RESEARCHERID
THOMSON REUTERS

[Ahmed*, 6(12): December, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PROCESSING OF MERYKHAT SAUDI TALC FOR DIFFERENT INDUSTRIAL APPLICATIONS

Prof. Hussin A.M. Ahmed
Mining Engineering Dept., King Abdulaziz University, Kingdom of Saudi Arabia
Permanent address: Central metallurgical R & D Institute, Helwan, Cairo, Egypt

DOI: 10.5281/zenodo.1130830

ABSTRACT

Talc, as an industrial mineral, has numerous applications. The run-of-mine talc ores usually have gangue minerals. The type, nature, and quantity of these minerals beside other variables as particle size, shape, hardness, specific gravity, morphology and brightness represent key parameters for its possible industrial applications. This paper aims at Characterization, liberation and processing of Saudi talc ore from Merykhat valley for different industrial applications. Characterization was carried out by size analyses, chemical analyses, petrographic studies and XRD. Liberation studies were implemented by using Bromoform and by using Frantez Isodynamic Magnetic Tester. Results showed that the Saudi Talc ore is of low grade. It has carbonates, magnesite, and dolomite as main gangue minerals. Liberation studies of the talc ore using Bromform is efficient in size fractions coarser than 0.09 mm while Frantez Isodynamic Tester is efficient for the whole range of tested size fractions. The lowest iron recovery possible to attain in the nonmagnetic fraction (using Frantez Isodynamic Tester) is approximately 5.5% when the degree of fineness of the ore is below 0.063 mm.

KEYWORDS: Talc, liberation, Bromoform, Processing

I. INTRODUCTION

Talc is a mineral of the phyllosilicate family. It is mainly hydrated magnesium silicates. Its chemical formula is $H_2Mg_3(SiO_3)_4$ or $Mg_3Si_4O_{10}(OH)_2$. Talc usually has magnesia, water and silica. Compared to serpentine talc has relatively higher silica content (Schandl et al., 1999; Schandl et al., 2002). Commercial talc has some other sheet silicates such as serpentine and chlorite, as well as, carbonates such as dolomite, calcite and magnesite (Gondim and De Loyola, 2002). Talc can be used as filler in different industries such as paints, paper, plastics, polymers, ceramics, animal foods, rubber, fertilizers, insecticides and cosmetics (Helmy and Kaindl, 1997; Sarquis and Gonzalez, 1998; Ferrage et al., 2003a).Talc resistance to heat, electricity and acids make it an ideal surface for lab counter tops and electrical switchboards. Typically, talc concentrates are produced applying dry processing techniques, while sophisticated wet processing techniques are recently used to satisfy the sharp market specifications for various applications (Schober, 1997; Yehia and Al-Wakeel, 2000; Ahmed, 2007; Mahmoud et al., 2011). The utilization of talc is determined by many variables such as the chemical and mineralogical composition, particle size, shape, specific gravity, hardness and morphology (Gondim and De Loyola, 2002). Particle size, loss on ignition and brightness are the most important parameters which are used to evaluate talc for market demands (Schober, 1997). The percentage of some constituents in talc such as calcium oxide, iron oxide and aluminum oxide determine also the quality of talc samples for industrial purposes. For ideal upgrading of talc ore, it is firstly recommended to evaluate the petrographical properties and geochemical characteristics of talc. Therefore, this paper aims at characterization and liberation studies of Saudi low grade talc ore for the purpose of its processing for filler industries.

II. MATERIALS AND METHODS

Characterization of the Talc Samples

About 500 kg-grab samples representing Merykhat valley locality of the Saudi talc were collected. The obtained samples were subjected to crushing in a pilot plant jaw crusher to less than 2 inches. The jaw crusher product was then further crushed using a roller crusher to less than 3.36 mm, the sample from the two different localities were completely mixed, and sampled by conning and quartering to obtain about 10 kg representative batches.

