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Kautokeino kobberfelter		Bidjovagge Gruber a.s.		

Tittel

Kautokeino Kobberfelter: Pilot Testing of Graphithe-rich Ore from Bidjovagge

Forfatter	Dato År	Bedrift (Oppdragsgiver og/eller oppdragstaker)
Mortenson, Magne Hattrem, Thor	13.12 1963	Kautokeino kobberfelter A/S, USB

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Kautokeino	Finnmark		18334	Nordreisa

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Oppredning		Bidjovagge
Råstoffgruppe	Råstofftype	
Malm/metall	Cu	

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

English translation of BV 7013.

The purpose of the test was to investigate the possibility og graphit ecleaning of graphitic ore in pilot scale, and further to look into the loss of copper as a consequence of the graphite cleaning.
The report concludes that it is possible to obtain lower copper losses in the graphite flotation, down to less than 5%.
The possibility of producing a saleable graphite product appears to be slight. (C-conc up to approx. 36%) Using a suitable collector it is possible to get the graphite content in the sulphide product to be insignificant.
The cost of reagents in this type of flotation can be calculated to approx. kr 0,75 pr. ton raw material.

PILOT TESTING OF GRAPHITE-RICH ORE FROM BIDJOVAGGE.

Summary:

The purpose of the test was primarily to explore the possibility for the graphite cleaning of graphite-rich ore in pilot scale, and at the same time to obtain more exact data on the copper-losses involved. The possibility of producing a saleable graphite product was also to be explored.

After graphite cleaning a bulk sulphide product was to be produced in order to determine its C-content.

From ore containing 1.87% Cu and 15.9% C, pilot testing has produced a graphite product with 0.43% Cu and a calculated copper-extraction of 4.6%. The graphite content of this product was 36.3% with a graphite extraction of approximately 65%. Thus about 35% of the ore's graphite content goes on to sulphide flotation.

Further cleaning of the graphite product proved that it was possible to reduce the copper content to 0.35%, which represents approximately 2.6% of the ore's copper. At the same time the graphite content increased from 36 to 41%.

From the ensuing bulk sulphide flotation a product containing approximately 6 % C was obtained. However, cleaning was insufficient. 20.1% of the product is not solvable in $3HNO_3:1HCl$ and includes graphite. Additional cleaning would result in a lower insolvable content and consequently a lower content of graphite, since graphite is a finely divided constituent of the silicatefels.

Conclusions:

It seems reasonable to assume that in the milling of an ore corresponding to the ores tested, graphite can be floated before sulphide flotation with a copper-loss in graphite of approximately [illegible], and [illegible] reasons [illegible] to believe that this loss can be reduced.

The possibility of producing a saleable graphite product appears to be slight. The graphite product obtained is very fine grained. A screening test showed that 90% passes 0.044 mm mesh (325 mesh Tyler). Also the cleaning tests without return of the tailings to the system gave an additional concentration of merely 5% after the rougher and 2 preceding cleaner-steps had created a concentrate with 36% C from the ore containing 16% C. In addition to the silicate minerals and chalcopyrite, the graphite product contains pyrite and/or pyrrhotite.

Using T.E.B.-frother (triethoxy butane) as the collector it seems probable that in floating graphite before sulphide a sulphide product will be obtained containing insignificant graphite.

The same results were obtained earlier using MIBC (methyl-isobutyl-carbinol) as frother and collector.

Reagent costs in the flotation of graphite from this type of ore can be estimated to approximately kr. 0.75 (ca. $ 0.11) per ton. The price for T.E.B. delivered to the consumers nearest railroad point is Sw.kr. 3.00 (ca. $ 0,60).

Ore Dressing Laboratory, December 13, 1963.

B. Kottersson
Sign.

PILOT TESTING OF GRAPHITE-RICH ORE FROM BIRTAVARRE.

Report of test 160763.

After some experimentation the test was set up and run as shown in figure 1.

The ore was ground to approximately 62% - 0,074 mm (figure 2). The frother used was T.E.B. (triethoxy butane) in the amount of approx. 200 ml/ton or 175 g/ton. Approx. 100 ml/ton was added to the tank before the first rougher and approx. 50 ml/ton before both the second and the third rougher directly to the flotation cell. Since graphite has a natural ability to float, no collector was used. The sulphides were floated using approx. 150 g/t K-a-xantate as collector. Additional frother was not necessary for the sulphide flotation.

