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Suitability of Gypsum from Fatha Formation for Production of Building Materials in Bazian -Takiya area, North-East Iraq

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ABSTRACT

Gypsum products are one of the most widely used materials in the industry. The wide use of gypsum as a building material over a very long period of time. A number of manufacturers introduce different professional quarries, but their physical and chemical properties were still questionable. Five gypsum samples were taken for chemical and physical analysis. Chemical analysis shows that gypsum are of high purity, more than 95.25% with varying amount of impurities; SiO2 (1.49-1.87) %, Na2O (0.17-1.00) %, MgO (0.03-0.13) % Al2O3 (0.06-0.23) % and Fe2O3 (0.05-0.09) %, .This can be used for Plaster of Paris without any purification of gypsum. The (SO3 and CaO) % shows that all studied samples are suitable for gypsum production as the final coating and building gypsum. The physical analysis shows that the colors of gypsum samples are suitable for building, Plaster of Paris, final coating and Juss according to the color chart of minerals and to Iraqi standard specification. The fineness percentage is less than 8%. Thus the specifications of all samples are agreements to standard specifications for building gypsums. In terms of setting time, the sample 1 and 2 are suitable for building gypsum and plaster of Paris and classified as Borax. However, samples 3, 4, and 5 are suitable for anhydrous calcined gypsum – final coat and classified as Knee cement. Moreover, the setting time for all the samples increased with the increase of the water powder ratio.

Introduction

The rock gypsum is a major raw material for the production of building materials. It is locally available in Sargrma-Qishlagh Mountain in the Darbandi Bazian area. Gypsum is a soft sulphate mineral composed of calcium sulphate dehydrate, with the chemical formula of $CaSO_4.2.H_2O$. Gypsum contains calcium, sulfur bound to oxygen and water. Gypsum is an abundant mineral and takes different forms. This mineral can be helpful to humans, animals, plant life, and the environment. Gypsum of primary and secondary origins is widely used in Iraq as a building material in various applications and as a retarder in the cement industry [1]. However, the chemical composition of gypsum rock varies from one geographical site to another. Gypsum is associated with a wide assortment of accessory minerals, mainly carbonates, silica, and metal oxides [2]. The complete characterization of the raw material (as rock and powder) allows us to choose the best one to be used to manufacture plasters for building applications, with thermal and acoustic insulating purposes. In the construction field, gypsum paste and mortar are among the most ancient building materials in the world. It was used in a wide range in old Iraq, which is known as Mesopotamia. It has been used as a bonding material to build houses, temples, and finishing the walls. Different sites in Iraq showed that gypsum was used in its construction, such as Al Ekhaider fort, which is located in Karbala, Babylon Temple located in Babylon Province (Al Hillah City), and Al Mustansiria School in Baghdad [3]. In Iraq, the Gypsum, as a powder, is still one of the main building materials which are used for different construction purposes. This can be related to different reasons such as its low cost, availability of its raw materials, and can also be used in the production of

isolating materials. As afore mentioned, it is still the main building material to cover the cement on the walls before the use of Plaster of Paris. Moreover, gypsum is used in the middle and the south of Iraq to cover the roofs as a binding material beneath the mud tiles. In addition to that, there is still a desire for low-cost housing to use gypsum mortar as a binding material for the bricks in wall buildings and ceilings.

This research aims to evaluate of Gypsum quarries in the Takya -kakamand area for the production of building gypsum, according their chemical and physical properties in different quarries in the Bazian – Takya kakamand area. Gypsum rocks are mainly used to manufacture a plaster, cement, sulfuric acid, and other industrial applications due to their low cost and aesthetics [4], [5]. Moreover, this study introduces the Iraqi gypsum as one of the best materials in the Arab region, which needs a little development to be exported outside of Iraq as a good building material.

