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Comparative Study of Phosphate Concentrate from Abu Tartur Phosphate Rocks from the Egyptian Western Desert Obtained from the Froth Flotation and Hydrolytic Operations

Amira A Mahmoud[1], Mohamed Sh Atrees[2],Said T Mohamed[1], Samia M Abdeldayem[2]

[1]Faculty of Science, Zagazig University, Zagazig, Egypt
[2]Nuclear Materials Authority, New Cairo,PO 530 ElMaadi, Cairo, Egypt
***Corresponding autho**r: smatreessemida@gmail.com

***ABSTRACT* : Background: In this work The upgrading of Abu Tartur phosphate ore, Western desert, Egypt by using physical beneficiation methods which mean that treatment of metal surface by using surface difference between different metal which is composed of one raw material, whatever type of charge which placed on it or difference between specific density between them or magnetic density or electrostatic separation by using many techniques by using many different devices. We make upgrading by many stages such as gravimetric separation, hydrolytic separation and magnetic separation to get best rust of upgrading. After many experiments and analysis which determine chemical composition of phosphate sample by using XRD analysis which shows that the presence of insoluble P205 %, CaO % ,SiO2 % , SO2 %, Fe2O3 % , and reach to upgrading of P2O5 from 21% to 34% to use it in many fields and industries. And the compared the present obtained results with the resultant obtained from the froth flotation operation by using a collector of petroleum and oleic acid , which approved in our past work. A concentrate product comprising less than 0.70 MgO was attained under the appropriate conditions from abu tartur feed (2.88% MgO) with a P2O5 recovery of more than 86.14 % with 28:29 P2O5 %.**

KEYWORDS:Abo Tatur phosphate rock, Upgrading process, Froth flotation, Up classifier, Concentrate

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I. INTRODUCTION

The phosphorus source for numerous commodities, such as fertilizer, phosphoric acid, and elemental phosphorus, is phosphate ores. Nowadays, the concentration and treatment of low-grade dolomitic phosphate ores have become increasingly important due to the depletion of phosphate-rich siliceous ores. In the phosphoric acid industry, contaminants prevalent in the phosphate ores, particularly magnesium, can pose a significant nuisance. Consequently, the study of phosphate minerals is significant from the economic, agricultural, environmental, and (human and animal health) perspectives. Furthermore, industrial chemistry and agriculture are significantly influenced by phosphate minerals [1] Yehia et al. [2]. At present, a phosphate rock that contains 30% P2O5 is commercially acceptable provided that it contains less than 1% MgO. The magnesium content of phosphate ores has been reduced through the development of various beneficiation techniques: Damp A comprehensive examination of magnetic separation is conducted by, Blazy and Jdid [3]. He mentioned that the Abu Tartur phosphate deposit is distinguished by the presence of ferriferous dolomite, which contains 60 to 70% MgO. This property enables the reduction of the MgO content in specific fractions through magnetic separation. In reality, moist magnetic separation on a High Gradient Magnetic Separator (HGMS), Upon application to the [210–74] and [74–38] µm fractions, which respectively assay 2.6 and 5.8% MgO (75% of the total MgO content of the unprocessed ore), a final concentrate with a phosphate recovery of 70% and a 31.2% P2O5 and 1.17% MgO grade can be obtained. Consequently, the [1500–210] µm fraction of this concentrate, which contains 32.9% P2O5 and 0.4% MgO, is used to produce a commercial concentrate that contains 32.3% P2O5 and 0.69% MgO. In this instance, P2O5 recovers at a rate of 79%.

- The flotation of dolomite and carbonates from apatite, Anonymous [4];
- Blazy et al.[5]; Blazy et al.[6]; And Houot et al.[7]; Ratobylskaya et al.[8] ; Abdel Khalek (2001) [9] studied about the same subjects
- The dolomite undergoes heavy media separation (HMS) and is subsequently followed by milling of the HMS sink product. The phosphate minerals are then floated away from the dolomite., Lawver et al.[10]; Snow [11].
- The phosphate flash calcinations,Blazy and Jdid [12].
- The separation of Mg2+ using an ion exchange resin and the removal of magnesium from weak phosphoric acid using resins are followed by leaching with a carbon dioxide-based leaching solvent, khaled Ezzat Yassin [13].

The introduction of froth flotation as an efficient method for the refining of fine particles (10-150 µm) has been made. Rao, (2004) [14]; Nunes et al., 2012)[15];

Veloso et al., (2020) [16]; X. Zhang et al. (2021) [17]. It selectively isolates minerals based on differences in their physicochemical surface properties after treatment with specific reagents, thereby distincting hydrophobic particles from hydrophilic ones (Wills and Napier-munn, 2006) [18]. If the principal mineralogical carrier, dolomite, is well crystallized, magnesium from phosphates is effectively removed through physical methods of separation, particularly flotation, according to reports. Jdid and Blazy [19]. In an effort to identify more effective reagents and processing methods, numerous investigations have been conducted. Nevertheless, the proposed strategies may not be justified by the large reagent requirements and recovery limitations. Biologically derived reagents are of particular interest due to their unique interactions with minerals [Boice [20];El mahdy et al [21];Zheng et al {22];Namita et al [23]. The phosphate material is found in admixtures with detritus materials, including quartz, mica, and clay, in sedimentary deposits of marine origin. It is frequently present in conjunction with limestone and, on occasion, with dolomite. Igneous apatite's may contain additional impurities that are not frequently observed in sedimentary deposits. These impurities are derived from other components of the magma from which the apatite crystallized [24]. Phosphate fertilization of soils has always been crucial; as vast areas of agricultural land can be severely deficient in phosphate (p). The term "available phosphate" is employed due to the fact that phosphate is the most immobile of the major plant nutrients, and if it is not in a soluble form, it is difficult, if not impossible, for plants to accumulate it [25], also the form and origin of phosphate minerals are the primary determinants of their composition. Phosphate fertilizers are manufactured using approximately 90% of the minerals, while the remaining 10% are utilized as a source of phosphorus for the chemical and culinary industries [26]. The significance of phosphate is widely recognized in the field of biochemistry. The metabolic functioning of all living organisms, from microorganisms to humans, is based on this small, uncomplicated molecule, which is composed of oxygen and phosphorus. From the energy derived from food to the sensation of growth, locomotion, and nerve impulses in cells and organisms, phosphate is essential for nearly every aspect of existence. Additionally, it serves as the backbone of DNA, the molecule of heredity. The Abu Tartur mine is a massive mine situated in the New Valley Government. It is estimated to have 980 million tons of ore with a 30% phosphate content, making it one of the largest phosphate reserves in Egypt [27] the annual consumption about 150 million tons of phosphate rock in year. phosphorus has important role in many industries. phosphorus is the most required nutrient of plants, but its availability in Egypt Is relatively low [28].it also used in food and medical industries. This work aims to compare the products of phosphate ores from Abu Tartur ores in the Egyptian Western Desert, in which different physical concentration processes have been carried out, starting from processing the ore and even concentrating it using vibrating tables depending on the density, passing through magnetic and electrostatic separation devices, then mixing their products with hydrolysis devices to remove the total Fine impurities and analysis of this product and its comparison with the product resulting from foam flotation processes to adopt the easiest and most economical method.

