Crushing and grinding : Practice and problems in Kalyadi copper mine concentrator

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Location of the plant :

Kalyadi is 21 Km. away from Arsekere. It can be reached by diverting on the Naranahalli-Javagal Road, at 7. 4 Km. from Naranahalli. A 2 Km. long mud road connects the plant with the main road.

INTRODUCTION

At Kalyadi concentrator plant the ROM ore is required to be reduced to 70%—200 mesh size for liberation of valuable mineral. The metallic minerals that are mainly present in the ore are chalcopyrite, pyrite, magnetite, and pyrrhotite the latter two being of minor occurance within quartzite. These minerals occur as disseminations, specks, particles, thin veinlets and concentrations. Ore is highly abrasive in nature with specific gravity of 2.9. Ore grade varies from 0.5 to 0.8% Cu. giving an average grade of 0.65% Cu.

Description of the plant :

Kalyadi copper concentrator is designed to process 250 tonnes per day. The ROM ore is crushed in two stages. The ore is fed directly from the mine shaft bin through an apron feeder and a conveyor belt to the primary (jaw) crusher which operates in closed circuit with a double deck vibrating screen (50 mm and 30 mm openings). The crushed ore (—30 mm) is further reduced to −15 mm in a secondary (gyratory) crusher, operating in closed circuit with 15 mm screen. The crushing section is designed to handle 250 tonnes per shift.

The crushed ore (−15 mm.) from the bin is fed by a conveyor to an overflow ball mill (180x360 cm) for grinding. The weightometer installed on the mill feed conveyor indicates instantaneous feed rate and cumulative tonnage. The ball mill operates in closed circuit with a double pitch rake classifier (120x787 cm). Lime is added to the mill manually for selective flotation of chalcopyrite.

The overflow from classifier (60% −200 mesh size)is treated in a conditioner (180x180cm) with the collector Potassium Ethyl Xanthate and subjected to flotation in rougher cells (6 Nos.), using pine oil as frother. Rougher concentrate (16-17%Cu) is fed to cleaner cells (6 Nos.) while rougher tails go to scavenger cells (6 Nos.). Scavenger concentrate (2—3% Cu) go back to the conditioner. Cleaner concentrate is fed to recleaner cells. Re-cleaner tails flow back to cleaner cells. The scavenger tails (final tails) are rejected. Recleaner cells concentrate is the final concentrate (25% Cu) which is dewatered in concentrate thickener (540x300 cm) and drum filter (180x120 cm). The filter cake (90—92% solids) is bagged and despatched to smelter. The tailings are pumped to a tailings thickener (1800x420 cm) where slurry is thickened. The clarified water is re-used in the plant. The thickened product is discharged to adjoining tailing disposal area. Flowsheet of the plant is given in the figure.

Present trend is to replace the mechanical classifiers with hydrocyclones on account of their efficiency in classification and less capital costs. However the hydrocyclone is not opted at Kalyadi concentrator due to some practical problems like inconsistent power supply, high wear of the slurry pumps to feed the cyclones etc. Laboratory experiments by Bhaba Atomic Research Centre suggested heavy amount of reagents

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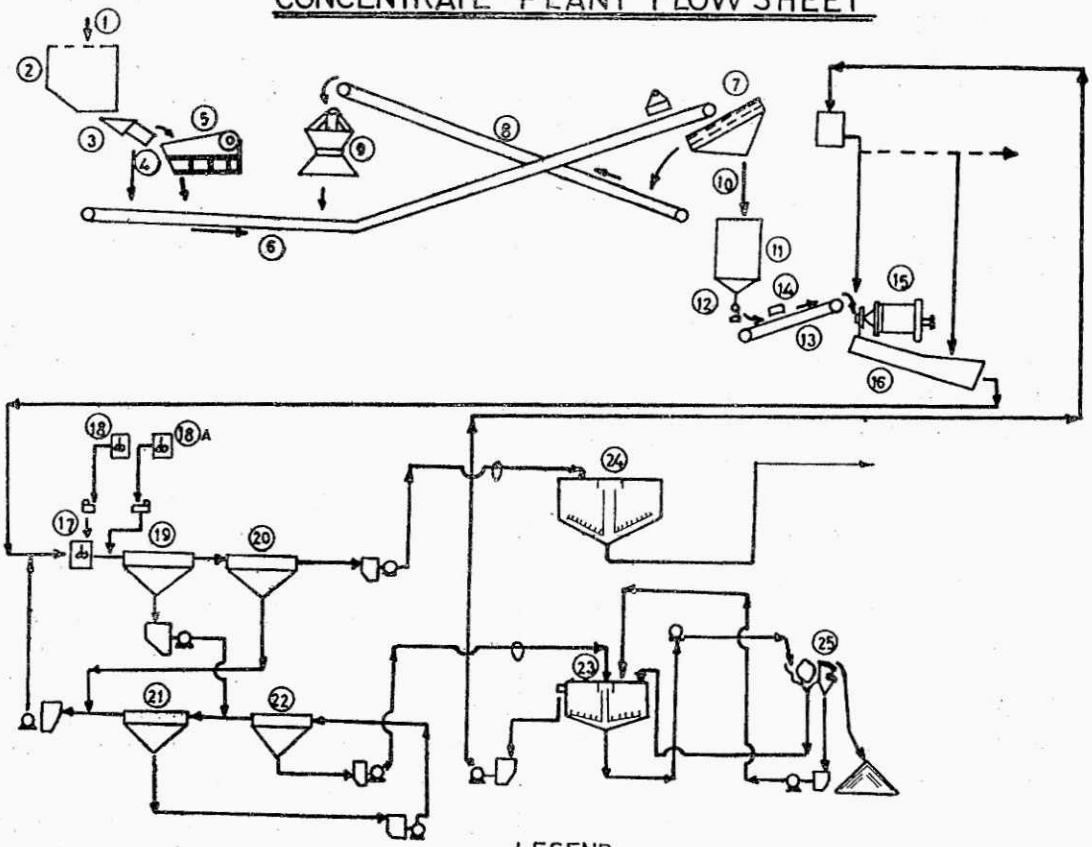
KARNATAKA COPPER CONSORTIUM; KALYADI COPPER MINES

