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MAGNETIC SEPARATION OF CHROMIUM-CONTAINING LATERITES

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ABSTRACT
Investigations on the separation of ore, utilizing the difference in magnetic properties of the minerals were performed. The influence of the magnetic induction and the cross slope of Franz-isodynamic separator were studied in a laboratory scale. Experiments with ore ground for different durations were made. Experiments with semi-industrial separators – flat Jones separator and cross band separator were performed with the estimated optimal particle sizes. The optimal conditions for mineral processing of chromite material were found.

INTRODUCTION

The exploitation of less-important and poor deposits attracts growing attention along the recent development of mineral processing technologies. For example, chromium-containing laterites, formed by weathering of ultrabasic rocks, represent an interest in chromium production (Savvidis, S., Cargiotis, E., 1997.). Exploitation of this kind of rocks is cost-effective. The mineral processing ability of laterites is facilitated by the differences established in the grindability and magnetic properties of the constituting minerals.

Chromium containing laterites from the Philippines were investigated, with the aim to check the opportunity of application of magnetic methods in production of chromite concentrate. Preliminary studies of magnetic properties of the minerals contained in the ore were the reasoning of the present studies.

METHODS AND EQUIPMENT

Concomitant minerals, such as magnetite, silicate minerals, etc., have been found in the larger fractions of the ground material, which do not contain limonite aggregates. It has been established that their magnetic properties differ from those of chromite and they could be processed by magnetic separation.

Different vein minerals, accreted with the chromite grains are uncovered by selective grinding. Those which could not be separated, are, in most cases, strongly magnetized. In order to achieve high degree of mineral processing of the chromite concentrate, the accreted grains containing low percentage of chromite, should be separated by magnetic methods.

Franz-isodynamic separator was used for that purpose. To estimate the feasibility of the separation results in semi-industrial scale a “Jones separator” and a “cross band separator” were used.

The samples were dried at a temperature of 50^{0}C. The parameters of the classifier were established preliminary.

The initial separation of the material was made in 20 mT magnetic induction. Further experiments were made in higher intensity of the magnetic field. The magnetic induction has been increased on discrete levels, starting from 20 mT to the uppermost level of 120 mT (fig 1).

MINERAL PROCESSING OF CHROMITE IN FRANZ-ISODYNAMIC CLASSIFIER

Preliminary experiments for magnetite separation

The fraction 100 μm was used for these experiments. The content and extraction of Cr_2O_3 and FeO in the magnetic material depend on induction. In 20 mT magnetic induction, the ferromagnetic, i.e. strongly magnetized minerals, are being separated. The content of FeO was 8.6%, in extraction rate 0.1%. The chromite content was represented mainly by incorporation of chromite ions in magnetite lattice and small proportion of accreted chromite.

In 40 mT magnetic induction (fig. 2), FeO content decreased to 68.3%, while the extraction was 4.9%. Contrary to this, Cr_2O_3 content increased to 20.3% and its extraction to 0.9 %. The grains were with magnetite or martitized magnetite. Mainly, strongly magnetized minerals accreted to chromite are being involved here.It was found in the material accreted together magnetite and martitized magnetite.

A decrease of FeO content, respectively an increase of Cr_2O_3 content, was observed in induction values between 60 and 80 mT. Yet, not accreted ferrimagnetic materials were not observed. It can be inferred from the metallic content of the products, that iron-rich accreted grains should be separated as a rock material. Therby small chromite loss could not be avoided.

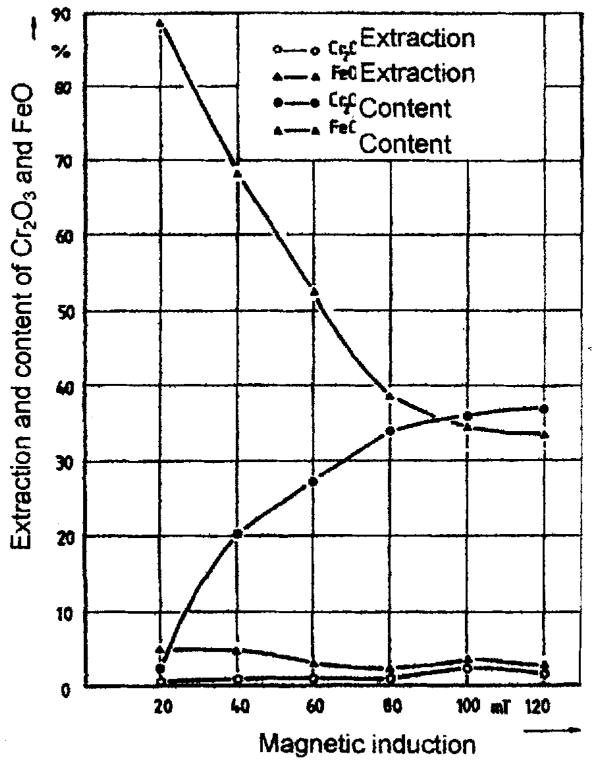

Figure 1. Extraction and content of Cr_2O_3 and Fe0 in the magnetic product of Franz-isodynamic separator in terms of magnetic induction