2. SUBJECTS AND METHODS

Ore Preparation:

In our work, a representative ore sample was obtained, the Abu-Tartur deposits in the Western Desert of Egypt were the 100 kg source of a low-grade calcareous phosphate rock used in this study.

Pulverization and Sampling:

The bulk sample was subjected to primary crushing in a laboratory Denver Jaw crusher with a capacity of 2.25x3.5 and an IH.P. motor. A representative 20 kg sample was obtained for granulometric analysis by yard sampling the completely mixed ore aggregate using the coning and quartering method. The entire quantity was subsequently secondary pulverized in a Wedage roller measuring “12x12” until it reached a particle size of 100 percent - 1mm. The "(Denver)" Jones riffler was used to sample the crushed product from approximately 100kg quantities that were stored in sealed sacks. One of these quantities was finely pulverized to -200 mesh. An analytical sampler was employed to divide the fine product into approximately 250 g samples as in Figures (1,2).

Figure (1): Shows that the shape of Hammer mill.

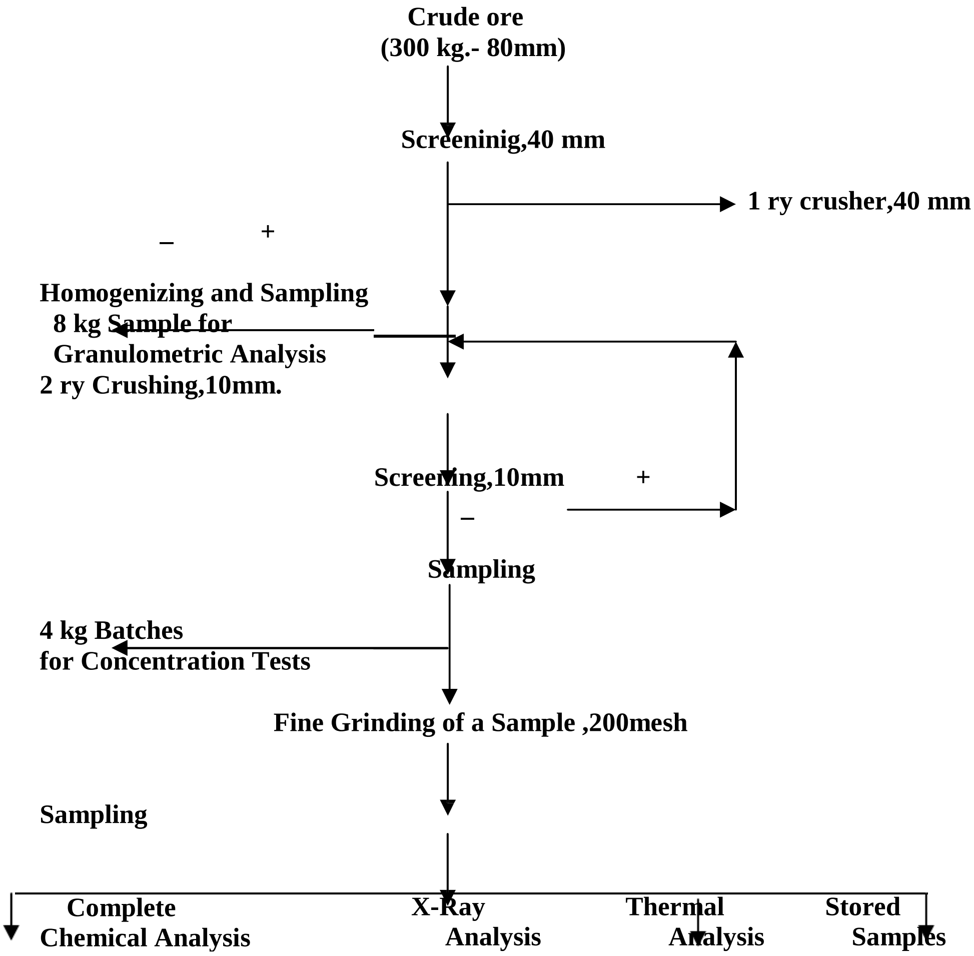


Figure (2): Generalized flowsheet for sample preparation.

Granulometric Analysis of the sample

Using the germane "Din" set sieves 11.2, 8, 4, 2, 1,0.84, 0.5, 0.35, 0.211, 0.125, 0.105, and 0.074mm, a laboratory "Wedge" Ro-tap sieve agitator was employed for dry screening of the ore. The weight sample was chosen to represent about two particles layers on the screen and the screening time was usually fixed at twenty minutes. Figure (3) showed the shape of dry Sub sieve analysis.

Figure (3): Shows that the Dry Sub sieving machine

Methodology techniques

Up Current Classifiers

The sample is mechanically cleaned, and all slimes (Kaolinite) and fine quartz are removed using up current classifiers, which are predicated on the variations in the density and size of mineral particles. The perforated spray pipelines were used to inject an appropriate amount of water, and the mechanical agitator, the stirring speed of 200 rpm and the horsepower of 1 HP are both adjustable (Figure (4)). The purified sample was subsequently desiccated and concentrated using gravimetric separation. The tailing, the sample, which consisted of slimes and low-density mineral particles, was filtered, desiccated, weighed, and bagged for analysis.