The latest obtained batches were further sampled using chute riffle samplers to obtain ~ 2.5 kg batches which were stored in plastic bags to avoid climatic moisture and to be suitable for futuristic use in the experimental work.

Talc Ore Chemical Evaluation

A one 2.5 kg -batch sample was successively ground, thoroughly mixed and split by a Chute-type sampler until it was divided into a number of 250 g samples. One of these samples was ultra fine ground to pass 200-mesh screen. This was further sampled using a Rotary riffle sampler to about 25 g small samples, one of which was subjected to complete chemical analyses. This chemical analysis was carried out by fusion of the talc sample using fusion mixture. Iron and aluminum were determined by complexmetry. Total silica was evaluated gravimetrically by the double baking method. Calcium and magnesium were measured by atomic absorption methods (Perkin Elmer 2380) whereas sodium and potassium were determined by flame photometry (Ferrage et al., 2003b).

Petrographic Examination of Talc Ore

This was carried out by both X-ray diffraction analysis method and ore microscopy. A Shimadzu X- ray diffractometer model "labx XRD 6000" was used for the former purpose. While in ore microscopy both thin and polished sections of the samples were prepared and inspected by either transmitted or reflected light using an "Orthlux leitz" microscope. Results of the mineralogical study either using XRD or microscopic investigations showed that main gangue minerals of talc are carbonates, magnesite, dolomite, serpentine, chlorite and calcite, which contribute to production of undesirable characteristics. The existence of trace minerals including magnetite, pyrite, quartz and tremolite was also microscopically noticed.

Size Analyses of the Talc Samples

This was carried out, on dry bases, using the secondary crushed product and the ground product. Different sets of sieves were used according to the Tylor system basing on the sample degree of fineness. The percent weight of every size fraction was calculated. The different size fractions were subjected to chemical analyses for the purpose of following up the distribution of talc and iron bearing minerals in the talc samples.

Liberation Study of the Talc Samples

For the considered Talc ore liberation studies were carried out using Sink-float tests and Frantez isodynamic magnetic tester. In both of the techniques, the following size cuts were studied for liberation purposes -4.0 + 2.5 mm, -2.50 + 1.25 mm, -1.25 + 0.70 mm, -0.70 + 0.250 mm, -0.250 + 0.125 mm, -0.125 + 0.090 mm, -0.090 + 0.075 mm, -0.075+0.063, mm, and -0.063 mm size fractions.

In the Sink-float tests, a mass of each size fraction was poured in a separation funnel that is filled with Bromoform. The mixture was shacked and lifted for 5 minutes to achieve complete separation. The floated and the suspended materials were collected as float fraction. On the other hand, the sunken material was collected as sink fraction. Both fractions, sink and float, were washed, dried, weighted and chemically analyzed for mass balance calculations. The chemical analyses were run for the purpose of determining iron as Fe_2O_3 and Silica as SiO_2 in each product for each size fraction.

In the Frantez isodynamic tester, a mass of each fraction was subjected to magnetic separation on the device. Ferromagnetic minerals were first separated from the feed sample by a hand magnet and the remainder was subjected to high intensity magnetic separation process under predefined operating conditions of field strength and angle of inclination of the feed from the horizontal. Different magnetic and nonmagnetic fractions were collected, weighed, analyzed and sometimes mineralogically investigated.

III. RESULTS AND DISCUSSION

Characterization of the Talc Samples

Complete Chemical Analysis of the Original Ores

Results of the complete talc ore chemical analysis are shown in Table 1. It indicates that the ore is out of market specifications for industrial applications as filler. This is due to its extremely high iron content, which reaches 7.63 % Fe_2O_3 compared to a maximum acceptable of 1.5% Fe_2O_3 of talc as fillers in paper industry while other applications accept talc of lower iron contents. At the same time, the ore is of low silica content 55.43 % SiO_2 compared to a minimum required of 58.5% SiO_2 for talc filler in the paper industry with higher silica contents needed for other industries (Helmy and Kaindl, 1997).