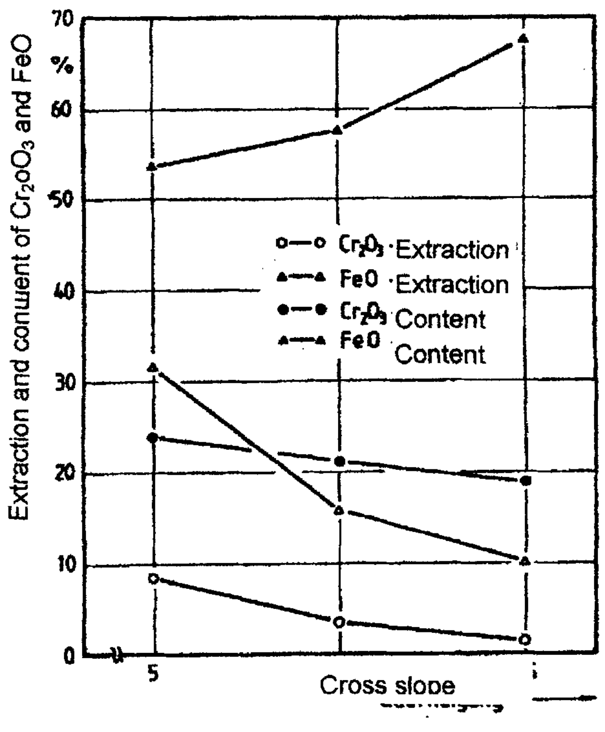

Figure2.. Extraction and content of Cr_2O_3 and FeO in the magnetic product in terms of the cross slope of the classifier at magnetic induction 40 mT

Cr_2O_3 content in the magnetic product increases significantly at more higher magnetic induction values. So, at 120 mT, Cr_2O_3 content was 38.3%, with extraction 1.7%, and Fe content in the raw material was 31.9%. Cr/Fe ratio was 1.06

CHROMITE SEPARATION BY DRY MAGNETIC METHOD

The fractions >100 μm and 100-163 mμ were used in the experiments of mineral processing of cbromite by the method of dry magnetic separation. Because the fraction 63-20 mμ consists mainly of limonite aggregates, it could not be processed by magnetic separation methods.

The separation of the raw material was implemented in two stages. Three products were obtained:

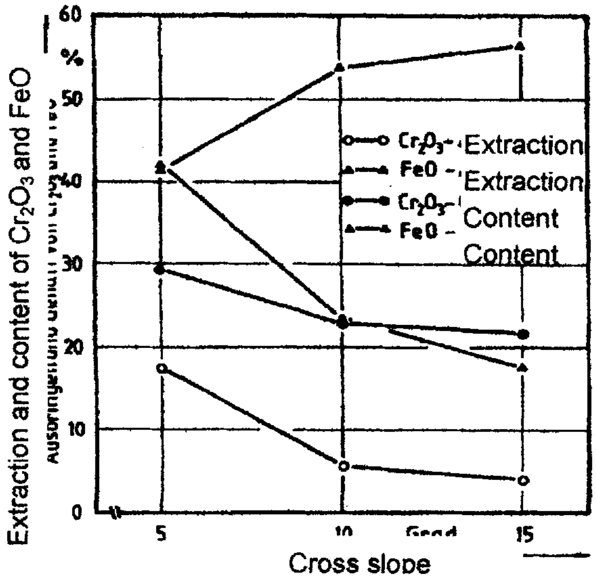

Figure 3. Extraction and content of Cr_2O_3 and FeO in the magnetic product in terms of the cross slope of the classifier at magnetic induction of 60 mT

iron rich product; chromite concentrate; and waste product. The magnetite and the grains strongly accreted with magnetite were separated at magnetic induction 480 mT. Table 1 shows the results of this separation.