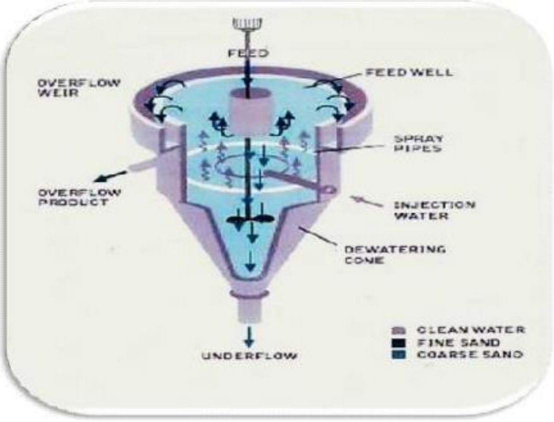


Figure (4): Shows that the Longitudinal section of up-current classifiers.

Gravimetric separation

In order to concentrate P2 O5 in the cleansed sample, the swaying table concentrator is implemented that is derived from the previous phase. On the basis of the disparity in specific gravity between the gangue and the essential minerals, this procedure is implemented. Sivamohan, R., and Forssberg, E. 1985, S. Sharam, R. Aisan, and S. Armin 2015, Terry, R.L., 1974, Wills, B.A., 1981, Wills, 1992, and Manser, R.J., et al. 1991). The main components of the gravity concentrating table are the bed surface, the undulating table head, and the frame (Figure 6).

1. Bed surface

Other materials, including wood, metals (such as aluminum and cast iron), and FRP (glass fiber reinforced plastic), can be used to construct the bed surface. The bed surface is frequently shaped as a rectangle, trapezoid, or diamond. Numerous parallel grooves or bed stripes are present on the swaying table's surface in the longitudinal direction. The length of the feeding chute is approximately 1/3 to 1/4 of the total length, and it is situated on the upper right side of the bed surface. In order to ensure that the slurry is uniformly disseminated across the bed surface, the feeding chute is equipped with numerous tiny holes on one side. The flushing receptacle, which occupies 2/3 to 3/4 of the bed surface, is connected to the feeding mechanism. In order to ensure that the flushing water is distributed uniformly along the longitudinal axis of the bed, numerous tiny openings are drilled into the tank's side.

2. Head of shaking table (driving mechanism)

The head of the table reciprocates the bed surface of the swaying table asymmetrically along the longitudinal direction, which is connected to the bed surface by a draw rod and powered by an electric motor.

The speed of the bed surface changes from sluggish to rapid and then abruptly ceases as it advances.

The speed of the bed surface increases swiftly from 0 to the maximum as it retreats, and then gradually decreases to 0. A "Wielfley" shaking table was used for the gravity concentration of the ground ore, Figure (6). Optimizing of the process includes the following operating parameters:

Rate of feed.

Water flowrate.

Table inclination, and Length of the stroke.

Magnetic Separation

The concentrate calcareous phosphate sample which using the "Induced Roll Separation" method, A 1.5 Tesla magnetic intensity (15000 Gauss) was employed to subject the material from the previous phase to dry magnetic separation after it was desiccated (Figures 5,6).

Figure (5): Shows the Laboratory high intensity induced roll magnetic separator.

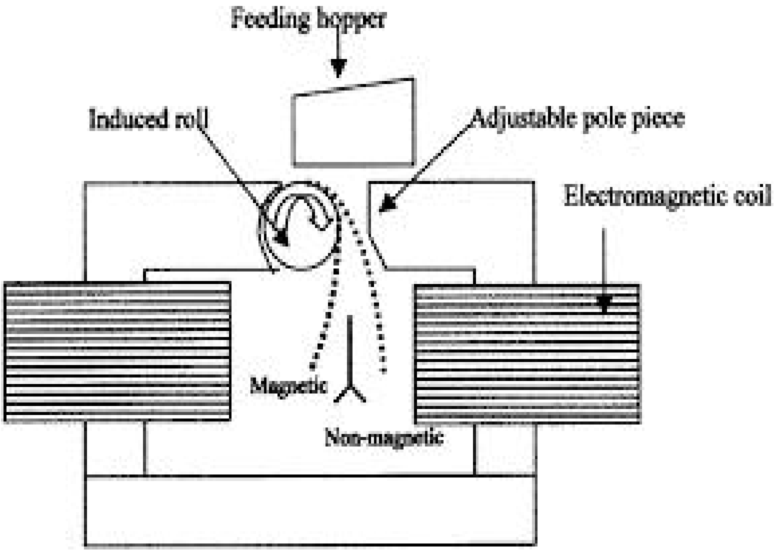


Figure (6): Shows the Illustration of the induced roll magnetic separator

Result and Discussion

Up current classifiers

Currently, classifiers are employed to mechanically clean and All slimes (Kaolinite) and fine quartz must be removed from the sample, as they are influencing the differences in the size and density of mineral particles. The cleansed sample was dried and concentrated through gravimetric separation. The tailing, which consisted of slimes and low-density mineral particulates, was filtered, desiccated, weighed, and then bagged for analysis.

The bed surface's sustaining function can be classified as either seated or suspended.

The seated type is characterized by the direct connection of the bed surface to the bracket, and in order to modulate the lateral incline of the bed surface, a slope adjustment device is installed on the bracket.

Utilizing a wire rope, the suspension type suspends the bed surface from the support. The inclination of the bed surface, which is suspended in the air, is influenced by the tension of the wire rope.

How does a shaking table work?

Water and bed surface vibration in the bed strips or channels cause the ore particulates to be stratified and loosened as the material transitions from the feeding conveyor to the bed surface. The bulk of the light mineral particles in the upper stratum migrate downward along the bed surface to become sediments, as they are subject to a substantial impact force. As a result, this region of the bed surface is referred to as the detritus side.

