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Recovery of Chromite From Plant Tailings By Falcon Concentrator

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ABSTRACT: *The objective of the present study was to investigate to recover chromite from Sivas -Kangal-Çamözü chromite plant tailings assaying 4.95% $Cr_2O_3$by using a Falcon Concentrator. By using L40 type Falcon Concentrator a concentrate assaying of 13% Cr_2O_3 with 63.03% recovery was obtained from Çamözü plant tailings at 30 G rotor rotation speed with -150 micron feed grain size at 40 kPa water pressure. It was found that the degree of liberation is an important parameter for Falcon Concentrator. At -600µ, -500µ and -300µ grain sizes by increasing rotor rotation speeds the grades of chromite decrease and recoveries are increase.*

KEY WORDS:*Chromite, Chromite tailings, Falcon gravimetric concentrator.*

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I. INTRODUCTION

97 of the minerals present in the earth crust contain chromium and the only one economically producing chrome mineral is chromite [1]. About 90% of chromium ores produced worldwide are used in the metallurgical industry. The most important area of the metallurgical industry is the production of ferrochrome for stainless steel production and for the production of 1 tonne of ferrochrome approximately 2.5 tonnes of chromite are used [2].Nowadays, the importance of tailings and low-grade reserves has increased due to the production of high-grade chrome deposits and the growing chromium need because of developing technology. Studies to enrich low-grade chrome ore in Turkey remained insufficient, especially in the chromite plants constructed in the first years, the chromite grade in the tailings was more than 6% [3]. Therefore it is important to determine the most suitable method to recover chromite mineral from tailings.

Extensive work has been carried out by numerous researchers for the beneficiation of tailings by adopting different methods of beneficiation techniques exploiting the difference of physical properties. As a general rule, the separation efficiency decreases when the particle size becomes finer [4].

The Falcon Gravity Concentrators are primarily used to maximize mineral recovery and reduce tonnage to downstream processes. The Falcon Concentrator is capable of collecting fine minerals that would be missed by dense medium separators, spirals and other processes. The Falcon Concentrator consists of a linatexed, single walled, almost-conically shaped basket. The feed is introduced near the base of the bowl where it impacts on a rubber impellor rotating with the bowl. The centrifugal force generated by the rotation of the bowl forces the material to settle out to the wall of the bowl where it will migrate up the slightly inclined wall. The light material flows upwards and out of the bowl into a collection launder. The heavy material remains in the bowl and is eventually removed by water flushing once the operating cycle is complete [5,6].

The objective of this study was to determine the feasibility of enhanced gravity separation for the recovery of fine chromite particles from the tailings generated from the chromite beneficiation plant of Sivas-Kangal-Çamözü. Further it was aimed to understand the effect of the process variables such as rotor rotation speed, grain size on grade and recovery of % Cr_2O_3 in concentrate fraction of Falcon Concentrator for recovering chromite.

II. MATERIAL AND METHOD

2.1. Material

The XRF of the sample obtained from Sivas-Kangal-Çamözü Chromite Plant tailings is given in Table A and the XRD analysis is given in Figure A.

Table A. The results of XRF of the original sample.

Component	Quantity (%)
Cr_2O_3	4,95
Fe_2O_3	8,11
MgO	37,3
SiO_2	33,2
Al_2O_3	1,6
Others	0,84
LOI*	14

* Loss on Ignition

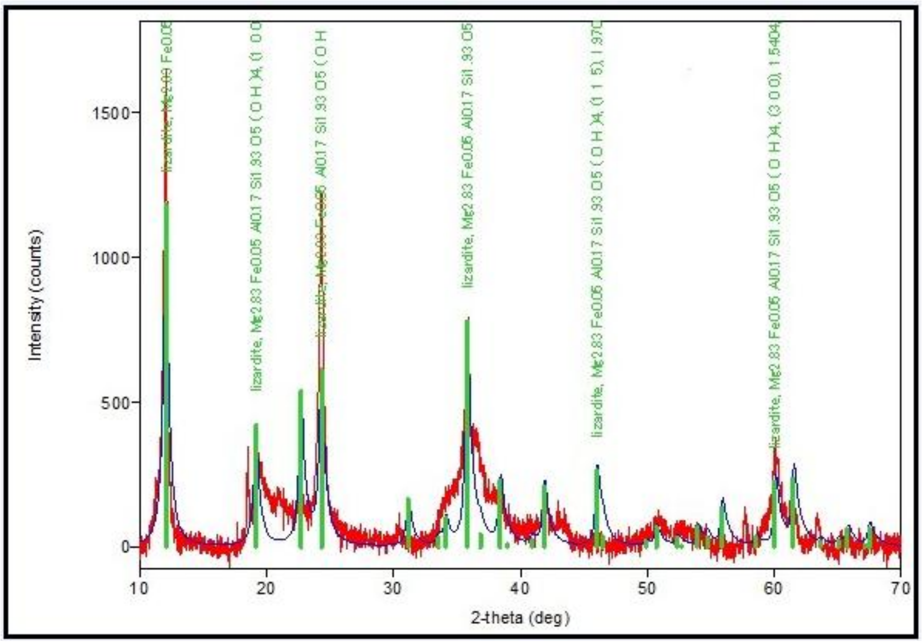

Figure A. XRD graph of the original sample.