The data from the separation of fraction >100μm are shown in Table 2. In increasing the time of grinding the amount of iron rich product decreases from 6,7 to 3,2%. In the same time the extraction of Cr_2O_3 decreases from 3,6 to 1,6%. The metallic contents show, that in these conditions part of the accreted with magnetite chromite grains have not been separated. So, for example, at milling time 20 min the content of Cr_2O_3 in metallic product was 18,2%, at extraction 1,6%. This amount of chromite should be separated from the iron concentrate. Thus the chromite concentrate was obtained, by separation of the iron rich product from the waste product.

The raw material, which was milled for 5 min exhibited high chromium extraction rate in the concentrate – 95,1%. The mineral processing of Cr_2O_3 got increased from 31,5% to 37,4%, but in general, stayed on a low level. The remaining limonite aggregates in the material were removed mainly together with the chromite. The content of FeO in the concentrare, therefore, was very high -29,4%.

Since for 10 min grinding, limonite aggregates were almost absent in the fraction >100μm, Cr_2O_3 content in the concentrate greatly increased in comparison to the product ground for less time. Cr_2O_3 content in the concentrateв was 42,9%, at extraction rate 96,2%.

In increasing the milling time, the result of the magnetic separation was further improved. In 15 мin milling time Cr_2O_3 content in в the concentrate was 44,5% at extraction rate 96,8%. In 24,1% FeO content, the ratio Cr/Fe was 1,62. The metallic contents show, that a part of this concentrate still contains chromite grains accreted to the iron minerals. An increase of the milling time to 20 min resulted in further increase of chromium content. Based on this result, one can conclude that for these milling conditions, the raw material should not be milled for more than 15 min, since great part of the chromite will go in the finer fraction.

In 480 mT induction, a small part of the chromite did not get magnetized, thus went into the waste product, together with the rock minerals. The chemical composition of these chromite spynels determines their magnetic properties. The content of FeO in the grains varied between 13,3 and 16,5%, while MgO content was between 14,3 and 17%.

Table 1. Weight distribution and distribution of the metal for laterite chromite ore of the magnetic products in different magnetization (ρ>4.1)

Magnetic induction [mT]	Weight [%]	Content[%]				Cr/Fe-Ratio	Cr_2O_3 - Extraction [%]
		Cr_2O_3	FeO	MnO	Al_3O_3		
-40	5.6	15.6	69.4	2.2	4.3	0.20	2.1
40-80	7.9	30.3	42.2	4.3	10.4	0.63	5.6
80-120	8.8	34.2	34.0	6.6	12.8	0.89	7.1
120-160	3.6	36.9	29.2	7.0	13.2	1.11	3.1
160-200	4.9	39.3	27.8	7.9	14.2	1.24	4.5
200-240	2.3	41.3	24.9	8.5	14.4	1.46	2.2
240-280	8.6	43.2	23.5	9.7	14.4	1.62	8.8
280-320	11.0	46.5	21.8	10.3	14.8	1.88	12.1
320-360	16.7	48.7	19.2	10.9	15.0	2.27	19.2
360-400	23.4	49.4	18.5	11.6	15.1	2.48	27.3
400-440	5.2	48.3	18.2	12.7	16.5	2.47	5.9
440-480	0.7	47.7	17.4	13.3	16.8	2.41	0.9
+480	1.3	39.2	18.0	14.5	15.3	2.03	1.2
	100.0	42.4	26.1	9.3	13.8	1.43	100.0

This shows that the ferromagnetic Fe^{2+} ions, have been replaced by paramagnetic Mg^{2+} ions. Since the magnetic permeability of these grains does not differ at all from iron containing silicate minerals, they could not be separated by magnetic method. The extraction of Cr_2O_3 in the waste product varied between 1.3 and 1.7%.

As it can be seen from Table 3 the separation of the iron rich product for the fraction 100-63μm showed almost the same tendency as the fraction >100μm. Since the magnetic separation of the products containing limonite aggregates was performed together with the chromite, Cr_2O_3 content in the concentrate did not reach high rates. In increasing the milling time, the content of Cr_2O_3 was increased from 31,1% to 38,2%. Due to the high content of FeO, Cr/Fe ratio varied between 0.86 and 1.29. This fraction should be processed by other sorting methods.

Influence of the cross slope of the classifier upon the separation.

The content of Cr_2O_3 in the magnetic concentrate of the fraction >100μт could not reach the values of the same product extracted from the primary ore. Part of the laterite concentrate consists of chromite grains having low value of Cr/Fe ratio. Since these grains get magnetized easier than those which have not accreted to chromite, they should be separated in order to achieve better mineral processing of chromium concentrate.