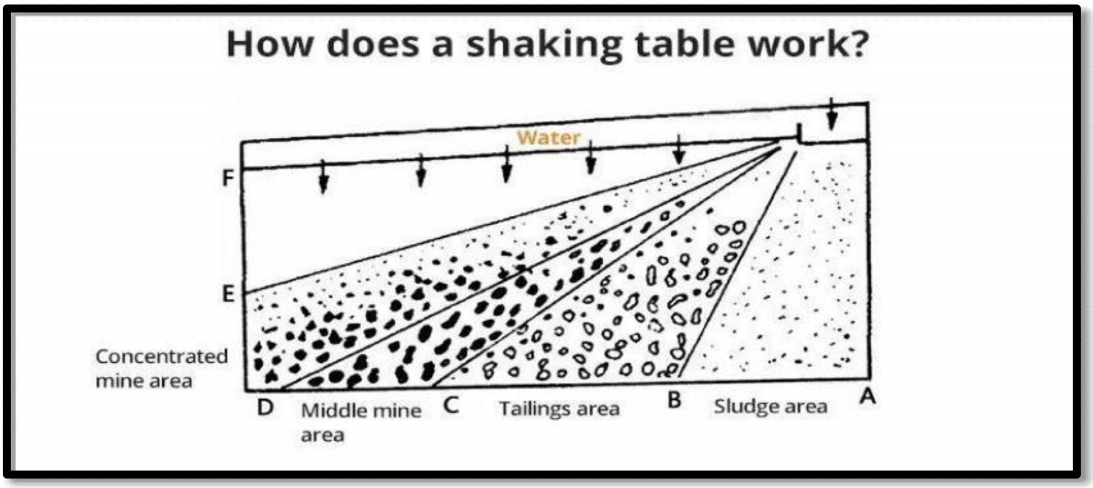


Figure (7): Shows that the Working principle of a shaker table

The heavy mineral particles at the bottom of the bed migrate longitudinally as a result of the differential movement of the bed surface. In order to generate a Concentrate, they are released from the opposite end of the transmission line. (Figure 7). The term "concentrate end" denotes the position of the bed surface that corresponds to this. The bed surface is influenced by mineral particulates of varied densities and sizes in both the horizontal and longitudinal directions. A diverse array of products of varying quality can be obtained as the materials inexorably disperse in a fan shape on the bed surface.

After cleaning, the phosphate sample was concentrated using a swaying table with varying flow rates and inclinations. Under the optimal conditions, the optimal deck slip of the undulating table was 10 degrees, and the optimal input water flow rate was 8 liters per minute. The particulate size was less than 150 mesh (100 microns). The greatest results were achieved.

Two grades of phosphate (A, B) were separated as a consequence of the gravimetric separation procedure (by swaying table) (Figure 6), as illustrated below. The concentrate phosphate samples were desiccated, weighed, and bagged for analysis.

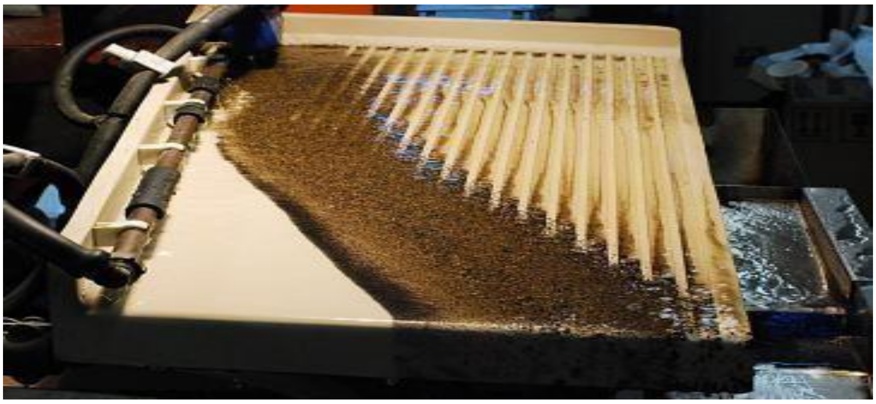


Figure (8): Shows that the Shaking Table Concentrator

Magnetic Separation

The "Induced Roll Separation" method was employed to subject the concentrate calcareous phosphate sample from the previous phase to achieve dry magnetic separation at a magnetic intensity of 1.5 Tesla (15000 Gauss). The sample was desiccated (Figures 7,8). This device is employed to produce mineral purification by continuously extracting small magnetic particles from specific minerals. The high-intensity magnetic field is applied to the phosphate (grade B) that is to be treated at a controlled rate from a hopper or vibratory conveyor. Material that is magnetic either adheres to the roll face or is redirected toward the roll. Material that is not magnetic is ejected from the surface in a conventional manner. The discharge of magnetic material from the roll face at a site of reduced magnetic intensity is facilitated by a brush. A divider plate is located between the two product sources (Wills, 1992). Consequently, Magnetic materials are separated from the concentrate phosphate, which affects the purity of the upgraded ultimate phosphate concentrate. The non-magnetic (product phosphate) and magnetic (impurities) materials were both weighed and bagged for analy

Ultimately, the findings of this investigation resulted in the production of the desired product, a high- quality phosphate that is essential for satisfying market demands.

Overall Chemical Analysis of Samples

The standard methods for phosphate analysis were employed to conduct routine chemical analysis of the samples. Additionally, scanning electron microscope (SEM) and X-ray fluorescence (XRF) techniques were implemented to evaluate the primary oxides. The Perkin-Elmer Atomic Absorption 2380 was employed to determine magenism and iron oxides. The Perkin-Elmer spectrophotometer model 3B UV/VIS spectrophotometer was employed to determine phosphorous. XRF was employed to conduct a thorough chemical analysis of the original sample. The Nuclear Materials Authority's chemical laboratories conducted the chemical analyses of the samples. The main oxides were analyzed using the Scanning Electron Microscope (SEM) and X-ray fluorescence (XRF) techniques, as shown in Table 1. Table (2) illustrates the utilization of Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) for the analysis of trace elements. The principal mineral constituents of the original sample were analyzed using X-Ray Diffraction (XRD), as illustrated in Table (3). P2O5 and CaO were analyzed using colorimetry after digestion with HClO4-HCl (Technic on Auto-analyzer, Bran-Luebbe, SPX Process Equipment, Norderstedt, Germany). Atomic adsorption spectroscopy (Perkin Elmer-A Analyst 800, Perkin Elmer, Norwalk, CT, USA) was employed to analyze MgO, Fe2O3, Al2O3, Cu, Zn, Mn, and Ni following digestion with HClO4-HF-HNO3, SiO2, and HNO3. Following digestion with HClO4-HF-HNO3, flame spectrometry was employed to analyze K2O and Na2O. Gravimetry was employed to conduct a BaCl2 assay to analyze SO3 after its digestion by HCl and the subsequent precipitation of SO4− ions as BaSO4. A muffle furnace was employed to evaluate loss-on-ignition (LOI) at 1050 ◦C. In order to confirm the veracity of the phosphate material under investigation, the same protocol was employed to decompose and analyze the standard reference phosphate material SRM694 (Western phosphate rock) and SRM120C (Florida phosphate rock). Experimental errors of less than 5% were observed in all chemical analyses.

Table (1): Results of major oxides of phosphate rock of Abu-Tartur deposits.