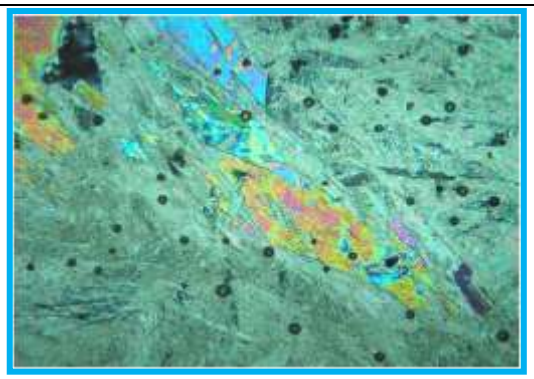
Table 1. Complete Chemical analysis of the Talc ore

Constituent	SiO_2	MgO	CaO	Al_2O_3	Fe_2O_3	P_2O_5	Na_2O	K_2O	MnO	SO_3
Percent	55.43	28.98	0.86	5.88	7.63	0.41	0.1	0.12	0.14	0.28

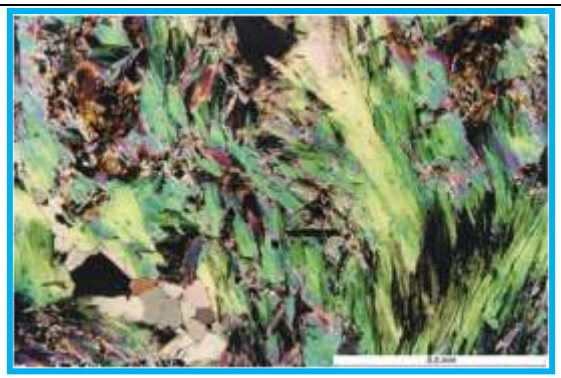
Petrographic Examination of the Talc Ore

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Microscopic study (both thin and polished sections) of the talc samples were carried out. The investigated talc samples were found to be from fine to medium grained rocks, composed mainly of talc (30 to 60 %), carbonaceous constituents (dolomite, magnesite and calcite ≈ 10 to 20 %). Chlorite, plagioclase, garnet, pyrite and other opaques are the main accessory minerals (Fig. 1a-f). On the other hand, X-ray diffraction analysis of the bulk talc samples shows peaks for talc and carbonaceous minerals with absence of iron bearing minerals peaks due to their low concentrations that are below detection limit of the XRD technique (Fig. 2).

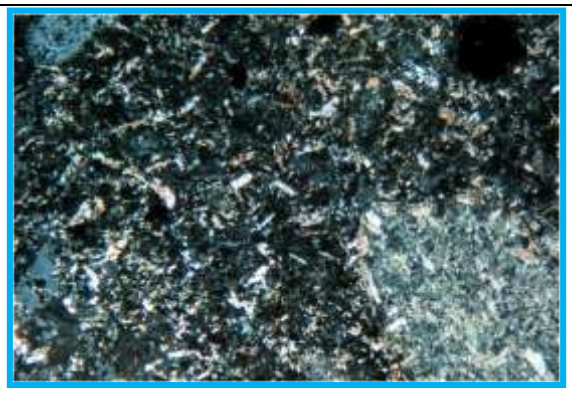


a. high interference colors of elongated talc crystals embedded in chloritized groundmass, C,N., X 50

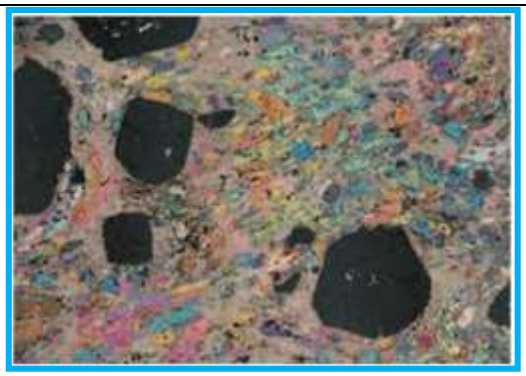


b. elongated talc crystals with wavy extinction, crystallized quartz filling the interstitials. , C.N.