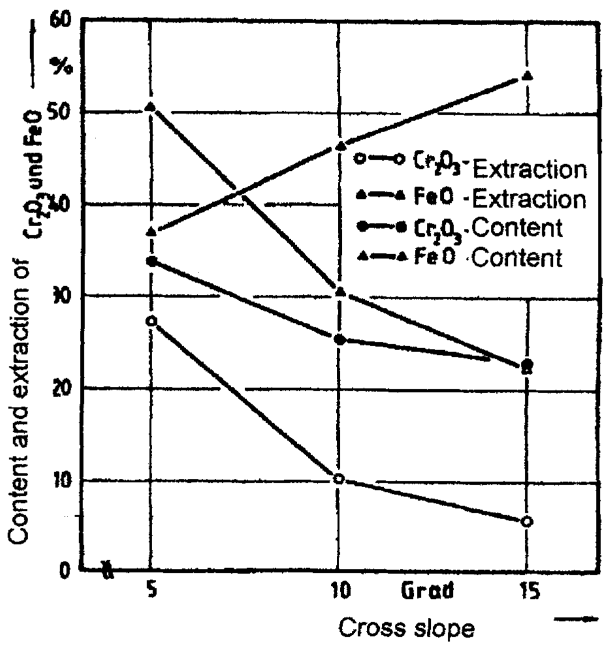

Figure 4. Extraction and content of Cr_2O_3 in the magnetic product in terms of cross slope of the classifier at magnetic induction 80 mT

According to the accretion the grains magnetize to a different degree, so they could be separated by increasing the magnetic induction, without formation of aggregates. Since the cost of magnetic separation in industrial scale is very high, this way for mineral processing of chromite is not used in practical cases.

Magnetic separation should be implemented in two stages. In the first stage should be separated the iron minerals, as well as the grains with low Cr/Fe ratio accreted to them. A high induction is necessary for that purpose. An increase in the magnetic field gradient leads to an increase of the magnetic force action between the grains. Magnetic aggregates are formed, in which could participate slightly magnetized grains.

Because of that, the classifier could chock with the aggregates formed. If the cross slope of the classifier decreases, the gravitational force F_eO, acting upon the grains decreases too. This means a relative increasing of the magnetic force F_M. In this way, aggregate formation could be diminished, from one side, and the separation of the material is improved, from the other side.

Table2. Results from the magnetic separation of the fraction >100 μm

Milling time			Content, %		Cr/Fe-	Cr_2O_3 -
[min]	Product	Weight, %	Cr_2O_3	FeO	Ratio	Extraction
5	Iron rich product	6.7	16.9	70.3	--	3.6
	Chromium concentrate	80.1	37.4	29.4	1.12	95.1
	Waste	13.2	3.2	4.2	--	1..3
	Total	100.0	31.5	28.8	--	100.0
10	Iron rich product	4.2	20.0	66.1	--	2.3
	Chromium concentrate	81.8	42.9	25.3	1.49	96.2
	Waste	14.0	3.9	3.8	--	1.5
	Total	100.0	36.5	24.0	--	100.0
15	Iron rich product	3.3	18.9	67.3	--	1.7
	Chromium concentrate	82.0	44.5	24.1	1.62	96.8
	Waste	14.7	3.8	3.6	--	1.5
	Total	100.0	37.7	22.5	--	100.0
20	Iron rich product	3.2	18.2	68.5	--	1.6
	Chromium concentrate	78.6	44.8	23.9	1.65	96.7
	Waste	18.2	3.4	2.9	--	1.7
	Total	100.0	36.4	21.7	--	100.0

The separation behavior of the raw material should be kept in terms of magnetic induction and cross slope. The cross slope of the classifier was changed to 5, 10 and 15 degrees. The fraction sized >100μm and milled for 15 minutes was sent to a magnetic classifier.

The first experiments were performed at magnetic induction 40 mT. Fig. 2 shows the extraction and the content of Cr_2O_3 and FeO of the magnetic product. At cross slope of 5^0, it was achieved high level of separation of FeO containing material. The content of FeO in the product obtained, amounted a 53.7% at extraction rate 31.3%; Cr_2O_3 content was 23.9% at extraction rate 8.3%. This separation result shows that, at relatively high degree of mineral processing of the chromium concentrate, an inevitable, high loss of chromium is observed.

Table 3. Results from the magnetic separation of the fraction 100- 63 μm.