CONCENTRATE PLANT FLOW SHEET



LEGEND

NO	DESCRIPTION	NO	DESCRIPTION
1	HORIZONTAL GRIZZLEY 10'x10' 250MM APERTURE	14	WEIGHTOMETER
2	ROM BIN 50T CAPACITY	15	6'x12' OVER FLOW BALL MILL
3	APPRON FEEDER Mx50T/Hr	16	SPIRAL CLASSIFIER 4' W x 24L
4	DD SCREEN 4'x8' 50MM AND 30MM APERTURE	17	CONDITIONER 6'x6'
5	RBDT JAW CRUSHER 20"x30"	18,18 A	REAGENT FEEDERS
6	900MM SCREEN FEED CONVEYOR 79.4 T/Hr SPEED 75M/S	19	1·69M^3 ROUGHER CELLS 6 NOS
7	VIBRATORY DD SCREEN 5'x12' 30x15MM APERTURE	20	1·69M^3 SCAVENGER CELLS 6 NOS
8	900MM RE CYCLE CONVEYOR 46·1 T/Hr SPEED 0·32M/SEC	21	1·13M^3 CLEANER CELLS 4 NOS
9	37·5" GYRATORY CRUSHER	22	1 13M RECLEANER CELLS 2 NOS
10	600 MM BIN FEED CONVEYOR 31·25 T/Hr SPEED 0·40M/SEC.	23	18'x14' CONCENTRATE THICKENER
11	FINE ORE BIN 750 M.T.CAPACITY	24	60'x14' TAILING THICKENER
12	1050MM DISC FEEDER	25	6'x4' DRUM FILTER
13	600 MM MILL FEED CONVEYOR 10.42 T/HR.SPEED 0·34M/S.		

such as 0.035 to 0.05 kg. per tonne of collector, 0.04 kg per tonne of frother and 3 to 5 kg. of lime and also some depressants for flotation of Kalyadi Copper ore. Though at the starting of the plant reagents were added at the rate as suggested by laboratory, later based by practical results it has been brought down to 0.01 kg. per tonne collector, 0.02 kg. per tonne frother and 2.5 to 3 kgs. per tonne lime successfully without affecting recovery. The conditioner allows a total conditioning time of about 6—7 minutes

Others :

The plant requires water at the rate of 4000 gallons fresh water per hour taking into consideration of 30% of reclaimed water from tailing thickner. The requirement is fulfilled by 50,000 gallon capacity main tank for which supply of water is done by three borewells. Plant itself is having one borewell which can supply 800 gallons of water per hour.

A 11 KV substation provides electricity to the plant. Normal operating conditions require 35 kWh per tonne of ore milled.

Problems :

(i) High hardness of ore

(ii) Low grade of ore.

(i) Due to high abrasive nature of ore, chutes, jaw liners, grinding ring and mantle wear out too fast. It becomes essential to change the spider of gyratory crusher within two and half years of installation because of excessive wear.

It becomes essential to change gyratory crusher mantle and ring for every 15,000 tonnes of ore crushed.

Ball mill shell liners 'Wearonil' type wear out for every 18,000—20,000 tonnes of ore ground. This further increases the cost per tonne of ore milled. It has been suggested to improve the life of liners by changing over to Ni-hard liners and is being tried out during the next change of liners.

(ii) As the ore deposit is completely disseminated, it requires optimum grinding to liberate valuable mineral. Any change in the ball mill discharge immediately affects recovery. As the ore grade varies from 0.5 to 0.8% Cu whenever plant is running with lowest grade, improving the grade of concentrate becomes very difficult. In that case over feeding the ball mill is required to get the grade of concentrate. As the pyrite content in the ore is very high, to depress it effectively pH of 10—10.5 should be maintained. Other wise there will be sudden fall in the grade of concentrate.

Due to low grade of ore, getting required grade of concentrate becomes more important than tailing loss, which is negligible.