Flotation Studies for the Up-Gradation of Rock Phosphate of Kakul Hazara

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Introduction

Rock phosphate is an economical mineral, mainly used in phosphatic fertilizers and as animal feed. It is also used as builders for detergents, surface treating agents metals and food additives [1].

Pakistan imports substantial quantity of rock phosphate and phosphatic fertilizers from Morocco, Jordan and Tunesia [2,3]. Sarhad Development Authority has reported 0.70 million tons of rock phosphate at Kakul Hazara (N.W.F.P.) in collaboration with British Mining Consultants. These deposits are spread over 155 Km^2 area and located at a distance of 10 Km from north-east of Abbottabad. Petrological and geochemical studies of these deposits were first reported by Latif [4]. Detailed stratigraphic and other related investigations were later on carried out by Bhatt *et. al.* [5] and Hasan *et. al.* [6]. Mineralogically these deposts have been identified as fluoro apatite [7,8].

The present work describes the application of flotation technique for the removal of silica and subsequent upgradation of the Kakul rock phosphate dumps.

Results and Discussion

The average chemical evaluation (%) of Kakul mining project dumps show loss on ignition 2.15; Silica; 34.53; P_2O_5; 22.32; MgO; 0.31; Fe_2O_3; 0.73; and Al_2O_3; 0.87.

Table-1 shows sieve analyses data of P_2O_5. The data indicates that the silica is scattered in all fractions. However, 140 +200μm was found the optimum mesh size for maximum liberation of P_2O_5. At +200μm mesh, the slimes increase pulp viscosity and interfere in the recovery of the coarser particles.

Table -2 indicates the dosage of 0.6 ml/200 g of the oleic acid collector which results in 28.08% contents of P_2O_5 with the recovery of 88.31%. Table 3 shows the effect of dosage of sodium silicate depressant on the grade and recovery of P_2O_5. It was noted that the recovery of P_2O_5 increases with the increase of depressant dosage. A series of flotation studies were also undertaken by varying the pH. Optimum recovery of P_2O_5 was obtained at pH 9. The results are shown in table-4.

Experimental

80 Kg of the representative rock phosphate sample was crushed in Jaw Crusher and subsequently powdered in a ball mill. Flotation tests were carried out by classic flotation technique using WEADAGE Laboratory flotation machine with a cell capacity of one litre.

Table- 1: Sieve analysis of the ground sample (Phosphate rock)

Mesh Size(μm)	% Weight Retained	Composition	Sample No. 1	2	3	Average
+ 40	17.17	P_2O_5	18.00	17.5	19.00	18.17
		SiO_2	38.00	38.45	38.25	38.23
-60 + 100	19.61	P_2O_5	18.45	19.00	19.50	18.98
		SiO_2	37.55	37.35	38.00	37.63
-100 + 200	6.73	P_2O_5	19.00	19.55	20.00	19.52
		SiO_2	37.00	37.00	36.75	36.92
-140 + 200	7.5	P_2O_5	20.52	21.00	21.50	21.01
		SiO_2	36.95	36.85	36.65	36.82
-200 + 250	19.34	P_2O_5	22.25	22.50	23.00	21.58
		SiO_2	34.25	34.65	34.25	34.56
-250	30.1	P_2O_5	22.30	22.50	23.25	22.68
		SiO_2	34.75	34.35	33.35	34.15

Table 2-Effect of Collector and depressant dosage on the grade and recovery of P_2O_5

Test No.	Collector dosage(ml)	Collection	%weight recovered	%age of P_2O_5	%age of SiO_2
1.	0.2	Concentrate	36.78	28.00	23.03
		Tailing	63.22	23.12	33.37
2.	0.4	Concentrate	38.29	30.09	21.10
		Tailing	61.71	22.83	32.29
3.	0.6	Concentrate	88.31	28.08	20.52
		Tailing	11.69	7.76	61.87
4.	0.8	Concentrate	89.38	27.82	22.20
		Tailing	44.62	15.72	43.79
5.	1.0	Concentrate	90.20	30.77	26.34
		Tailing	12.91	10.78	59.4

Table 3-Effect of depressant dosage on grade and recovery of P_2O_5

Test No.	Depressant dosage (gram)	Collection	%weight recovered	%age of P_2O_5	%age of SiO_2
1.	0.01	Concentrate	29.82	20.53	30.57
		Tailing	70.19	24.00	28.12
2.	0.05	Concentrate	53.21	28.43	24.59
		Tailing	46.79	26.40	27.26
3.	0.10	Concentrate	62.17	27.81	22.97
		Tailing	37.83	25.35	30.12
4.	0.20	Concentrate	49.73	24.94	27.61
		Tailing	50.27	24.20	31.28
5.	1.30	Concentrate	60.20	29.46	19.29
		Tailing	39.80	17.86	42.98

Table- 4: Effect of pH on the on the recovery of P_2O_5

Test No.	pH value	Collection	%weight recovered	%age of P_2O_5	%age of SiO_2
1.	6	Concentrate	43.75	22.30	31.25
		Tailing	56.25	21.20	33.16
2.	7	Concentrate	60.30	23.75	31.91
		Tailing	39.70	18.66	30.91
3.	8	Concentrate	60.85	25.00	26.97
		Tailing	39.15	17.35	40.14
4.	9	Concentrate	76.00	29.46	19.29
		Tailing	24.00	17.86	42.98
5.	11	Concentrate	85.30	24.66	33.26
		Tailing	14.70	16.99	30.26
6.	12	Concentrate	92.50	24.80	23.96
		Tailing	7.50	12.80	45.25
7.	13	Concentrate	54.20	20.95	30.00
		Tailing	45.80	18.89	27.55

200 gms powdered (-140 +200 μm) silicious phosphate rock was conditioned prior to its flotation for 5 minutes with sodium silicate. It was then conditoned with oleic acid collector and 2-3 drops of propylglycol ether (cynamide, Aero froth 65) was used as frother. The desired value of pH was adjusted by the addition of acid or base in the pulp and floated untill the froth barren off the mineral particles. The flotation time was normally noted to be less than ten minutes. The impeller speed was fixed at 1200 RPM and the pulp density at about 20%. The phosphate concentrates and tailings obtained were dried and assayed for P_2O_5 and SiO_2, by standard analytical methods [9].

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