Milling	Product	Weight, [%]	Content [%]		Cr/ Fe	Cr_2O_3
time min			Cr_2O_3	FeO	Ratio	Extraction
5	Iron rich product	6.6	15.8	69.5	--	3.8
	Chromium concentrate	83.2	31.1	31.7	0.86	94.2
	Waste	10.2	5.4	6.8	--	2.0
	Total	100.0	27.5	31.5	--	100.0
10	Iron rich product	4.1	16.9	68.3	--	2.3
	Chromium concentrate	83.7	34.5	28.9	1.05	95.4
	Waste	12.2	5.6	4.7	--	2.3
	Total	100.0	30.4	27.5	--	100.0
15	Iron rich product	2.9	18.4	67.2	--	1.7
	Chromium concentrate	82.5	37.0	27.2	1.20	95.8
	Waste	14.6	5.5	4.1	--	2.5
	Total	100.0	31.9	25.0	--	100.0
20	Iron rich product	2.5	19.2	66.1	--	1.5
	Chromium concentrate	82.2	38.2	26.0	1.29	95.7
	Waste	15.3	6.0	3.8	--	2.8
	Total	100.0	32.8	23.6	--	100.0

Chromium loss was diminished by increasing the cross slope. The decrease of FeO extraction was greater than that at 40 mT induction.

Due to magnetic aggregates formation however, magnetic induction should be limited up to 80 mT.

Chromium extraction diminished sharply at cross slope of 10^0; and FeO extraction rate was 15,8%.

In the next experiments the material was separated at 60 mT magnetic induction. Fig 3 shows that the weak induction increase leads to significant increase of the magnetic force which acts upon mineral grains. In cross slope of 5^0 FeO content was 41.7% in extraction rate 41.9%; Cr_2O_3 content was 29.4% at extraction rate 17.6%.

This result implies that, in increasing the magnetic induction, the cross slope of the classifier has more and more tangible effect upon the separation results. At cross section of 10^0 and 15^0, the extraction rate of Feo was lower, and FeO content was high: 53.8 and 56.5% respectively.

The final experiments were conducted at 80 mT magnetic induction. Fig 4 shows the results from the separation of the magnetic product. Magnetic aggregate formation occurred in this field intensity. This process increased chromium extraction in the magnetic product. Cr_2O_3 content was 33.9% at cross slope of 5^0, while the extraction was 27,4%. At 10^0 cross slope, the extraction of Cr_2O_3 was 10.2%, while the extraction of FeO was 30.6%. These results were not so good, in comparison to the other results, e.g. those at 40 mT induction and 5^0 cross slope.

For two stage processing of the chromite concentrate, a nonmagnetic material was transferred to the Franz – isodynamic classificatory. In this case the magnetic induction was 480 mT, and cross slope was 15^0. The results from this concentrate separation are shown on table 4. By separation of the silicate rock minerals, the material, whose iron rich grains were separated at 40 mT magnetic induction, was processed with a small Cr loss. Concentrate Cr_2O_3 content varied between 44.5 and 47.1%, and the extraction rate between 96,8 and 90,2%.

Table 4. Results from the magnetic separation for the fraction >100 μm, in different magnetic induction and different cross slope of the classifier

Magnetic induction	Cross slope	Weight	Content, %		Cr/Fe-	Cr_2O_3 -
mT	[°]	%	Cr_2O_3	FeO	Ratio	Extraction, %
40	5	72.2	47.1	21.6	1.92	90.2
	10	79.1	45.3	23.3	1.71	95.1
	15	82.0	44.5	24.1	1.62	96.8
60	5	62.7	48.6	20.0	2.14	80.9
	10	75.6	46.2	22.2	1.83	92.6
	15	78.3	45.5	23.0	1.74	94.5
80	5	54.8	48.8	19.5	2.21	71.2
	10	70.5	47.3	21.4	1.95	88.5
	15	75.7	46.1	22.2	1.82	92.6

The separation of the iron rich grains at 60 mT induction was accompanied with high Cr content in the concentrate. It reached 48.6% at cross slope of 5^0, at 80.9% extraction rate. In 20% FeO the Cr/Fe ratio of the concentrate was 2,15. This shows that the accreted to iron minerals chromite grains were separated almost completely.

The material from which the iron rich particles were separated at 80 mT magnetic induction and 5^0 cross slope, showed almost the same Cr_2O_3 content in the в concentrate as it was at 60 mT. And, chromium extraction decreased significantly and reached 71.2% value. At these separation parameters, the Cr rich grains were separated as magnetic material.

The separation results show that the two stage magnetic separation leads to high Cr_2O_3 in the concentrate. Furthermore, aggregate formation can be diminished. The least possible magnetic induction should be used for separation of the iron rich particles.