1. Geological setting:

The studied area is located in Sargrma-Qishlagh mountain in Darbandi Bazian /Takya kaka mand area, located NE of Bazian. The region lies between (35° 37' 43.5" – 35° 40' 03.29" N) and (44° 57' 43.3" – 44° 55' 47.56" E). This mountain, represented by Fatha Formation, is classified as a High folded zone [6]. The Qishlagh-Sargrma structure extends in length for more than 80 km and 2 to 3 km in width. One section logged along this structure selected is Takiya sections from NW to SE (Fig.1). The samples are collected from the Fatha Formation, which is (middle Miocene, Langhian). Busk and Mayo, in 1918 [7], introduced the name of Fatha Formation, which was adopted by the geologists of Geosurv in 1984 [8]. However, Al-Rawi et al. (1992) [9] announced the name of the Fatha Formation officially. The middle Miocene Formation is one of the most regionally widespread Formations in Iraq [10], [11] .The lower boundary is Jeribe Formation (Lower Miocene), and the Upper boundary is Injana (previously Upper Fars)

Formation that has ages of Upper Miocene[12]. A characteristic depositional feature of the Fatha Formation is high-frequency cycles of alternating Mud rock, limestones, gypsum, and/or anhydrite and halite [13].

According to (Al-Naqib and Aghwan, 1993) [14], three main lithofacies are recognized on Fatha Formation which is Clastics (Marls and Red Siliciclastics rocks), Carbonates (Marly Limestone, Arenaceous Limestone, and Limestone/Dolomite) and Sulphates (Nodular Gypsum, Laminated Gypsum, and Secondary Gypsum). The following fossils are recorded in the Fatha Formation by different authors: Ammonia beccarii LINNE, Elphidium sp., Quinqueloculina sp., Pyrgo sp., Spiroloculina sp., Clausinella sp., Modiolus sp., Paracypris sp., Ostrea sp. algae and bryozoa [15]. [16], [17], 18], [19].The depositional environment of the Fatha Formation was a closed lagoon of hypersaline conditions [20].

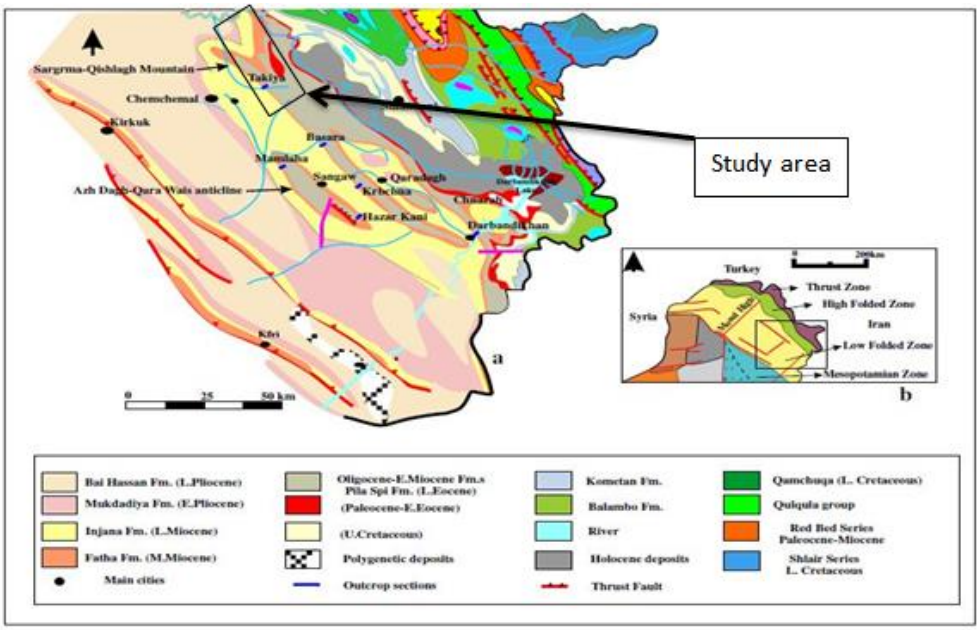

Fig. 1: (Geological map show the study area (modified Aqrawi et al. 2010)) [21].

