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Comparison Between Raw and Processed Gypsum from Bir Al-Ghanam Area and Imported Gypsum (Meknassi)

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Abstract:

Libya is considered one of the promising countries in terms of its natural resources, particularly gypsum deposits, which are widely distributed in various regions of the country. Despite the abundance of this resource, the industrial exploitation rate does not exceed 5%, with its main use being limited to cement production and the manufacture of medium-quality plaster. This study aims to conduct a comprehensive assessment of the quality of both raw and locally processed gypsum from the Bir Al-Ghanam area and compare it with imported gypsum (Meknassi gypsum) in terms of chemical composition, mineral structure, and physical properties.

A precise scientific methodology was followed, involving the analysis of samples using X-ray diffraction (XRD) to determine the mineral structure, and X-ray fluorescence (XRF) to identify the proportions of key chemical elements. Field visits were conducted to the fine gypsum factory in Bir Al-Ghanam and the adjacent quarries, in addition to reviewing relevant technical reports, ensuring the credibility of the obtained results.

The findings revealed that the local gypsum from Bir Al-Ghanam shares the same mineral structure as the imported gypsum, with differences in color due to the presence of organic impurities. Chemical analysis showed that the sulfate content of local gypsum was 52.31%, surpassing that of the imported gypsum, which was 49.87%. Regarding moisture content, Libyan gypsum recorded 3.55%, compared to 5.48% in the imported gypsum. However, the imported gypsum showed superior fineness, explaining the local preference for it despite its higher cost compared to the local product.

This study highlights the potential of Libyan gypsum and stresses the need for investing in the improvement of local manufacturing techniques to enhance its quality and competitiveness, thus reducing reliance on imports and supporting the national economy.

Keywords: Libyan gypsum, Meknassi gypsum, chemical analysis, mineralogical analysis, physical properties, raw material quality.

Introduction

Libya is a country rich in large reserves of gypsum deposits, which are found in abundance in many regions. Despite the large quantities of gypsum, its exploitation remains limited to specific areas. Gypsum is mainly used in cement production and certain industries related to gypsum for construction and medical purposes. Although gypsum is locally available, the Libyan product faces significant challenges in competing with imported products, as consumers prefer imported imported gypsum despite its higher cost compared to the local product.

This study aims to assess the quality of both raw and manufactured gypsum extracted from the Bir Al-Ghanam area and compare it to the imported Meknassi gypsum in terms of chemical and mineral composition. The study also seeks to identify the factors that may contribute to the low demand for the local product. This analysis follows the quality standards set by Libyan specifications, which allow for the evaluation of economic performance and the quality of raw materials.

Methodology

The study was conducted through field visits to the gypsum factory in the Bir Al-Ghanam area and the adjacent quarries, along with the collection of raw gypsum samples and locally manufactured gypsum, as well as imported samples. The study relied on advanced analytical techniques such as X-ray diffraction (XRD) to determine the mineral composition of the samples and X-ray fluorescence (XRF) for chemical analysis, allowing for a comparison of the results and identifying key differences between the products.

Objective of Study

The study aims to analyze and assess the chemical composition of the Bir Al-Ghanam gypsum and compare it to the imported Meknassi gypsum, in order to identify the strengths and weaknesses of the local product and provide recommendations for improving its quality and enhancing its competitiveness in the market.

Location of Study

The study area is located in Bir Al-Ghanam, west of Tripoli, extending from Wadi Zarat in the east to Bir Ayad in the west, with the southern edge reaching 60 km north, covering a wide plateau with diverse terrain including hills and high plateaus. The area lies within geographical coordinates between longitude 32°15' 32" and 32°16' 30" North and latitude 12° 33' 38" and 12° 34' 16" East[2].

Figure1: **Location of the Study area**

Geology of the Area

The Bir Al-Ghanam area is distinguished by its gypsum-rich deposits, which date back to the Middle Jurassic period. The elevation of the hills in the area ranges from 250 to 290 meters above sea level, gradually increasing towards the south to over 700 meters at the mountain edge. Most of these deposits consist of gypsum and anhydrite, separated by layers of limestone and dolomite, giving the area a complex geological structure [2].

Gypsum Ore

The gypsum in the Bir Al-Ghanam area consists of calcium sulfate dihydrate ($CaSO_4 2H_2O$) and is known for its high purity, with calcium sulfate content ranging from 77% to 90%. The estimated gypsum reserves in Libya amount to approximately 80 billion tons, with an average thickness of 30 meters. Gypsum occurs in several colors, including white, gray, and red, and the presence of these colors is linked to associated mineral impurities. Gypsum is often interspersed with anhydrite, which is usually white or gray in color, and sometimes reddish.