MINERAL PROCESSING OF CHROMITE BY FLAT JONES TYPE CLASSIFIER

The results from the Franz isodynamic classifier should be considered, thinking about practical application of magnetic separation in mineral processing of chromite from laterite ore. Dry Jones type classifier with strong field produced by Humboldt-Wedag company is widely used for separation of mineral raw materials. The above mentioned particle sizes of the material determine the width of the channel between the profiles of the plot. (Wenz, Aufbereitungs-Technik, S. 142/149 (1973) –f). The content of a solid substance in the pulp is 40 %. Magnetic induction varying between 0.10 and 0.25 T was applied in order to separate the iron rich mineral particles. The rotation speed of the rotor was 3.4 m/min. The magnetic material was moved upon the plot's surface by washing with water at 4 bar pressure. A sample of about 10 kg weight was used for each experiment. Fig. 5 shows the content and extraction rate of Cr_2O_3 and FeO. In this induction range, the material was separated without chocking of the channels.

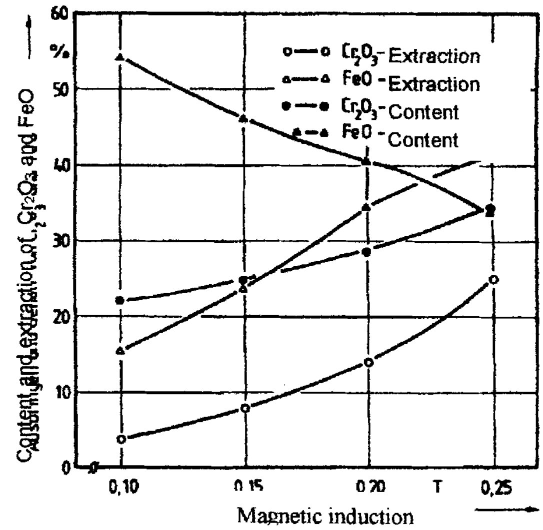

Figure 5. Extraction and content of Cr_2O_3 and FeO in the magnetic product, in terms of magnetic induction for the case of flat classifier.

It can be seen from the curves, that the separation of the iron rich grains was best implemented in the range of 1.10 – 0.20 T. The extraction of FeO increased from 15.5 to 34.6%, and the Cr_2O_3 extraction also increased from 3,8 to 14.4 %. Weakly magnetized iron containing silicates, such as enstatite and iron rich quartz, were found in the magnetic material, which was separated at 0.20T induction. In the separation zone, these light rock materials were kept in agglomerates consisting of strongly magnetized iron minerals. Due to this circumstance, the content of FeO decreased. At 0.25 induction rate, the extraction of Cr_2O_3 in the magnetic material increased strongly in comparison to the extraction of FeO. And, it was observed that, at this induction rate, the chromium rich grains separate like a magnetic material.

In comparison to the results obtained by Franz isodynamic classifier, a concluson can be drawn, that, at 0.20T induction rate, the separated nonmagnetic material is suitable for further mineral processing of the chromite The result obtained at this induction rate is shown on the table below:

Product	Yield	Content %		Extraction%	
	%	Cr_2O_3	FeO	Cr_2O_3	FeO
M	19.2	28.2	40.5	14.4	34.6
NM	80.8	39.9	85.6	85.6	65.4
Total	100,0	37.7	100.0	100,0	100,0

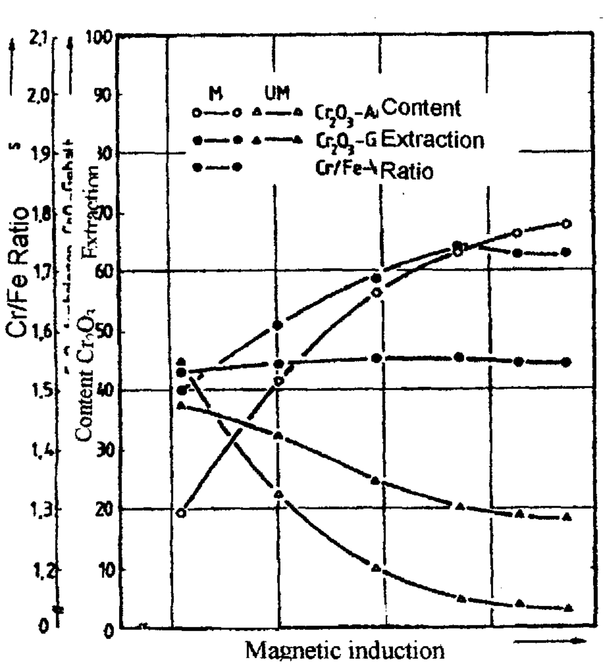

Figure 6. Extraction and content of Cr2O3 in the magnet magnetic product (M) and the nonmagnetic product (NM), and Cr/Fe ratio, in terms of magnetic induction for flat Jones type classifier