2. Materials and Methods

The samples for industrial study were collected in five different quarries as random sampling in the Fatha formation (Fig.2). The gypsum samples were collected in the form of powder with the 6 Kg, (Fig. 3). These samples were carefully investigated to study their suitability for the Production of Building Materials. The physical properties such as color, fineness, and setting time have been studied. The method used to describe the color of all samples of the gypsum depends on (Munsell color 2009) [22]. Gypsum fineness test was conducted according to the Iraqi Specifications, (28), 1969 , setting time test was conducted according to (ASTM Designation: C 191-

04a), and chemical analysis by titration method was tested in Gassin Cement Factory.

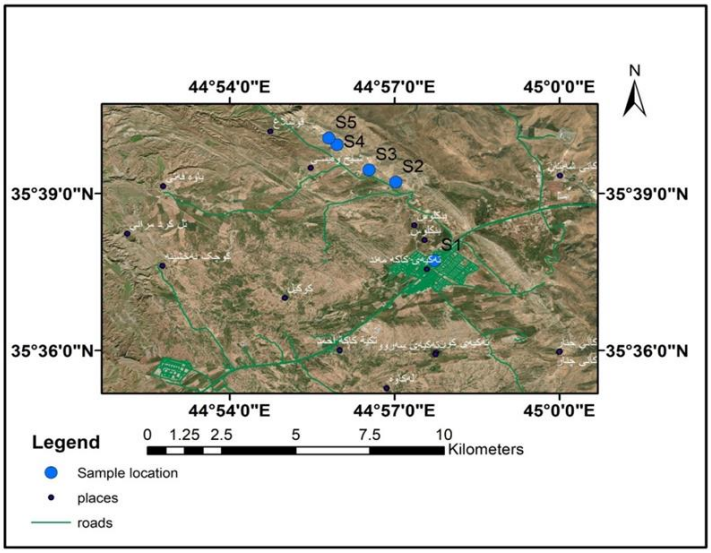

Fig. 2: (Google Earth image showing the location samples collected in different quarries of Fatha Formation)

Fig. 3: (Different quarries in the Bazian-Takaya area)

3. Results and discussions

3.1. Chemical composition of gypsum powder:

The concentrations of major oxides for five powder samples were determined by titration method was tested in Gassin Cement Factory. (Table 1), results revealed that the constituent elements' weight percentages varied between the five gypsum samples, confirming that the CaO and SO3 oxides are the major components of gypsum powder. According to comparison standard specification No (28), 1969, for all study samples, the percentages of CaO and SO3 are more suitable for producing gypsum, especially (final coating and building gypsum). The concentration of oxide impurities was more evident in the quarries in Takya-kakamand consists mostly of calcium Sulphate hydrate. The chemical analysis of gypsum samples shows that the high purity of more than 95.25% (Table 1), far above the (British standard 1971) [23] is highly pure (often 90%), which indicates does not require any purification. According to (Iraqi standard No. 28 – 2010) [24], the gypsum in these quarries is accepted for the production of plaster of Paris because of the percentage of impurities less than 5%. Gypsum for chalk, glass, ceramics, and Plaster of Paris (POP) require much higher purity up to more than 90% (Table 2). Despite this little change in mineralogy between the five gypsum materials, they can be considered pure gypsum materials used in plaster making, especially superfine gypsum plaster due to the fact that for this type of plaster, the percentage of SO3 is not less than 40 percent [25] . The loss on ignition ranges between (4.48 – 4.84)% of studies samples means suitable for making gypsum plaster according to (Standard Specification gypsum Plasters order, 1950) [25], with (Iraqi standard No. 28 – 2010) [24] standard range acceptable of LOI between (4 – 9)%.

Table 1: (Chemical composition of gypsum powder by Percentage).