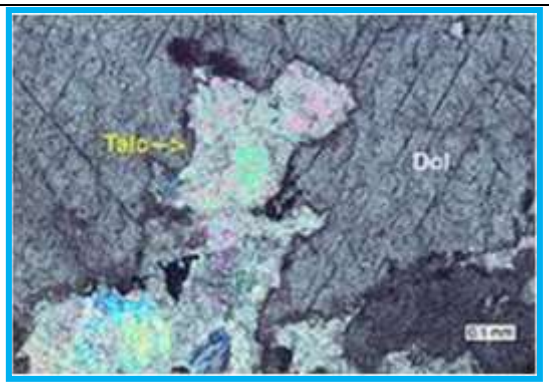
c. high releif of garnet, fibrous of talc crystals with relics of amphibole slightly to completely altered to chlorite. PPL. X150



d. prismatic cryptocrystalline of calcite arrange in two directions with relics of plagioclase crystals. C.N. X50



e. polygonal shape of garnet crystals with isotropism. C.N. X100



f. high corroded talc crystals with new recrystallized carbonate crystals. .C.N. X150

Figure1(a-f): photomicrographs showing talc petrographic examination

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

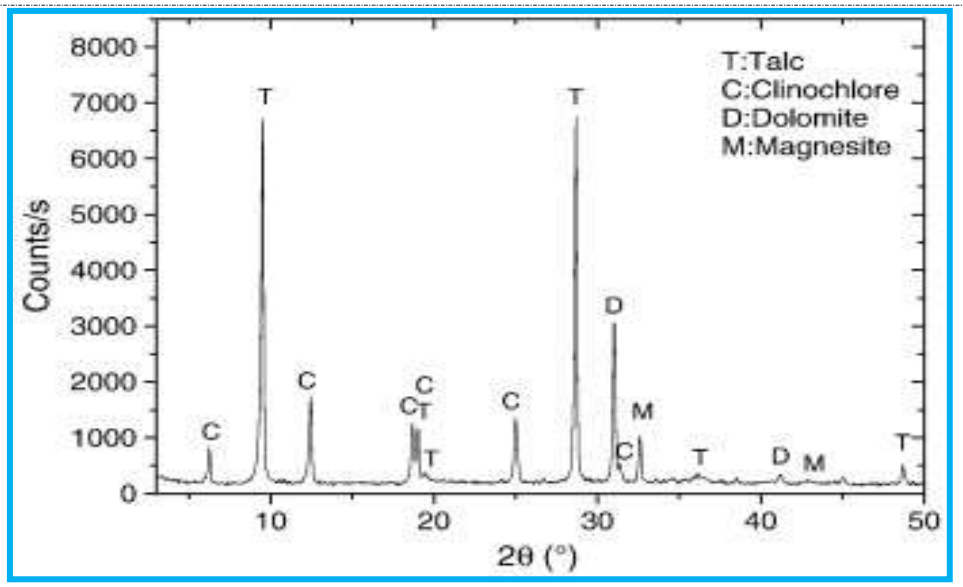


Figure 2: X-Ray Diffraction (XRD) Pattern of the Original Talc Sample

Granulometric Analysis of the Talc Samples

Size distribution of the crushed talc sample is shown in Table 2. It reflects a general unimodal distribution of the ore among the different size fractions with d_{50} of ~ 2.40 mm. The obtained d_{50} indicates that the talc product from the crusher is still of coarse size and cannot be subjected to liberation study. It needs more size reduction for obtaining finer size fractions. Table 3 shows size distribution of the ground talc sample. It indicates that the d_{50} has gone down to 0.8 mm. However, chemical analyses of the different size fractions in the crushed talc ore, shown in Table 2, implies that no preferential separation can be attained at this degree of comminution this is because both silica and iron did not have a certain fixed trend regarding their distribution at the different size fractions. On the other hand, a decreasing order of silica content in the fine size fractions corresponding to an increasing trend of iron is noticed with the ground ore (Table 3). This indicates that the chemical analyses of the ground talc ore implies a liberation characteristics in the fine size fractions where the percent of iron is increasing in the fine size fractions.