For the mineral processing of the chromite concentrate the magnetic induction values varied between 0.62 and 1.35T. Three products were obtained: magnetic product (concentrate); medium magnetic product (intermediate product); nonmagnetic product (waste product). Fig 6 shows the extraction rates and the contents of Cr2O3 of the magnetic and nonmagnetic product, as well as the Cr/Fe ratio. At 0.62T induction rate, only a small amount of the chromite in the concentrate was extracted. The content of Cr_2O_3 in the concentrate was 43.3% at extraction rate of 19.7%, and the process ran with a significantly higher induction, compared to that of the Franz isodynamic classifier. This shows that in the process of separation implemented with a flat Jones type classifier, with the same magnetic induction, the ratio between the gravitational and magnetic force is greater than the same ratio in Franz isodynamic classifier, so the iron poor chromite grains are extracted as nonmagnetic or medium magnetic raw material. And, the content of Cr_2O_3 in the nonmagnetic sample was 37.8% at induction rate of 44.4%. In magnetic induction 0.80T, the extraction of chromium in the concentrate increased sharply and reached a value of 41.7%. The Cr_2O_3 content in the sample, further, had a lower value of 44.5%. Still a considerable part of the chromite stayed in the waste product.

It was necessary to increase the magnetic induction rate, in order to magnetize the iron poor chromite, which has remained in medium product and in the waste product. The highest content of Cr_2O_3 in the concentrate was achieved at 1.14T induction; it reached 45.6% at extraction rate 63.4%. The Cr/Fe ratio was 1.74. A small part of the concentrate consisted of iron containing silicate rock materials, so despite the significant increase of the extraction rate, the chromite content did not reach high values. In further increase of the magnetic induction, it was increased both the Cr_2O_3 extraction and the incorporation of silicate rock materials in the concentrate. So, for example, at 1.35T induction, Cr_2O_3 content in the concentrate was 44.6%, and the extraction was increased to 68%.

In nonmagnetic sample the extraction of Cr_2O_3 showed very small value of 3.5%. This shows that in a flat Jones type classifier, for the iron-containing silicate minerals is true almost the same relation between the forces, as in the case of iron poor chromite grains , despite that the first ones have lower magnetic permeability than that of the chromite. It is due to density differences. The poor separation result could be improved by classification of the materials. For the laterite chromite as-applied method is not economically viable.

In increasing the induction, the extraction rate of FeO was increased from 25.3 to 49.7%, while the extraction rate of Cr_2O_3 was increased from 6.6 to 30.3%.

Induction rate of 0.2T targeted the achievement of very good result, which could be obtained in Franz- isodynamic classifier at 60mT induction and cross slope of 5^0.

The separation result is shown on the table below.

The separation of the rock minerals from the nonmagnetic product in the first stage of magnetic separation was performed at magnetic induction varying between 0.50 and 0.70 T. Fig 7 shows Cr_2O_3 content and the extraction of the concentrate and the waste product, as well as Cr/Fe ratio of the magnetic product in terms of the magnetic induction.

The low content of Cr_2O_3 in the concentrate –44.6% which came at 0.5T induction showed that one part of the chromium rich particles has not been magnetized and has gone to the waste product as nonmagnetic material. Thereby, the extraction of Cr_2O_3 reached the same low value – 58.2%.

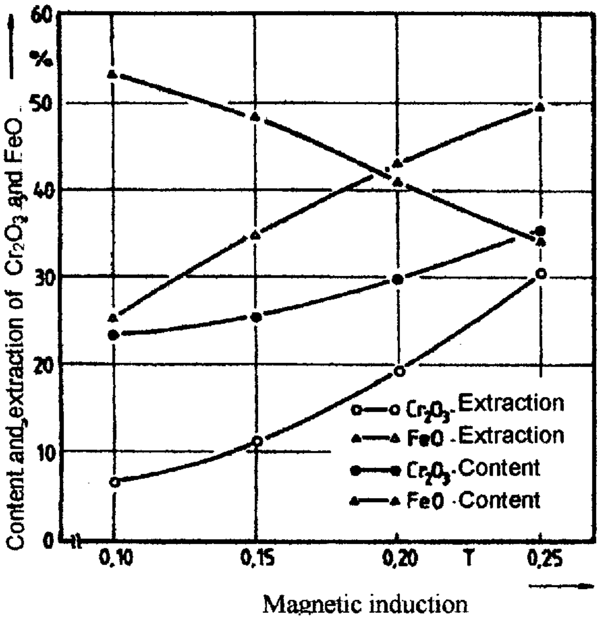

Figure 7. Extraction and content of Cr_2O_3 and FeO of magnetic product in terms of magnetic induction for cross band classifier.