Sample No.	SiO2	Al2O3	Fe2O3	CaO	MgO	SO3	K2O	Na2O	LOI	Total	Purity %
1	1.82	0.08	0.05	33.21	0.12	57.77	0.08	0.17	4.81	98.11	95.87
2	1.49	0.23	0.09	33.42	0.03	57.32	0.11	0.85	4.59	98.13	95.44
3	1.58	0.06	0.05	32.95	0.12	57.54	0.05	0.87	4.84	98.06	95.38
4	1.87	0.07	0.05	33.04	0.13	57.61	0.08	0.88	4.52	98.25	95.25
5	1.69	0.16	0.08	33.41	0.07	57.31	0.09	1	4.48	98.29	95.29

Table 2: (Chemical specification of gypsum in the chalk, glass, ceramics and POP industries (RMRDC, 2001)).

Oxides	SiO2	Al2O3	Fe2O3	CaO	MgO	SO3	L.O.I	Others
Wt.%	0.39	0.02	0.09	32.2	0.41	45.42	21.01	0.35

3.2. Physical Analysis of gypsum powder:

3.2.1. Color: Gypsum have monoclinic crystal symmetry, and its color varies from colorless to white when pure; the white color of pure gypsum changes to yellow, tan, blue, pink, brown, reddish-brown, or gray due to impurities [26], [27]. Gypsum is nearly always white or gray in color. According to the result (Table 4), sample (1) is very light gray may be used for building but samples (2, 3, 4 and 5) are white color which is used directly for plaster of Paris and may be used for final coating and Juss, according to Iraqi standard specification No.28, 1969.

Table 4: (Color measurement of the studied samples using Geological Rock color chart with genuine Munsell® color chips version 2009) [22].

Sample No.	Color Code	Color Name according to the Geological Rock Color cChart
1	N7	Very light gray
2	N9	White
3	N9	White
4	N9	White
5	N9	White

3.2.3. Fineness: Fineness is applied for estimating grain size of gypsum

The gypsum fineness is calculated according to equation (1):

Fineness of gypsum (FOG) =

(The left Weight of the sample on the sieve/Weight of the sample) * 100 ---------- (1)

The fine gypsum powder exhibits a greater expansion than a coarse material at a constant water-gypsum ratio [28]. The finer the particle size of the hemihydrate, the faster the mix will harden. Coburn et al. (1989) [29] explained that gypsum suitable for the production of plaster of Paris has to be broken down into uniform size particles. In accordance with (Iraqi standard No. 28 – 1985) [24], samples number 2, 4, and 5 has accepted for plaster of Paris because of the percentage retained on 1.18 mm sieve not more than 1% and used for anhydrous calcinal gypsum final coat according to the Iraqi standard specification No.28—1969). But the samples number 1 and 3 is not accepted for Plaster of Paris because the percentage is above the required limit. According to Indian and Australian standard specifications, the maximum level of particle retained on a sieve is 5%. Table (5) shows that the residual powder retained on the sieve for all the samples except the sample (No.1) was less than 5 % as specified by the Australian standard specification No. T-5: 1951 and Indian Standard specification IS: 6555-1972. The sample (No.1) retained the maximum particles (5.6 %). All samples, according to standard specification No (28), 1969, may be used for building because the fineness percentage (material retained on sieve No.16) is less than 8%. This indicates that all samples conform to standard specifications for building gypsums, such as ordinary gypsum and mechanical gypsum.

Table 5: (Fineness percentage for 5 different samples and compare with standard Iraqi specification No. (28), 1969: fineness (material remaining on sieve No.16)).

Sample No.	Weight of the sample (gm)	Retained on Sieve No.16 (gm)	Passed (gm)	Percentage of mass passing (%) (1.18)mm	Fineness (%) (FOG)	For building gypsum Retained on Sieve No.16 %	For anhydrous calcinal gypsum final coat Retained on Sieve No.16 %
1	150	8.44	141.57	94.4	5.6	Upper limit is 8%	Upper limit is 1%
2	150	1.56	147.80	98.5	1.0		
3	150	2.03	147.17	98.1	1.4		
4	150	1.20	148.40	98.9	0.8		
5	150	1.08	148.84	99.2	0.7		

3.2.4. Gypsum paste consistency Different experiments have been conducted to determine the suitable water quantity for consistency. According to the try and error method, the required quantity of water to mix gypsum to find each sample consistency is shown in (Table 6).