Gypsum is also valued for its thermal insulation properties, making it a natural building material. When heated, gypsum loses its crystalline water and transforms into calcium sulfate hemihydrate, and with continued heating, it converts into anhydrite.

Results and Discussion

Gypsum samples were collected from the Bir Al-Ghanam area in white and gray colors for laboratory tests, along with samples of manufactured gypsum from the local fine gypsum factory. An additional sample was taken from the imported Meknassi gypsum, which is preferred by Libyan consumers for construction and decoration. The following tests were conducted:

1. **Sieve Analysis**:

The sieve analysis, or fineness test, aimed to determine the fineness of the gypsum product by measuring the amount of material left on the sieve with a 0.200 mm opening, which should be less than 5% according to Libyan standards. The results are shown in Table(1).

Table 1: Sieve Analysis of Raw White and Gray Gypsum Samples

Sieve opening Size (mm)	Sample A		Sample B		Sample C	
	Weight of Residue on Sieve (%)	Weight Passing Through Sieve (%)	Weight of Residue on Sieve (%)	Weight Passing Through Sieve (%)	Weight of Residue on Sieve (%)	Weight Passing Through Sieve (%)
3.150	0	100	0	100	0	100
0.800	0.105	99.895	1	99.9	0.12	99.88
0.425	0.485	99.515	0.435	99.56	0.515	99.485
0.200	1.7	98.3	1.5	98.5	1.8	98.2

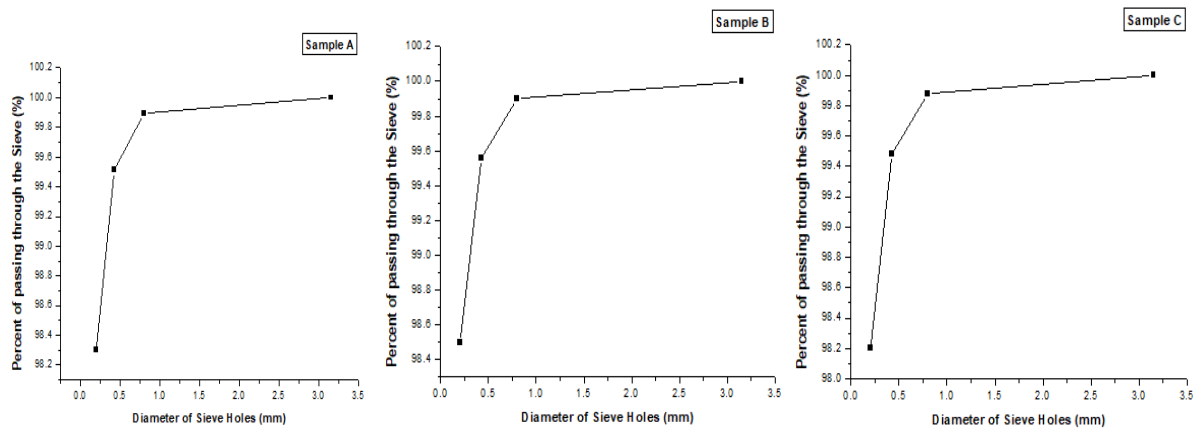
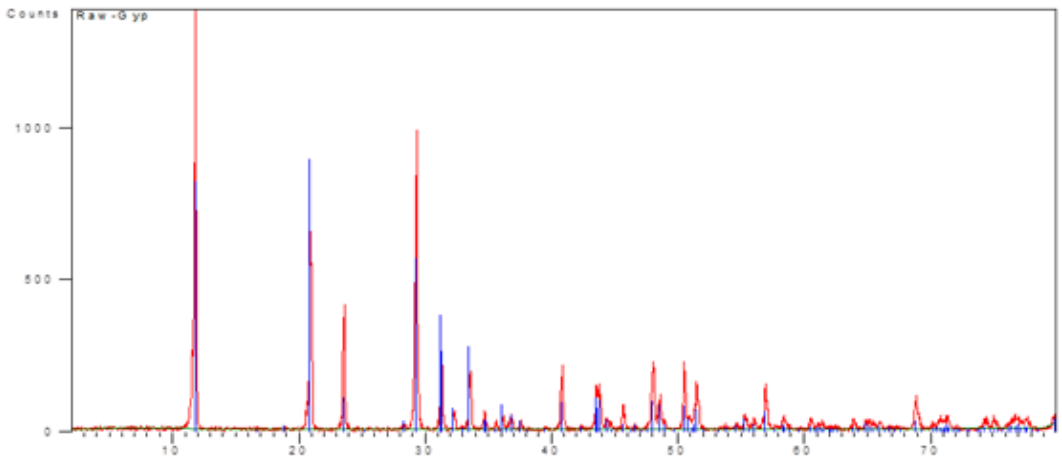