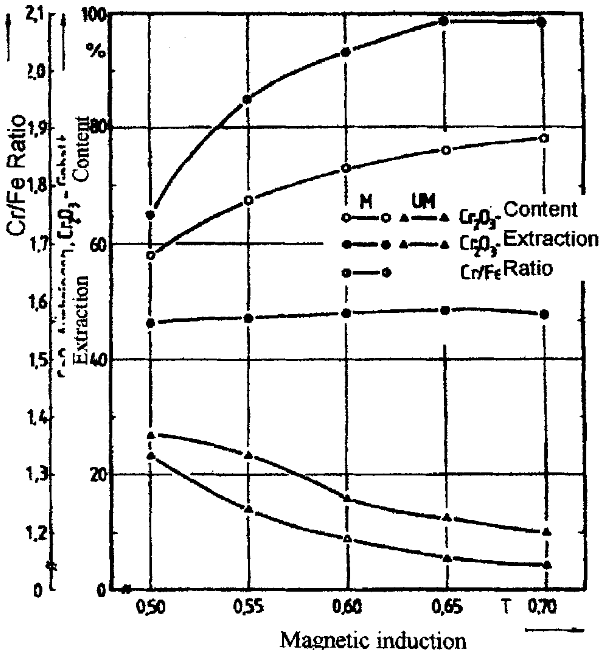

Figure 8. Content and extraction of Cr_2O_3 *in magnetic product (M) and nonmagnetic product (NM), Cr/Fe ratio of M in terms of induction for cross band separator. NM was separated at 0.2T magnetic induction*

Product	Mass %	Content %		Extraction%	
		Cr_2O_3	FeO	Cr_2O_3	FeO
M	23,7	29,6	40,9	18,6	43,1
NM	76,3	40,2	16,8	81,4	56,9
Total	100,0	37,7	22,5	100,0	100,0

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MINERAL PROCESSING OF CHROMITE BY CROSS BAND CLASSIFIER

Further, an attempt was made to check if the results obtained by means of Franz-isodynamic classifier could be transferred in an industrial scale in case of dry magnetic separation. Cross band classifier was used for these experiments. The classifier operated according to the following specifications:

Magnetic induction: 0.10-0.25 and 0.50-0.70 T	
Velocity of the main band:	0.36m/sec
Velocity of the cross band:	0.50m/sec
Sample amount:	10 kg

Fig 8 shows the content and the extraction rate of the magnetic product. In comparison to the results obtained by flat Jones type classifier, much more extraction rate of Cr and Fe was achieved for each of the induction values. This difference in the extraction shows that in the case of cross band classifier the magnetic force is greater than that in flat Jones type classifier. Therefore, in this case was achieved better separation of the iron rich grains. In increasing the induction, the chromium content in the magnetic concentrate was achieved. At 0.60T induction Cr_2O_3 induction was 47.9% at extraction rate 72.8% and Cr/Fe ratio 2.03. At 0.65T induction it was achieved the most higher Cr content in the concentrate – 48.2% at extraction rate 76.3%. At FeO content of 20.3%, Cr/Fe ratio in the concentrate was 2.08. And there was a loss of Cr_2O_3 in amount of 5.1%. This loss can be diminished by induction increase. At 0.70T induction the extraction of Cr_2O_3 was 3.8%. Despite that iron-containing silicate minerals were magnetized and have been extracted as magnetic product, Cr_2O_3 content in the concentrate decreased. The values were 47.8% at extraction rate 77.6%. And, the content of FeO decreased too, so the ratio stayed 2.08.

CONCLUSION

The investigations performed in this studies have shown that the difference in the magnetic properties of the minerals which are constituents of chromium containing laterites can be used for production of chromite concentrate.

The investigations, performed in a laboratory and semi-industrial scale have verified this.

REFERENCES

Savvidis, S., Cargiotis, E. 1997. Die Serpentin – Grouppe Minerale im Vourinos Ophiolith-Komplex, Nord Griechenland. Oberhessische Naturwissenschaftliche Zeitschrift ISSN 0340-4498, Band 59, S. 91-101.