Table 2: Dry Size and Chemical Analyses of the Crushed Talc

size, mm	Wt. %	Cum. Wt. % passing	Assay, %		Distribution %	
			Fe_2O_3	SiO_2	Fe_2O_3	SiO_2
+8	-	100.0	-	-	0.00	0.00
-8+5.6	5.60	100.0	6.90	56.03	4.99	5.63
-5.6+4	21.18	94.4	7.89	56.03	21.56	21.31
-4+2.8	21.20	73.2	7.89	56.03	21.59	21.33
-2.8+2	18.21	52.0	7.89	55.06	18.54	18.00
-2+1.4	8.57	33.8	6.90	56.03	7.64	8.63
-1.4+1	4.90	25.2	7.89	54.10	4.98	4.75
-1+0.71	3.61	20.3	7.89	55.06	3.67	3.57
-0.75+0.5	2.16	16.7	7.89	55.06	2.20	2.14
-0.5	14.56	14.6	7.89	56.03	14.82	14.65
Total (Calc.)	100.00		7.75	55.70	100.00	100.00
Head	100.00		7.63	55.43	100.00	100.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Table 3: Dry Size and Chemical Analyses of the ground Talc

size, mm	Wt. %	Cum. Wt. % passing	Assay, %		Distribution %	
			Fe_2O_3	SiO_2	Fe_2O_3	SiO2
+4	-	100.0	-	-	0.00	0.00
-4+2.5	17.24	100.0	6.58	57.03	14.45	17.66
-2.5+1.25	17.79	82.8	7.30	57.06	16.54	18.23
-1.25+0.7	17.99	65.0	7.95	56.10	18.23	18.13
-0.7+0.25	16.40	47.0	8.00	54.10	16.72	15.94
-0.25+0.125	10.98	30.6	8.02	56.03	11.22	11.05
-0.125+0.09	6.57	19.6	9.00	55.06	7.53	6.50
-0.09+0.075	4.41	13.0	9.30	55.06	5.22	4.36
-0.075+0.063	3.81	8.6	9.15	53.10	4.44	3.63
-0.063	4.82	4.8	9.20	52.03	5.65	4.50
Total (Calc.)	100.00		7.85	55.67	100.00	100.00
Head	100.00		7.63	55.43	100.00	100.00

Liberation Study

Liberation study by Heavy Liquid (gravity separation)

Table 4 shows the sink-float results of separating the different size fractions of ground Talc sample, using Bromoform (sp. Gr. 2.98). Data presented in this table, shows a gradual increase in the weight percent of the floated fractions with increasing degree of fineness till a certain limit (for size fractions coarser than or equal to -0.125+0.090 mm). This increase in the floated fraction corresponds to a decrease in the iron content in the floated fraction and increase in its silica content. The previously described phenomena may be attributed to an increase in liberation characteristics of the ore. This means that at coarse fractions iron bearing minerals are not liberated from the talc minerals and thus they go to the sink or float according to the percentage interlocking of the particles. These iron particles when liberated usually go to the sink fraction leaving the talc minerals reported at the floated fractions. However, this phenomenon is not valid for size fractions below 0.09 mm. this may be attributed to the separation efficiency in the Bromoform media, where it is expected that fine particles and electrostatic charges in each particle retard the separation and thus returning misleading results. Consequently, results obtained at these fine size fractions (below 0.09 mm screen) did not reflect the real case of liberation. However, Sink float liberation of the different studied talc size fractions show that the cleanest talc concentrate that may be obtained from this ore may have around 1.2 % Fe_2O_3 corresponding to size fraction of -0.090+0.075 mm, which cannot be considered as high quality talc concentrate. For this reason Frantz isodynamic tester will be used for further investigation of the talc liberation characteristics.