Component	Wt%
Al2O3	2.53
SiO2	6.69
P2O5	21.27
MgO	1.16
CaO	46.06
Na2O	0.76
K2O	0.46
TiO2	0.39
Fe2O3	7.23
MnO	0.34
Cl	0.23
F	0.97
SO3	3.32
L.O.I	8.55
Total	99.96

Table (2): Results of trace elements of phosphate rock of Abu-Tartur deposits

Element	Ppm	Element	Ppm
Sc	69	La	209
V	114	Ca	229
Cr	72	Nd	170
Co	59	Sm	48
Ni	48	Yb	10
Cu	32	Y	292
Zn	81	U	39
As	35	Th	13
Cd	4		
Sr	1486		

Table (3): Results of the main mineral constituents of phosphate rock of Abu- Tartur deposits.

Component	Wt.%	Component	Wt.%
Apatite	48.91	Iron oxides	7.23
Calcite	22.79	Clay	5.31
Dolomite	4.46	Quartz	3.91
Gypsum	7.36		
		Total	99.97

The results have shown that phosphate ore contains P2O5(21.27%), the CaO content (46.06%) and while U assays 39 ppm. Characterization showed that The sample is not essential for satisfying market demands. Following the characterization of the unprocessed material, it was subjected to the subsequent physical and leaching procedures.

Preparation of the ORE feed

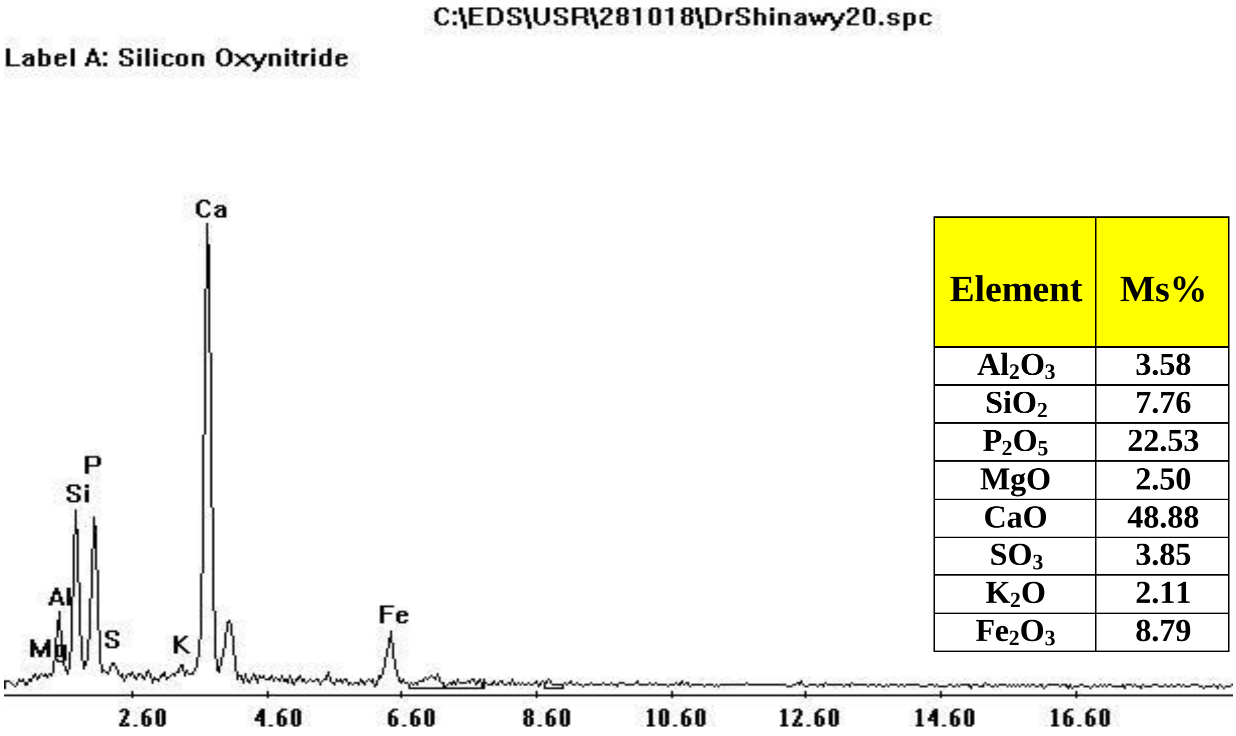
The phosphate ore sample from the Abu-Tartur locality in the Western Desert of Egypt was pulverized in a 5x6" Denver Jaw crusher and thereafter refined in a Wedag roller mill. The sample was not crushed. Utilizing a 0.25 mm sieve, the laboratory Wedag rod mill was employed to grind the pulverized sample to a fineness of less than 0.25 mm in a closed circuit. The flotation process was adversely affected by the thin character of the – 0.074 mm fraction, which was eliminated using a 0.074 mm sieve. Table (4) illustrates the magnetic separation outcomes of the (- 0.25 + 0.074) mm sample, which were conducted using a Dings cross belt separator. This investigation employed the nonmagnetic fraction as a flotation input.

Table (4): Results of The Magnetic Separation for Size (- 0.25 + 0.074) mm.

Product	Wt %	P2O %	MgO %	Fe2O3 %	SiO %
Magnetic fraction	20	10.94	3.20	12.38	14.7
Non Magnetic fraction	80	25.25	2.80	6.88	15.8
Feed	100	22.38	2.88	7.98	15.6