Figure 2: Sieve Analysis Curve for Raw Gypsum Samples (A, B, C)

2. Mineral Analysis Test (XRD):

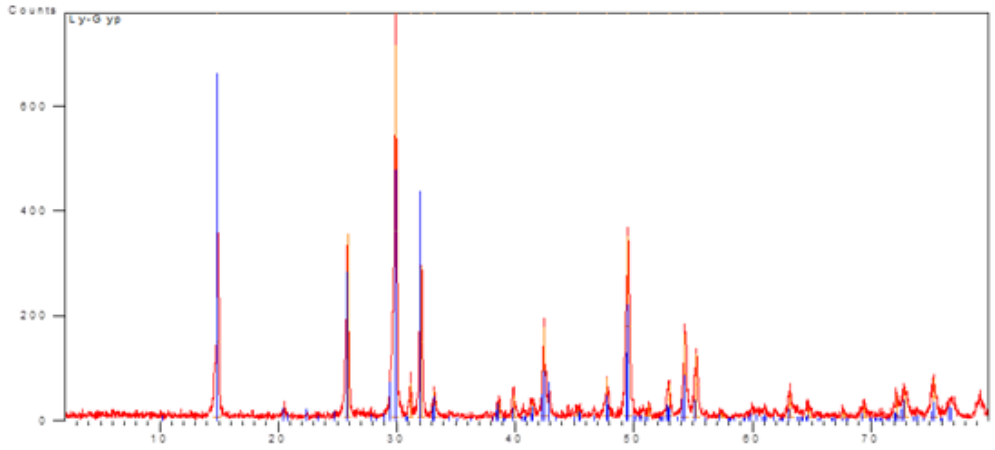
X-ray Diffraction (XRD) technique was employed to analyze the mineral composition of the samples and accurately identify the constituent minerals. The test was conducted on both raw gypsum and processed gypsum from the Bir Al-Ghanem area, as well as on imported gypsum (Meknassi) to verify its purity and absence of undesirable impurities. The results showed a match in the mineral phases between the local and imported samples, indicating a similarity in the mineral composition.



Pattern List & Semi Quantitative of Sample# Raw. Gyp.

Ref. Code	Compound Name	Chemical Formula	Semi Quantitative %
01-074-1433	Calcium Sulfate Hydrate	Ca (S O4) (H2 O)0.5	100

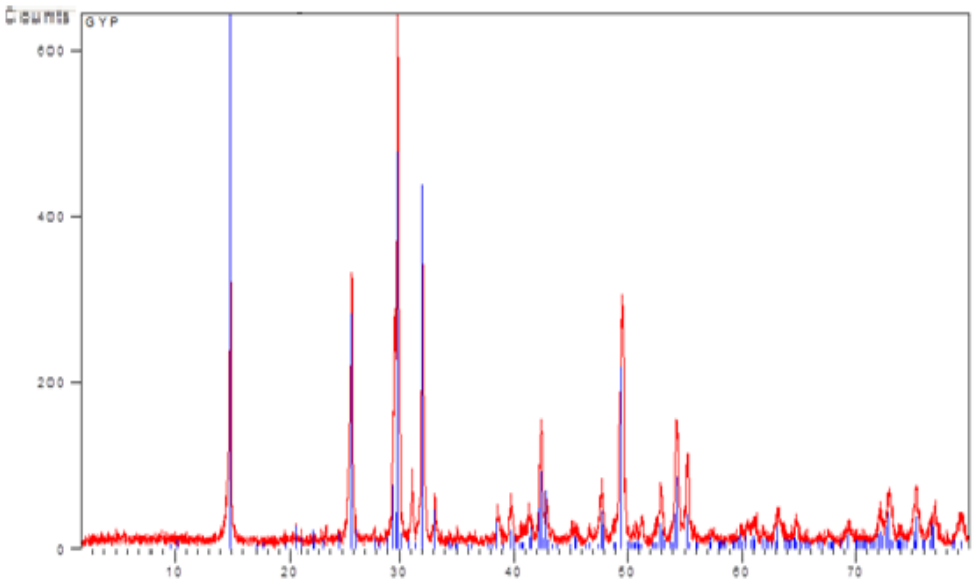
Figure 3: X-ray Diffraction Pattern of Libyan Raw Gypsum



Pattern List & Semi Quantitative of Sample# Mk. Gyp.