Table 4. Liberation study Results of the Talc Ground Sample Using Bromoform

Size, mm	Product	Wt., %	Assay, %		Operational Recovery, %	
			Fe_2O_3	SiO_2	Fe_2O_3	SiO_2
-4.0+2.5	Float	73.6	3.03	67.33	33.9	86.9
	Sink	26.4	16.47	28.30	66.1	13.1
	Total	100	6.57	56.91	100	100
	Head	17.24	6.58	57.03	100	100
-2.50+1.25	Float	79.5	2.70	63.33	29.36	88.23
	Sink	20.5	25.15	32.76	70.64	11.77
	Total	100	7.29	56.95	100	100
	Head	17.79	7.30	57.06	100	100
-1.25+0.70	Float	83.5	2.41	60.60	25.36	90.2
	Sink	16.5	35.96	33.32	74.64	9.8
	Total	100	7.93	55.98	100	100
	Head	17.99	7.95	56.10	100	100
-0.70+0.250	Float	86.88	2.06	56.79	22.36	91.2
	Sink	13.12	47.34	36.28	77.64	8.8
	Total	100	7.98	53.99	100	100

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Size, mm	Product	Wt., %	Assay, %		Operational Recovery, %	
			Fe_2O_3	SiO_2	Fe_2O_3	SiO_2
	Head	16.40	8.00	54.10	100	100
-0.250+0.125	Float	89.33	1.65	59.31	18.43	94.56
	Sink	10.67	61.31	28.57	81.57	5.44
	Total	100	8.00	55.92	100	100
	Head	10.98	8.02	56.03	100	100
-0.125+0.090	Float	90.25	1.66	58.33	16.63	95.6
	Sink	9.75	76.96	24.85	83.37	4.4
	Total	100	8.98	54.95	100	100
	Head	6.57	9.00	55.06	100	100
-0.090+0.075	Float	83.69	1.29	63.03	11.65	95.8
	Sink	16.31	50.38	14.18	88.35	4.2
	Total	100	9.28	54.95	100	100
	Head	4.41	9.30	55.06	100	100
-0.075+0.063	Float	81.55	1.76	57.69	15.69	88.6
	Sink	18.45	41.81	32.81	84.31	11.4
	Total	100	9.13	52.99	100	100
	Head	3.81	9.15	53.10	100	100
-0.063	Float	77.58	2.33	50.76	19.63	75.69
	Sink	22.42	32.98	56.41	80.37	24.31
	Total	100	9.18	51.92	100	100
	Head	4.82	9.20	52.03	100	100

Liberation Study using Isodynamic Magnetic Tester

The Frantz Isodynamic magnetic tester has been, always, an excellent tool in applied mineralogy studies, particularly with paramagnetic minerals. As a result it was used in the current work to evaluate the possibility of separating the iron bearing minerals from the talc minerals as a measure of liberation. In this case the talc ore was ground and classified in different size fractions as previously mentioned. A representative sample from each size was obtained and subjected to magnetic separation using the Frantez Isodynamic tester. Results of the magnetic separation of the different size fractions for the different fractions of the ground talc sample are shown in Table 5. Obviously, the separation is much sharper than in sink-float tests. This can be easily noticed when comparing results of the coarsest tested size fraction i.e. -4+2.5 mm. where in the case of sink-float the concentrate fraction (float) contained 3.03 % Fe_2O_3 while on using Frantez tester the same size fraction nonmagnetic concentrate was limited to 2.28% Fe_2O_3 with approximately a similar yield in both cases approaching 73% of the size reported to the concentrate product. Comparing the other tested size fractions confirm the same conclusion that is Frantez tester results is much better compared to the Sink- Float results. This enables more confidence level in the results obtained in the case of using the Frantez Isodynamic tester.