Beneficiation Methods of Upgrading Samples

Prior to the examination of the physical processes that XRD-analysis was performed on a sample of low- grade Egyptian phosphate ore from the Abu-Tartur deposits in the Western Desert of Egypt to concentrate P2O5. The low-grade phosphate sample that was tested exhibited an XRD pattern that indicated apatite (Ca10(PO4, CO3)6(F, OH)2) as the predominant phosphate mineral (48.91%), which is equivalent to 21.27% P2O5. Calcite (CaCO3) is the primary carbonate gangue mineral (22.79%) the ore is associated with a small amount of dolomite CaMg(CO3)2 mineral (4.46%). This suggests that over 50% of the objectionable components, including approximately 27.25% of the carbonate minerals, are present. As a result, in this investigation, acetic acid was implemented to eradicate the carbonate content of Abu-Tartur PR. Additionally, the sample was subjected to scan electron microscopy (SEM) analysis, as illustrated in Figures 9,10. Phosphate ore is composed of Al2O3 (3.58), SiO2 (7.76%), P2O5 (22.53%), MgO (2.50%), CaO (48.88%), K2O (2.11%), SO3 (3.85%), and Fe2O3 (8.79%). Consequently, the chemical analysis of the representative sample of the Abu Tartur phosphate rock under investigation was conducted prior to the commencement of the upgrading experiments. The results indicated that the sample contains Al2O3 (2.89%), SiO2 (5.69%), P2O5 (21.27%), MgO (1.89%), CaO (47.56%), Na2O (0.76%), K2O (0.46%), Fe2O3
(7.23%), MnO (0.34%), Cl (0.23), F (0.72%), SO3 (2.73%), and L.O.I. (8.). The consumption of sulfuric acid during the production of phosphoric acid may be increased by the presence of a high content of 52%CaO in the phosphate concentrate (Al-Fariss, T.F.; El-Aleem, F.A.A.; El-Nagdy, K.A. (2013). Additionally, the CaO/P2O5 ratio (2.23) is significantly greater than that of unadulterated CFA (1.6). As a result, the moderately low-grade phosphate minerals (17 to 25% P2O5) that do not meet these specifications are generally incapable of being directly utilized in sulfuric acid facilities and necessitate some form of beneficiation (Sengul, H.; Ozer, A.K.; Gulaboglu, M.S. 2006:).



Element	Ms%
Al_2O_3	3.58
SiO_2	7.76
P_2O_5	22.53
MgO	2.50
CaO	48.88
SO_3	3.85
K_2O	2.11
Fe_2O_3	8.79

Figure (9): Shows the Scanning Electron Microscope EDAX and Semi quantitative Analysis of the Raw Phosphate Sample.

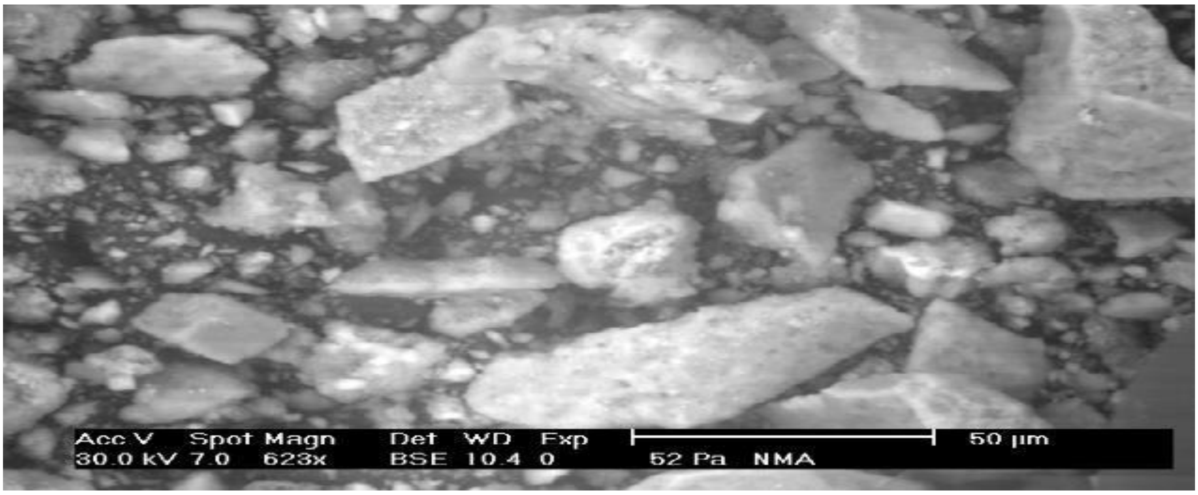
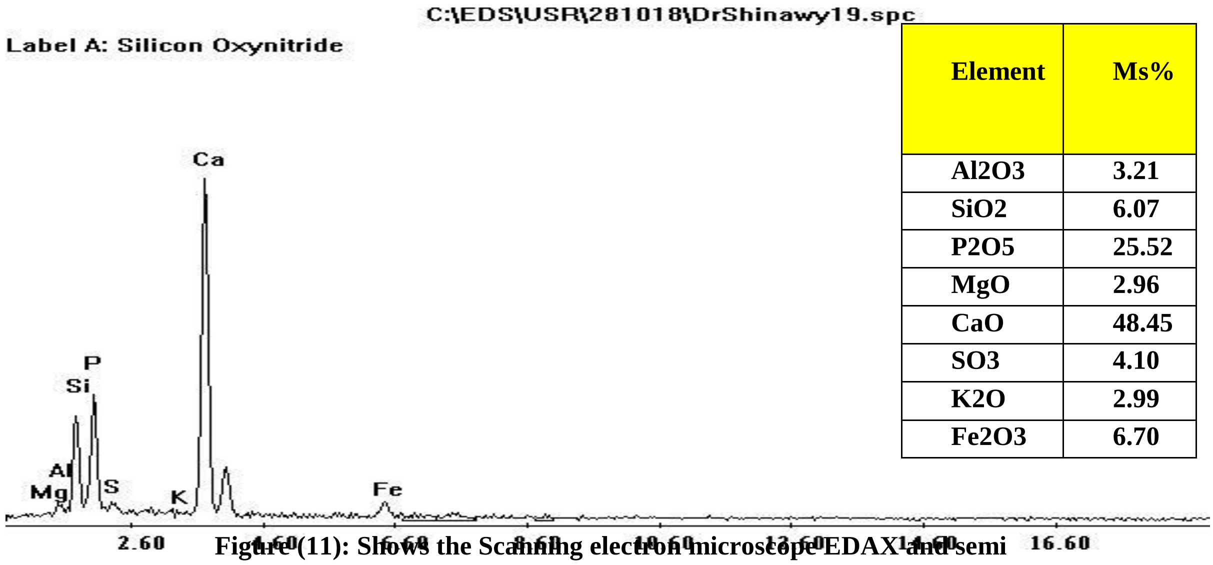


Figure (10): Shows the Photo shows the raw phosphate sample.

Afterward, the phosphate sample was subjected to the Crushing and Sieving process, and the ground sample was analyzed using the Scanning Electron Microscope (SEM) technique as shown in (Figures 11,12). Also the chemical analysis of the ground sample by a hammer mill and then roll mill was done and shown in Table (5).



Element	**Ms%**
Al2O3	**3.21**
SiO2	**6.07**
P2O5	**25.52**
MgO	**2.96**
CaO	**48.45**
SO3	**4.10**
K2O	**2.99**
Fe2O3	**6.70**

Figure (11): Shows the Scanning electron microscope EDAX and semi quantitative analysis of the ground phosphate sample.