The graphite was cleaned in 2 steps with the return of the combined cleaner tailings to the first rougher. In addition there was added a third cleaner step in order to determine the possibility for additional cleaning. The tailings from this third cleaning were therefore not returned to the system.

The tailings from the graphite flotation were pumped to another system for bulk sulphide flotation. In this system the number of cells were not sufficient to provide both high copper content in the concentrate and a high copper extraction. However, the purpose of this sulphide flotation was primarily to obtain orientation on the graphite content in the sulphide product after the proceeding graphite flotation.

The products obtained in this test are underlined in figure 1. The screen results are shown in figure 3. The graphite product Ck2R is very fine with 89% - 0,044 mm.

Assays of the various products are shown in figure 4. Graphite content has been determined by combustion loss at somewhat over 900°C after removal of mineral solvable in 3HNO_3: 1HCl. All sulphides and carbonates are assumed disolved by the acid, leaving only silicates and graphite. Combustion loss is given as weight percent of the original sample. Since the graphite is a finely divided constituent of the rock complete combustion is improbable and the actual graphite content may thus lie higher than combustion loss analyses indicate.

The amount of carbonate in the various products is assumed to be equivalent to that soluble in acetic acid

In figure 5 the mineral constitution of the products is calculated on the basis of chemical analyses. The amount of silicate minerals is calculated as the difference between that insoluble in $3HNO_3$:1HCl and combustion loss.

In figure 6 extraction is based upon chemical analyses.

As shown in figures 5 and 6 a graphite product, Ck2R, has been produced containing 0,43% Cu with a copper extraction of 4,6%. The graphite content in this concentrate is 36,3% and graphite extraction is calculated at approx. 65%.

Further cleaning of the graphite concentrate Ck2R, without return of the cleaner tailings to the system, reduces the copper content to 0,38% and increases the graphite content to 41,6%.

In figure 7 copper extraction in this cleaned graphite concentrate is calculated at approx. 2,6% of the feed.

Thus, it seems probable that copper losses in the ~~xxxxx~~ graphite flotation may prove lower than the 4,6% arrived at here.

It may well be possible to produce a graphite concentrate with a C-content higher than that attained in this test. The possibility of a saleable product, however, is slight. Rougher flotation with 2 cleaner stages increased the C-content from 16% to 36% or an avera of 7% per stage. The third cleaning increased the C-content from 36% to 41,5% or 5½%. Additional cleaning will in all probability result in diminishing concentration per step, thus quickly arriving at additional concentration approaching zero.

Copper distribution in figure 8 is depicted for the fractions - ∞ + 0,044 mm and - 0,044 + 0,0 mm. According to the tables it may be seen that a distinct enrichment of copper occurs in the finest fractions. In the cleaning of Ck2R only a little over 50% of the finely divided chalcopyrite in the concentrate has floated (figure 7). In bulk sulphide flotation copper extraction in coarse and fine fractions are similar, and thus similar to total extraction (figure 6). Bulk sulphide flotation produced a concentrate containing approx. 76,5% sulphide minerals (20% chalcopyrite and 56,5% iron sulphides), 21,5% insoluble in $3HNO_3$:1HCl, and 6% combustion loss (graphite) was produced. 3 cleaner stages were applied and it is assumed that additional cleaner stages will result in considerably lower insoluble content.

It should be possible to produce a bulk sulphide concentrate with comparatively low graphite content from an ore similar to that used in the test.

According to figure 9 it appears that mainly pyrite has floated whereas pyrrhotite has mainly gone in the tailings of the sulphide flotation.

Copper content in the tailings of the bulk sulphide flotation is approx. 0.6% and represents a Cu-extraction of approx. 19.5%. It may be assumed that an increase in scavenger volume will reduce the C-content in the tailings and thus the copper loss. The copper losses in the tailings from the sulphide flotation are definitively largest in the fine fraction (figure 8) and it appears that most of the chalcopyrite which has gone in the tailings exists as free grains. The scavenger volume has therefore been insufficient.

Figure 10 depicts a weight distribution on the basis of chemical analysis. Calculated weights show large deviations and reflect the chemical analyses' degree of reliability. Since the copper and sulphur analyses must be considered as most reliable, it was decided to use distribution calculated from these analyses as the basis for a collective tabularization of weights and extractions (figure 11).

The calculation of the combustion loss (graphite) is least reliable. This is because combustion loss analyses are difficult to determine.