However, both applied liberation techniques demonstrate a gradual liberation of iron-bearing minerals from talc minerals by grinding but not to the point to yield high grade concentrates as in both cases the lowest iron content ~ 0.5 % Fe_2O_3. Therefore, Fine grinding of the talc ore seems to be a prerequisite to achieve maximum liberation of the talc minerals from their associated gangue minerals. This agrees with previous literature findings (Ahmed, 2007; Mahmoud et al., 2011)

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Table 5. Liberation study Results of the Talc Ground Sample Using Frantz Isodynamic Magnetic Tester

Size, mm	Product	Wt., %	Assay, %		Operational Recovery, %	
			Fe_2O_3	SiO_2	Fe_2O_3	SiO_2
-4.0+2.5	Non Mag.	73.96	2.28	63.17	25.63	81.93
	Magnetic	26.04	18.79	39.57	74.37	18.07
	Total	100	6.57	56.91	100	100
	Head	17.24	6.58	57.03	100	100
-2.50+1.25	Non Mag.	77.5	1.96	63.20	20.85	85.83
	Magnetic	22.5	25.68	35.94	79.15	14.17
	Total	100	7.29	56.95	100	100
	Head	17.79	7.30	57.06	100	100
-1.25+0.70	Non Mag.	81.56	1.79	61.18	18.39	88.95
	Magnetic	18.44	35.18	33.62	81.61	11.05
	Total	100	7.93	55.98	100	100
	Head	17.99	7.95	56.10	100	100
-0.70+0.250	Non Mag.	84.48	1.25	58.26	13.25	90.98
	Magnetic	15.52	44.72	31.44	86.75	9.02
	Total	100	7.98	53.99	100	100
	Head	16.40	8.00	54.10	100	100
-0.250+0.125	Non Mag.	88.39	1.13	58.67	12.45	92.56
	Magnetic	11.61	60.48	35.90	87.55	7.44
	Total	100	8.00	55.92	100	100
	Head	10.98	8.02	56.03	100	100
-0.125+0.090	Non Mag.	90.35	1.10	54.90	10.9	93.6
	Magnetic	9.65	84.31	35.14	89.1	6.4
	Total	100	9.11	52.88	100	100
	Head	Total	9.13	52.99	100	100
-0.090+0.075	Non Mag.	90.99	1.04	58.03	10.5	95.89
	Magnetic	9.01	89.40	25.12	89.5	4.11
	Total	100	8.98	54.95	100	100
	Head	6.57	9.00	55.06	100	100
-0.075+0.063	Non Mag.	90.87	0.88	58.33	8.63	96.26
	Magnetic	9.13	93.07	22.56	91.37	3.74
	Total	100	9.28	54.95	100	100
	Head	4.41	9.30	55.06	100	100
-0.063	Non Mag.	90.92	0.56	57.19	5.53	97.93
	Magnetic	9.08	95.20	12.10	94.47	2.07
	Total	100	9.13	52.99	100	100
	Head	3.81	9.15	53.10	100	100

IV. CONCLUSION

From the presented results the following conclusions can be drawn:-

- The Saudi talc ore is of low grade due to its high iron content and low silica
- The liberation of talc increases with increasing the degree of fineness.
- Liberation study of talc using brmoform is not the ideal technique because it fails at degree of fineness below 90 µm
- The weight of talc ore reported to the nonmagnetic fraction increases with increasing the degree of fineness with a possible yield reaching approximately 90%.
- The lowest iron recovery possible to attain in the nonmagnetic fraction is approximately 5.5% when the degree of fineness of the ore is below 0.063 mm. this iron recovery corresponds to an iron assay of 0.56 as Fe_2O_3%.
- It might be possible to obtain a Talc concentrate from the ore by grinding to less than 0.250 mm of iron content near 1 % Fe_2O_3 and higher grade concentrates by fine grinding to less than 0.063 mm where the iron content is near 0.5 % Fe_2O_3.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

V. ACKNOWLEDGEMENTS

This work was funded by the Deanship of Scientific Research (DSR), King Abdulaziz University, Jeddah, under grant no. 618/135/1437. The author, therefore, acknowledges with thanks DSR technical and financial support.