3.2.5. Setting time: The setting time is the time from the beginning of mixing the powder with water until the material hardens. The time can be measured by

GILMOR DEEDLE APPARATUS or by VICAT APPARATUS in which needles of different weight and thickness are used. The penetration of these needles measures at various times during setting. Many factors affect the setting time, such as: - Water/powder ratio, finesse, mixing, temperature, impurities, and chemical modifiers. This test was done through the method of testing cement according to (BS EN 196-3:2016) [30], the results shown in table (6). Paris' plaster has a short setting time, which sometimes limits its usefulness in some conditions like in buildings; however, the short setting time is a useful property. The optimum setting time is usually determined by the user's needs and convenience, which can also be controlled using additives.

Several standards have been established to determine the limits of setting times of gypsum plaster, which establishes a standard time of at least 20mins for an initial setting when the gypsum is to be manually applied, and 50 minutes as the initial setting time when it is to be mechanically sprayed [28]. Setting time must be long enough to allow the craftsman (a dentist, for example) to manipulate gypsum product into the desired shape. However, several retarders like borax (disodium tetraborate) and accelerators, like potassium Sulphate for lengthening or shortening setting time respectively and as desired [31]. As consistency increased, so did the setting time (Figure 3). Table 6 shows the setting time for various types of plasters at the five different water powder ratios of (32.8, 56.6, 66, 65, and 73) % for sample 1, 2, 3, 4, and 5 respectively. The above table may be observed that the setting time for all the products increased with the increase in water powder ratio. Moreover, the initial setting times for samples number 1 and 2 is 5 and 6 minute respectively, and final setting time is 8 minute for the samples of the two quarries. This indicates that these two quarries are suitable for building gypsum (Jus) according to (Iraqi standard specification No.28—1969) and also suitable for plaster of Paris. While the initial setting time of samples of 3, 4, and 5 are (69, 79, and 84) minute respectively, and the final setting time of the three samples of the quarries are (229, 249, and 293) minutes respectively. Therefore, these quarries with a setting time of (20 minutes to 6 hours) are more suitable for anhydrous calcined gypsum-final coat according to Iraqi standard specification No.28—1969.

Table 6: (Setting time of gypsum in different quarries and compare with Iraqi standard specification).

Sample. No.	Consistency (%)	Initial Setting Time (min.)	Final Setting Time (min.)	Plaster of Paris	anhydrous calcined gypsum-final coat	Building gypsum (Juss)
1	32.8	5	8	Setting time (minutes): Not less than 8 Not more than 25	Setting time (minutes): Lower limit 20 Upper limit 6 hour	Setting time (minutes): Lower limit 5 Upper limit 15
2	56.6	6	8			
3	66.0	69	229			
4	65.0	79	249			
5	73.0	84	293			

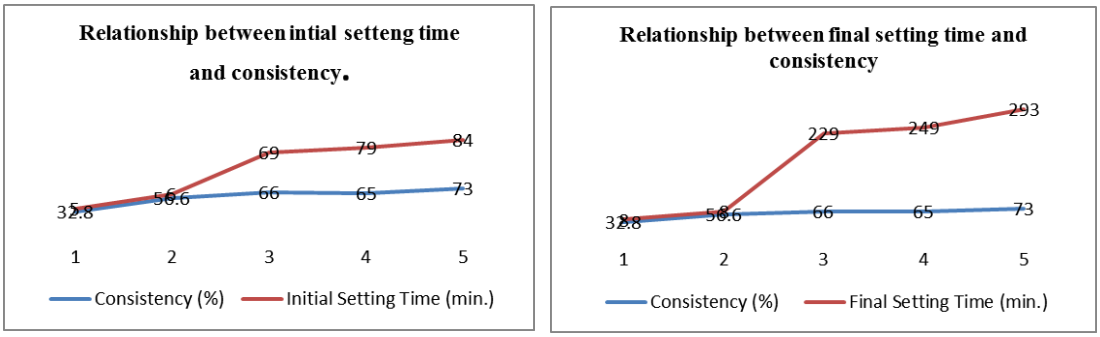

Fig. 3: (Relationship between setting time and consistency is directly proportion).

