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Beneficiation Studies on Cobalt Bearing Ore from Africa

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Abstract

Cobalt bearing ore is used in Africa for hydro-metallurgical extraction of Co. The party desired to know whether it is possible to pre-concentrate this ore in order to reduce the material handled by metallurgical operations. This cobalt bearing sample (5% Co) was beneficiated in the Modern Mineral Processing Laboratory and Pilot Plant of Indian Bureau of Mines at Nagpur. The cobalt was identified by EPMA to be present as WAD where manganese is replaced by cobalt. The as-received sample was dominated by fines. Screening the as received sample on 10 mesh followed by desliming of -10 mesh fraction yielded a Co concentrate assaying 7.2% Co with 94.6% cobalt recovery. Although the concentrate assays only 7.2% Co, this simple process developed offers the advantage that around 33% of the slimes (<20 microns in size assaying around 1% Co) can bypass the metallurgical operations to follow thus drastically reducing the handling, settling and filtration problems in the extraction of Co by hydrometallurgical route with minimum Co losses in the tailings.

INTRODUCTION

An ore of unknown mineralogy containing mostly fines and assaying around 5% Co is the basic raw material used by a metallurgical company in Africa for the hydrometallurgical extraction of Co. The rejects from this plant assays around 1% Co. Due to presence of huge amount of fines the company is facing lot of problems in leaching and filtration during processing for recovery of Co. The need is, therefore, felt to exploit its beneficiation potential to assess if this material can be upgraded preferably by rejecting fines and keeping the tailing losses around 1% Co. The paper presents the details of the test work carried out in the Modern Mineral Processing Laboratory and Pilot Plant of Indian Bureau of Mines at Nagpur for the development of process flowsheet to meet the above objectives.

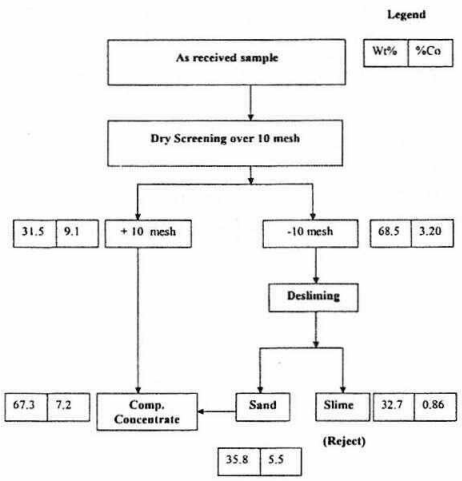

Fig. 1: Proposed Flow Sheet

EXPERIMENTAL WORK

The as-received sample was first characterized for its physical, chemical and mineralogical analysis.

Physical

The sample, light brown in colour, was dominated by fines.

Chemical

The sample assayed 5.1% Co, 1.3% Cu, 1% Mn, 1.2% Ca, 1.3% Mg and 7.1% Al.

Mineralogy

Microscopic study was not found effective for identification of cobalt bearing mineral. Electron Probe Micro Analyser could establish asbolite as the cobalt bearing mineral. Asbolite is a hydrated Manganese oxide (WAD) where Manganese is replaced by cobalt and copper. Quartz with other silicates like mica and feldspar are the main gangue minerals along with limonite and goethite.

Process Development

The as-received sample contained lot of fines. It was first dry screened at 10 mesh. The result of the screening test are given in Table 1.

Table 1: Screening at 10 Mesh

Product	Wt%	Assay %			Rec. %
		Co	Cu	Mn	Co
+10 mesh	31.5	9.1	1.93	1.34	56.0
-10 mesh	68.5	3.29	0.9	0.81	44.0
	100.0	5.12	1.22	0.98	100.0

The +10 mesh and -10 mesh fractions thus obtained were separately treated.

Treatment of +10 Mesh Fraction

It is seen from Table 1 that by simple screening the as received sample on 10 mesh screen, the +10 mesh fraction assays around 9.10% Co. This fraction was treated on a jig to see if an enriched product can be generated.

Jigging

The results of the jig test are given in Table 2.

Table 2: Jigging of +10 Mesh Fraction

Product	Wt %	Assay %		
		Co	Cu	Mn
Jig Conc.	11.0	17.5	3.1	2.2
Jig Tails	20.5	4.6	1.3	0.9
	31.5	9.11	1.93	1.35

It is observed from this table that even though there is substantial upgradation of Co in jig conc. , the tailing losses are also very high.

Treatment of -10 Mesh Fraction

The -10 mesh fraction was deslimed in a hydrocyclone. The results are given in Table 3.

Table 3: Desliming Test on -10 Mesh Fraction

Product	Wt.%	Assay%			Rec.%
		Co	Cu	Mn	Co
Sand	35.8	5.50	1.23	1.22	38.6
Slimes	32.7	0.86	0.56	0.40	5.4
	68.5	3.29	0.91	0.82	44.0

It is seen that desliming can produce slimes as reject fraction assaying 0.87% Co as envisaged.

The composite of +10 mesh fraction and the sand obtained by desliming -10 mesh fraction is given in Table 4.

Table 4: Composite of +10 Mesh Fraction and Sand of -10 Mesh Fraction

Product	Wt.%	Assay%	Rec.%
		Co	Co
+10 mesh	31.5	9.1	56.0
Sand	35.8	5.5	38.6
Total	67.3	7.2	94.6

It can be observed from the metallurgical results given in Table 1,3 and 4 that the composite of +10 mesh fraction of the original sample and the deslimed sand of -10 mesh fraction assays 7.2% Co with overall cobalt recovery of 94.6%. The rejects from this process assays 0.86% Co.

CONCLUSION

The process i.e. screening the as received sample on 10 mesh followed by desliming of the -10 mesh fraction produced a concentrate assaying 7.2% Co with 94.6% cobalt recovery. Though the sample could not be upgraded to an appreciable extent, about 33% of the slimes (<20 micron in size) assaying only 0.86% Co could be rejected with a recovery loss of 4 -5%.

Thus, the simple process developed not only produced a clean, slime free cobalt concentrate assaying 7.2% Co with 94.6% recovery but also helped in eliminating slimes thereby reducing the handling problems in leaching and filtration, during extraction of cobalt, maintaining the tailing losses around 1% Co as envisaged.

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