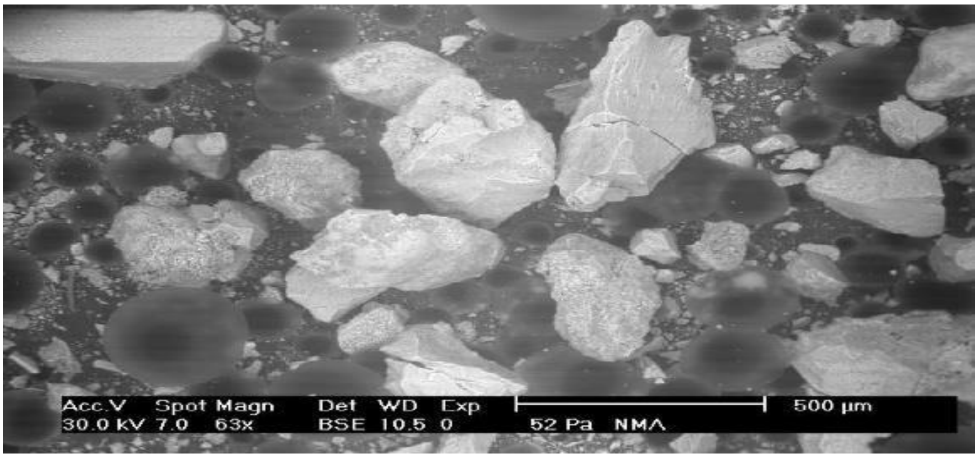


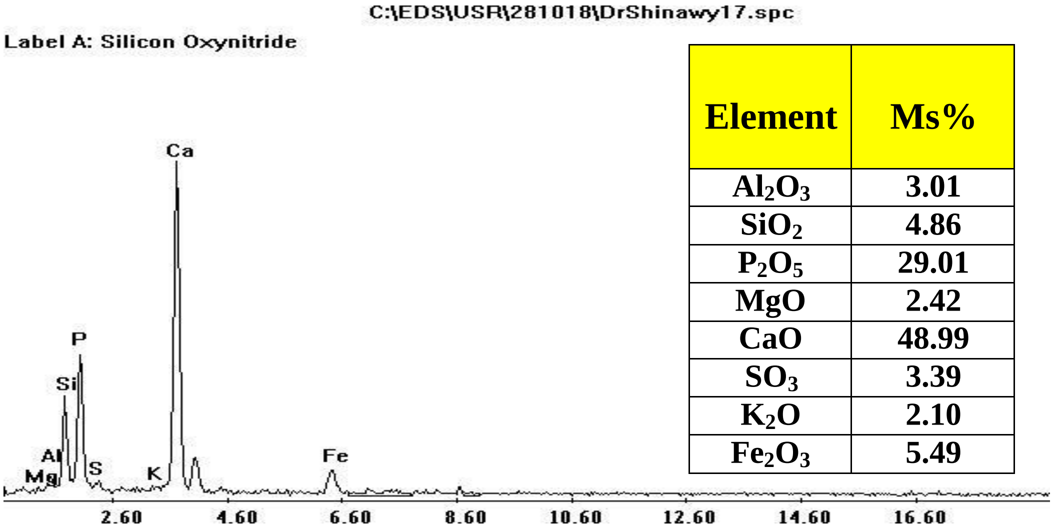
Figure (12): Shows the Photo shows the ground phosphate sample.

Table (5): Shows the Chemical analysis of the ground phosphate sample by a hammer and roll mill.

Oxides	Content%
P2O5	**23.96**
CaO	**48.03**
MgO	**1.59**
SiO2	**4.14**
Na2O	**0.85**
K2O	**0.65**
SO3	**2.91**
Al2O3	**2.69**
Fe2O3	**5.43**
Mn	**0.47**
Cl	**0.35**
F	**0.81**
L.O.I	**8.08**

Hence, the results show us the importance of the grinding and Sieving stage used in the physical concentration processes which, chemical analysis from 21.27% (before grinding) to 23.96%. The ground phosphate sample was subsequently subjected to the acid leaching procedure using acetic acid. The optimal reaction time was 60 minutes, and the dissolution temperature was 40°C. The greatest result was obtained by utilizing a 15 wt. % acetic acid concentration, which was combined with a liquid-to-solid ratio of 15:1. Consequently, the phosphate minerals are separated from the carbonate gangue minerals. The Scanning Electron Microscope (SEM) technique was employed to dry the treatment phosphate sample for analysis. The results are shown in Figures (13,14) and it appear that the sample contains Al2O3(3.01), SiO2(4.86%), P2O5 (29.01%), MgO(2.42%), CaO (48.99%), SO3 (3.39%), K2O(2.10%), Fe2O3(5.49).

Additionally, the chemical analysis of the enhanced sample through the dissolution procedure was conducted and is illustrated in Table (5). The acid leaching process test results (Table 6) indicated that the P2O5 content increased by 3.89% in comparison to the pulverized phosphate sample (23.96%). However, the CaO/P2O5 ratio remains high (1.70) in contrast to the ratio necessary for industrial applications (CaO/P2O5 <1.6). Furthermore, the concentrations of Fe2O3 and Al2O3 are assessed to be elevated; consequently, the MgO and SiO2 contents decreased from 1.59% to 1.31% and from 4.14% to 3.23%, respectively. The phosphate ore was upgraded by mechanically eradicating impurities from the treatment phosphate sample using up current classifiers. This was done to eliminate the majority of slimes and clay coatings.