4. Conclusions

Based on the results of the study, the following conclusions have been drawn:

1. Chemical analysis of gypsum shows that they are of high purity, more than 95.25% with varying amounts of impurities; SiO2 (1.49-1.87) %, Na2O (0.17-1.00) %, MgO (0.03-0.13) % Al2O3 (0.06-0.23) % and Fe2O3 (0.05-0.09) %, which does not require any purification. The gypsum can be used for preparing a Plaster of Paris, in cement manufacturing without undergoing further beneficiation and reprocessing as for other industrial uses.
2. The result of chemical analysis (SO3 and CaO) shows that all study samples are more suitable for producing final coating and building gypsum, in comparison with the requirements of Iraqi standard specification No (28), 1969.
3. According to standard specification No (28).1969. Sample number 1 may be used for building purposes because the color of the sample is very light gray, but the samples Number 2,3,4 and 5 which is used directly for plaster of Paris and may be used for final coating and Juss, according to Iraqi standard specification No.28, 1969.because their color is white.

4. All samples may be used for building because fineness percentage (material retained on sieve No.16) less than 8%. Which indicate agreement to Iraqi standard specification for building gypsums such as ordinary gypsum and mechanical gypsum. Sample No.1 showed 5.6 % of particles retained on sieve No. 16 and hence is coarser than other samples. The sample 2, 3, 4 and 5 retained 1.0, 1.4, 0.8 and 0.7 % respectively. Sample No.5 had the finest particles as the particles retained on the sieve were only 0.7 % and is the most preferred quarry.
5. The setting time for samples 1 and 2 is between 5 and 8 minutes, which mean these samples are suitable for building gypsum and plaster of Paris and classified as Borax. But the samples 3, 4, and 5 with the setting times of 69 – 293 minutes are suitable for anhydrous calcined gypsum – final coat and classified as Knee cement. Moreover, the setting time for all the samples increased with the increase in the water powder ratio.