Ref. Code	Compound Name	Chemical Formula	Semi Quantitative %
01-081-1849	Calcium Sulfate Hydrate	Ca (S O4) (H2 O)0.5	100

Figure 4: X-ray Diffraction Pattern of Libyan Processed Gypsum



Pattern List & Semi Quantitative of Sample# Mk. Gyp.

Ref. Code	Compound Name	Chemical Formula	Semi Quantitative %
01-081-1849	Calcium Sulfate Hydrate	Ca (S O4) (H2 O)0.5	100

Figure 5: X-ray Diffraction Pattern of Imported Gypsum (Meknassi)

3- Chemical Analysis Test (XRF):

The X-ray Fluorescence (XRF) test was conducted at the Arab Union Contracting Company (Al-Burj Cement Factory) to determine the percentage of chemical elements present in the gypsum. These analyses assisted in evaluating the physical and chemical properties of the samples, enabling a comparison of the quality of raw and processed gypsum from the Bir Al-

Ghanem area with the imported gypsum.

Table 2: Chemical Analysis of Raw, Processed, and Imported Gypsum

Element	Imported Gypsum	Libyan Processed Gypsum	Raw Gypsum (Rami)	Raw Gypsum (White)
	Wt%	Wt%	Wt%	Wt%
Na_2O	0.00	0.01	0.01	0.01
MgO	2.84	0.62	0.56	0.52
Al_2O^3	0.55	0.26	0.13	0.23
SiO_2	2.95	0.32	0.25	0.55
SO_4	49.87	52.31	46.93	46.95
Cl	0.01	0.00	0.03	0.02
K_2O	0.20	0.04	0.00	0.00
CaO	32.99	42.70	30.97	31.65
TiO_2	0.00	0.00	0.01	0.00
Fe2O3	0.28	0.17	0.04	0.01
Water of Crystallization	**10.31**	**3.55**	**20.05**	**20.054**

Conclusion

The chemical analysis results of raw and manufactured gypsum samples from Bir Al-Ghanam compared to the imported Meknassi gypsum revealed slight differences in some element compositions. The iron oxide (Fe_2O_3) content in Libyan raw gypsum was 0.10%, rising to 0.17% in the manufactured gypsum, while the imported gypsum had 0.28%.

Field observations of the gypsum stockpiles in the factories indicated the presence of gray and yellowish-white gypsum, with varying amounts of carbonaceous rock[3]. The chemical analysis showed that the sulfate content in the white gypsum was 46.95% and in the gray gypsum, it was 46.93%. The calcium oxide (CaO) content in both types was 31.65%. The color difference was attributed to organic impurities, which are removed during the manufacturing process at low temperatures, without affecting the product's quality[4].

The study concluded that Libyan gypsum has a higher sulfate content (52.31%) compared to the imported gypsum (49.87%). The moisture content in Libyan gypsum was also lower at 3.55% compared to 10.31% in the imported gypsum. This difference is due to a lack of precise control over the burning temperature during the manufacturing process[5].

Summary

The study showed that Libyan gypsum contains a higher sulfate content (52.31%) compared to imported gypsum (49.87%). Additionally, the moisture content in Libyan gypsum was only 3.55%, compared to 10.31% in the imported gypsum.

The study indicated that Libyan gypsum has a higher sulfate content, reaching 52.31%, compared to 49.87% in the imported gypsum (Meknassi). The results also revealed that the moisture content in Libyan gypsum is lower (3.55%) compared to the imported gypsum (10.31%), and this reduction is attributed to the lack of precise control over the burning temperature during the manufacturing process, which affected the ability of Libyan gypsum to retain water [5].

Furthermore, it was found that Libyan gypsum is coarser than the imported gypsum, with 10.43% of material remaining on the 200-micron sieve, compared to 4.65% in the imported gypsum. This indicates a lower fineness of the local product, and fineness is a key factor that determines the quality and usability of gypsum, which has led consumers to prefer the imported product despite its higher cost [6].

The results of chemical and mineral analyses confirmed the similarity in the basic composition between Libyan and imported gypsum, with differences in physical properties affecting the quality of the local product [7]. Based on these results, the study recommends improving manufacturing processes, particularly with regard to controlling temperatures and enhancing the fineness of local gypsum to boost its competitiveness in the market.

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