VI. REFERENCES

[1] Ahmed, M. M. "Improvement of Egyptian talc quality for industrial uses by flotation process and leaching" in International Journal of Mineral Processing, Volume 83, Issues 3–4, Pp 132–145, 2007. DOI: 10.1016/j.minpro.2007.07.002
[2] Ferrage, E., Martin, F., Petit, S., Pejo-Soucaille, S., Micoud, P., Fourty, G., Ferret, J., Salvi, S., De Parseval, P. & Fortune, J.P., "Evaluation of talc morphology using FTIR and H/D substitution" in Clay Minerals, Vol. 38, pp. 141-150, 2003a
[3] Ferrage, E., Martin, F., Micoud, P., Petit, S., De Parseval, P., Beziat, D. & Ferret, J. "Cation site distribution in clinochlores: a NIR approach" in Clay Minerals, Vol. 38, pp. 329-338, 2003b
[4] Gondim, A.C. & De Loyola, L.C. "Ponta Grossa and Castro zones in Parana talc district, Brazil, ore properties and mineral industry" in Boletim Paranaense de Geociencias, Editora UFPR, No. 50, pp. 9-14, 2002, http://ojs.c3sl.ufpr.br/ojs/index.php/geociencias/article/viewFile/4150/3349
[5] Helmy, H.M. & Kaindl, R., "Contribution to the mineralogy and petrogenesis of the talc-base metal sulfide" in the Egyptian Geol. Soc. 35th Annual Meeting, Cairo, Egypt, Abstract, 1997
[6] Mahmoud M., Galal A., & Mohamed M.A, "Beneficiation of Talc Ore" I. Ahmad Dar, M. Ahmad Dar (Eds.): Earth and Environmental Sciences, DOI: 10.5772/27935, 2011
[7] Sarquis, P.E. & Gonzalez, M., "Limits of the use of industrial talc-the carbonate effect" in Minerals Engineering, Vol. 11, No. 7, pp. 657-660, 1998, DOI: 10.1016/S0892-6875(98)00050-8
[8] Schandl, E.S., Gorton, M.P. & Bleeker, W., "A systematic study of rare earth and trace element geochemistry of host rocks to the Kidd Creek volcanogenic massive sulfide deposit" In Hannington, M.D., Barrie, C.T. (Eds.), Economic Geology Monograph, Vol. 10, pp. 309-334, 1999
[9] Schandl, E.S., Gorton, M.P. & Sharara, N.A., "the origin of major talc deposits in the Eastern Desert of Egypt: relict fragments of a metamorphosed carbonate horizon" in Journal of African Earth Sciences, Vol. 34, pp. 259-273, 2002, DOI: 10.1016/S0899-5362(02)00024-6
[10] Schober, W., "Quality compounds require premium talc grades and sophisticated formulations" in Eurofillers97-filler, Manchester (UK), September 8th -11th , pp. 1-12, 1997
[11] Yehia, A. & Al-Wakeel, M.I., "Talc separation from talc-carbonate ore to be suitable for different industrial applications" in Minerals Engineering, Vol. 13, No. 1, pp. 111-116, 2000, DOI: 10.1016/S0892-6875(99)00154-5

CITE AN ARTICLE

Ahmed, H. A., Prof. (n.d.). PROCESSING OF MERYKHAT SAUDI TALC FOR DIFFERENT INDUSTRIAL APPLICATIONS . *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*, *6*(12), 491-498.