According to XRF analysis results, the original sample used in the experiments as feed material contains 4.95% Cr_2O_3. Cr/Fe ratio of the original sample was calculated as 0.6/1.When XRD powder diffraction patterns of the sample are examined, they support the results of elemental analysis. It can be found from XRF analysis that the dominant elements in the tailings obtained from the plant are primarily Si and Mg. All of the peaks in the XRD powder diffraction pattern were recorded with ICDD card 04-015-3239 overlap and show that itwas lizardite [7].

2.2. Method

The chromite plant tailings sample was beneficiated by using L-40 type laboratory Falcon Gravimetric Concentrator with -600 µm, -500 µm, -300 µm, -150 µm and -75 µm particle sizes , at 20 G, 30 G, 40 G rotor rotation speed for each fraction at 40 kPa constant water pressure.

The quantities, grade and recovery values of the concentrates and tailings obtained in the experiments are given in Table B and the results of XRF analysis of concentrates obtained at different particle size fractions and rotor rotation speeds are given in Table C. Figure B shows the relationship between recovery and grades of concentrates.

Table B. The grade and recovery values obtained from Falcon experiments

Grain size (µm)	Rotor rotation speed (G)	Product	Quantity (%)	Cr_2O_3 (%)	Recovery (%)
-600	20	**Concentrate**	**23,68**	**7,11**	34,01
		Tailing	76,32	4,28	
	30	**Concentrate**	**64,52**	**3,94**	51,36
		Tailing	35,48	6,79	
	40	**Concentrate**	**73,55**	**3,39**	50,37
		Tailing	26,45	9,29	
-500	20	**Concentrate**	**18,12**	**9,87**	36,13
		Tailing	81,88	3,86	
	30	**Concentrate**	**56,21**	**5,57**	
		Tailing	43,79	4,15	63,25
	40	**Concentrate**	**61,74**	**5,46**	68,10
		Tailing	38,26	4,13	
-300	20	**Concentrate**	**15,58**	**11,50**	36,20
		Tailing	76,32	4,28	
	30	**Concentrate**	**29,41**	**10,40**	
		Tailing	35,48	2,68	61,79
	40	**Concentrate**	**60,53**	**7,42**	90,73
		Tailing	26,45	1,16	
-150	20	**Concentrate**	**16,56**	**IS****	
		Tailing	76,32	4,28	
	30	**Concentrate**	**24,00**	**13,00**	63,03
		Tailing	76,00	2,41	
	40	**Concentrate**	**25,68**	**11,80**	61,22
		Tailing	26,45	9,29	
-75	20	**Concentrate**	**23,68**	**8,65**	11,39
		Tailing	76,32	4,69	
	30	**Concentrate**	**64,52**	**7,76**	10,66
		Tailing	35,48	4,74	
	40	**Concentrate**	**73,55**	**7,16**	12,79
		Tailing	26,45	4,74	

** Insufficient Sample

Table C.XRF analysis of concentrates obtained at different particle size fractions and rotor rotation speeds

Grain size (µm)	Rotor rotation speed (G)	Cr_2O_3	Fe_2O_3	MgO	SiO_2	Al_2O_3	LOI*
-600	20	7,11	8,51	36,10	31,70	2,14	13,3
	30	3,94	7,73	37,70	33,80	1,33	14,5
	40	3,39	7,63	38,10	34,30	1,20	14,6
-500	20	9,87	9,18	34,60	29,70	2,80	12,4
	30	5,57	8,19	36,90	32,80	1,74	13,9
	40	5,46	8,19	37,00	32,80	1,70	13,9
-300	20	11,50	9,57	33,50	28,50	3,28	IS**
	30	10,40	9,35	34,30	29,30	2,91	12,2
	40	7,42	8,69	35,90	31,40	2,21	13,5
-150	20	IS**	IS**	IS**	IS**	IS**	IS**
	30	13,00	10,50	32,60	27,80	3,55	11,3
	40	11,80	9,90	33,50	28,30	3,26	12,00
-75	20	8,65	10,03	32,30	30,12	3,49	14,9
	30	7,76	9,41	33,10	31,60	2,94	14,40
	40	7,19	9,16	33,80	31,10	2,64	15,2

