling water (high sulfur concentrate) or the speed of the screw conveyor feeding the additional coal (low sulfur concentrate).

The chalcosite-carrolite flotation concentrates are now satisfactorily treated by fluidized bed roasting, whether they contain 15 or 10 pct S. This operation involves no large labor or maintenance costs.

Table I. Operating Statistics for March 1958

Assay	Cu	Co	Stot.	SsO4
Feed, pct	40.58	2.31	11.95	—
Overflow, pct	33.85	1.94	9.07	8.86
Cyclone dust, pct	33.77	1.87	8.10	7.59
Leach residues, pct	4.83	0.37	1.19	0.50

The metal recoveries are now 96.15 pct Cu and 94.8 pct Co.
The carry over amounts to 18 pct.
The average feed density is 265 kg per cu m per hr.

L. F. THEYS is Resident Manager, Union Miniere du Haut Katanga, Jadotville, Belgian Congo.

[1] L. F. Theys and L. V. Lee: Sulfate Roasting Copper-Cobalt Sulfide Concentrates, JOURNAL OF METALS, February 1958, vol. 10, no. 2, pp. 134-136.