Element	Ms%
Al_2O_3	3.01
SiO_2	4.86
P_2O_5	29.01
MgO	2.42
CaO	48.99
SO_3	3.39
K_2O	2.10
Fe_2O_3	5.49

Figure (13): Scanning electron microscope EDAX and semi quantitative analysis of the treatment phosphate sample by Froth flotation

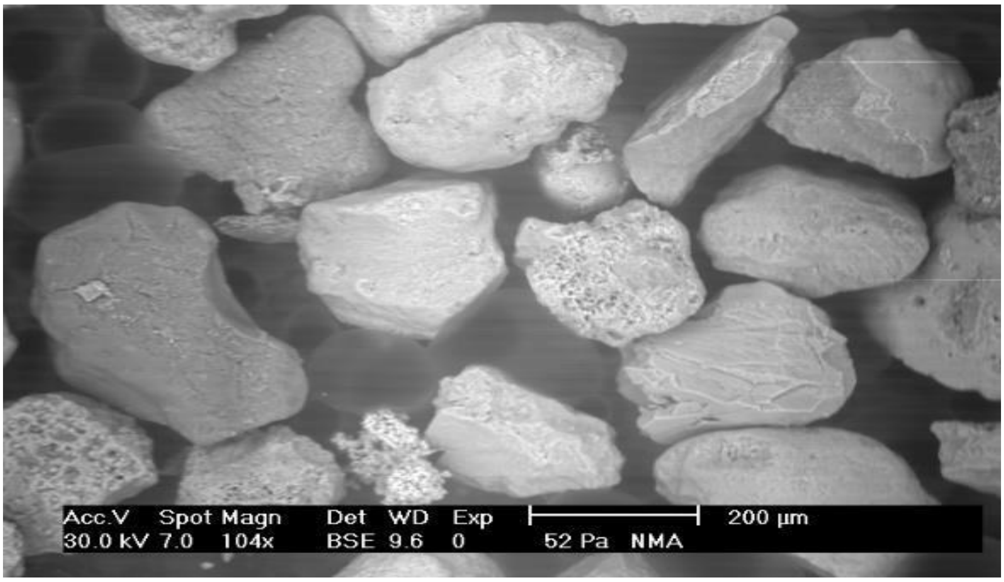
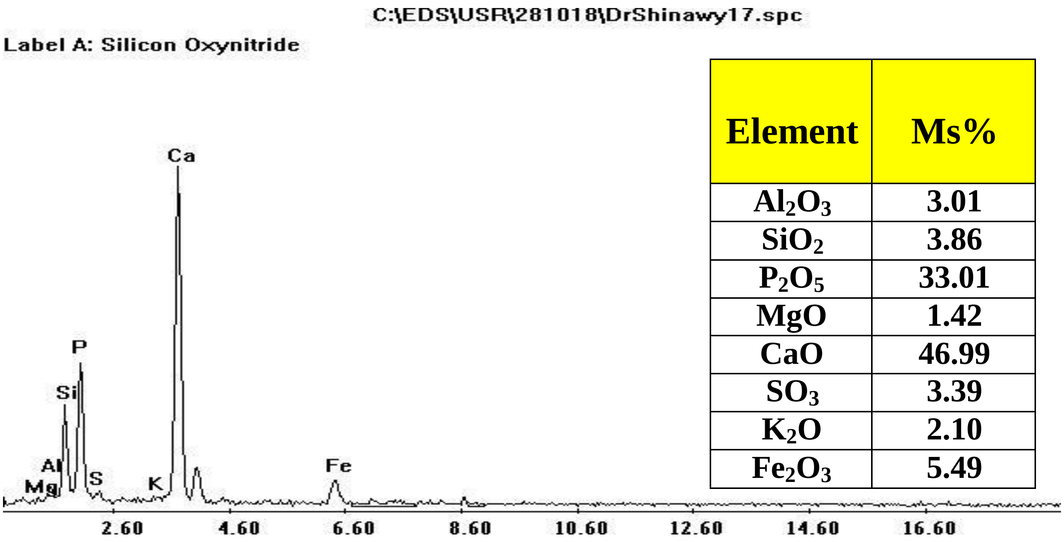


Figure (14): Shows the Photo shows the treatment phosphate sample by the froth flotation .



Element	Ms%
Al_2O_3	3.01
SiO_2	3.86
P_2O_5	33.01
MgO	1.42
CaO	46.99
SO_3	3.39
K_2O	2.10
Fe_2O_3	5.49

Figure (15): Scanning electron microscope EDAX and semi quantitative analysis of the treatment phosphate sample by Up-Classifier

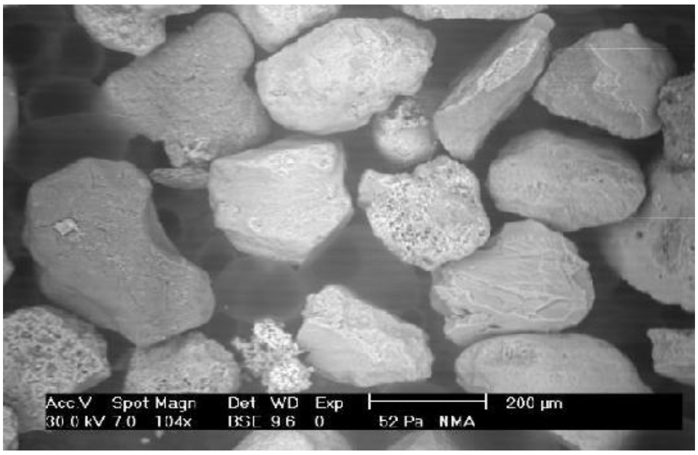


Figure (16): Shows the Photo shows the treatment phosphate sample by the Up-Classifier

Summary and Conclusions

using physical beneficiation methods which mean that treatment of metal surface by using surface difference between different metal which is composed of one raw material, whatever type of charge which placed on it or difference between specific density between them or magnetic density or electrostatic separation by using many techniques by using many different devices. classifiers are employed to mechanically clean and All slimes (Kaolinite) and fine quartz must be removed from the sample, as they are influencing the differences in the size and density of mineral particles. The cleansed sample was dried and concentrated through gravimetric separation. The tailing, which consisted of slimes and low-density mineral particulates, was filtered, desiccated, weighed, and then bagged for analysis.

After cleaning, the phosphate sample was concentrated using a swaying table with varying flow rates and inclinations. Under the optimal conditions, the optimal deck slip of the undulating table was 10 degrees, and the optimal input water flow rate was 8 liters per minute. The particulate size was less than 150 mesh (100 microns). The greatest results were achieved. After many experiments and analysis which Analyze the chemical composition of the phosphate sample using X-ray diffraction (XRD) shows that the presence of in soluble P2O5 % ,CaO % ,SiO2 % , SO2 %,Fe2O3 %, and reach to upgrading of P2O5 from 21%to 33% to use it in many fields and industries and then compared the present obtained results with the resultant obtained from the froth flotation operation which approved in our past work.

In the fatty acid flotation of calcareous phosphate rock, a collector consisting of petroleum and oleic acid was implemented. A concentrate product comprising less than 0.70% MgO was attained under the appropriate conditions from the Abu-Tartur feed (2.88%MgO) with a P2O5 recovery of more than 86.14% with 28: 29 P2O5 %.

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