*Loss on Ignition ** Insufficient Sample

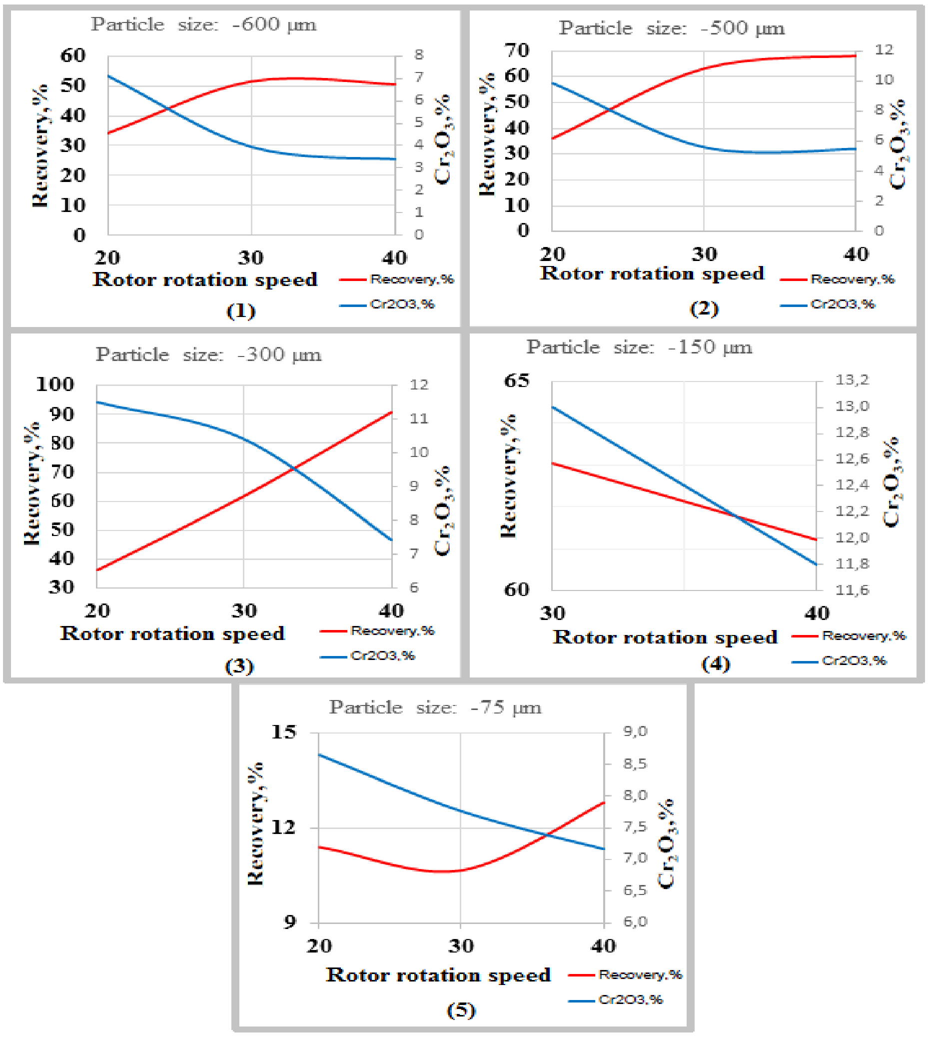

Figure B. Relation between grade and recovery obtained from Falcon experiments

When Tables and Figure B are examined it can be seen that a concentrate of 7,11% Cr_2O_3 was obtained at a rotor rotation speed of 20 G with a particle size of -600 microns.On the other hand, in experiments conducted at 30 G and 40 G rotor rotation speeds, concentration grades are decreased while tailing grades are increased. - 600, -500, -300, and -75 microns size particles experiments show that as the rotor rotation speed increases Cr_2O_3, Al_2O_3 and Fe_2O_3 contents of the product taken from the concentration region decreased while the SiO2 and MgO contents increasing.A concentrate assaying of 13% $Cr_2O_3$with 63.03% recovery was obtained from Çamözü plant tailings at 30 G rotor rotation speed with -150 micron feed particle size at 40 kPa water pressure.On the other hand, measurement value was not taken from the 20 G rotor rotational speed concentration. The reason of this situation is that the Cr_2O_3 content possibly is more than 15% in the concentrate of the sample concerned. The method chosen for the XRF analysis could detect a maximum content of 15% Cr_2O_3, above this value measurements could not be taken within the scope of accreditation. In this case,it was thought that at 20 G rotor rotation speed a concentrate assaying more than 15% $Cr_2O_3$is obtained with -150microns particle size.

III. RESULTS

Fine chromite can be concentrated from the chromite plant tailings by using Falcon Conentrator.In the enrichment experiments using Falcon concentrator, the highest gradeswere obtained at 20 G rotor rotation speed for all particle size fractions.7.11, 9.87,11.50, > 15 and 8.65 % Cr_2O_3 grades were obtained with -600, -500, -300, -150, -75 microns particle sizes respectively.

By using Falcon concentrator 51.36 % and 63.03 % recovery was obtained with -600 and -150 micron particle size fractions. By increasing rotor rotation speeds the chromite grades decrease and recoveries are increase at -600µ, -500µ and -300µ grain sizes.At the rotation speeds of 20 G, 30 G, 40 G, as the particle size decreases the grades of the concentrate increases and -150 micron can be chosen as optimum particle size for recover chromite from the tailings.

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