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References

[1] Jassim, R, (2019). Gypsum deposits in Iraq: an overview gypsum deposit in Iraq. Research Journal of Iraqi Bulletin of Geology and Mining, Special Issue, No.8, p 241 – 261 .
[2] Green, H., Gleadow, A., Finch, D., Hergt, J., & Ouzman, S. (2017). Mineral deposition systems at rock art sites, Kimberley, Northern Australia—Field observations. Journal of Archaeological Science: Reports, 14, 340-352.
[3] Raaf, Zain Al-Abadin Muhammad, Nada Mahdi Fawzi, Al-Obaidi, Hadeel Khaled Awad.(2012), Improving the Properties of Plaster by Using Additives, Engineering Journal, Issue 1, Volume 18 January, pp. (1-18)
[4] Strydom, C. A., Groenewald, E. M., & Potgieter, J. H. (1997). . . . Thermo gravimetric studies of the synthesis of case from gypsum, $CaSO_4 \bullet 2H_2O$ and phosphor gypsum. Journal of thermal analysis, 49(3), 1501-1507.
[5] Mahmoudi, S., Bennour, A., Chalwati, Y., Souidi, K., Thabet, M., Srasra, E., & Zargouni, F. (2016). Tunisian gypsums: Characteristics and use in cement. Journal of African Earth Sciences, 121, 267-273.
[6] uday, T., & Jassim, S. Z. (1987). The Regional geology of Iraq, vol. 2: Tectonism, Magmatism and Metamorphism. Publication of GEOSURV, Baghdad, 352.
[7] Busk, H. G. (1918). Some notes on the geology of the Persian oilfields. Institution of petroleum technologists.
[8] Jassim, S.Z., S.A. Karim, M. Basi, M.A. Al-Mubarak and J. Munir (1984). Final report on the regional geological survey of Iraq. Vol. 3, Stratigraphy. Geological Survey of Iraq, Baghdad, Iraq.
[9] Al-Rawi, Y. T., Sayyab, A. S., Al-Jassim, J. A., Tamar-Agha, M., Al-Sammarai, A. H. I., Karim, S. A., ... & Hagopian, D. (1992). New names for some of the Middle Miocene–Pliocene formations of Iraq (Fatha, Injana, Mukdadiya, and Bai Hassan formations). Iraqi Geological Journal, 25(1), 1-7.
[10] AL JUBOURY, A. I., AL NAQIB, S. Q., & AL JUBOURY, A. M. (2001). Sedimentology and mineralogy of the Upper clastic units of Fatha Formation, South of Mosul, Iraq.
[11] Jassim, S.Z. and T. Buday (2006). Latest Eocene-Recent Mega sequence AP11. In, S.Z. Jassim and J.C. Goff (Eds.), Geology of Iraq. Chapter 14, p. 169-184. Dolin and Moravian Museum, Czech Republic.
[12] Bellen, R. V., Dunnington, H. V., Wetzel, R., & Morton, D. (1959). Lexique stratigraphic international. Asie, Fasc. 10a, Iraq, Paris, 333pp.
[13] Al-Juboury, A. I., & McCann, T. (2008). The middle Miocene Fatha (lower Fars) formation, Iraq. GeoArabia, 13(3), 141-174.
[14] Al-Naqib, S. Q., & Aghwan, T. A. (1993). Sedimentological study of the clastic unit of the Lower Fars Formation. Iraqi Geological Journal, 26(3), 108-121.
[15] Amer, R.M., (1977). Micropaleontology and biostratigraphy of Upper Cretaceous – Pliocene rock units in Sinjar area, NE Iraq. GEOSURV, int. rep. no. 828.
[16] Behnam, H. A. (1979). Stratigraphy and paleontology of Khanaqin Area, NE Iraq. DG of Geological Survey and Mineral Investigation. Iraq.
[17] Al-Biaty, K. H. (1978). Micropaleontology and biostratigraphy of the Upper Eocene–Miocene rock units in Makhmour area. N. Iraq. GEOSURV, int. rep, (905).
[18] Buday, T. (1980). The regional geology of Iraq: stratigraphy and paleogeography (Vol. 1). State Organization.
[19] Al-Hashimi, H. A. (1985). Tertiary microfacies of Iraq. Directorate general for Geological Survey and mineral investigation.
[20] Sissakian, V.K, and Al-Jiburi, B.S.M. (2014). Stratigraphy of the high folded zone. Iraqi Bull. Geol. Min., Special Issue, No.6, 2014: Geology of the High Folded Zone, p 73- 161.
[21] Aqrawi, A. A., Goff, J. C., Horbury, A. D., & Sadooni, F. N. (2010). The petroleum geology of Iraq. Scientific press.
[22] Munsell, C. (2009). Geological rock—color chart. Geological Society of America (GSA). Munsell Color.
[23] British Standard Institution BS 1191 (1991): Plaster classifications. Her Majesty Stationery office, London.

[24] Central Organization for Standardization and Quality Control, Iraqi Standard, IQS 28-2010, Gypsum for Buildings.
[25] S.I. No. 240 (1950). Standard Specification (Gypsum Plasters) Order.
[26] National Toxicology Program, (2006). Chemical Information Review Document for Synthetic and Naturally Mined Gypsum (Calcium Sulfate Dihydrate) [CAS No. 13397-24-5.
[27] Bateman, A. M., & Jensen, M. L. (1999). Economic mineral deposits , 2nd Edition. New York: Wiley.
[28] Sophia, M., Sakthieswaran, N., & Ganesh, B. O. (2016). Gypsum as a construction material-a review of recent developments. International Journal for Innovative Research in Science & Technology, 2(12), 315-323
[29] Coburn, A., Dudley, E., & Spence, R. J. (1989). Gypsum Plaster: Its manufacture and use.
[30] (BS EN 196-3:2016)31: Methods of testing cement Part 3: Determination of setting times and soundness, published standard.
[31] Craig RG. (1997). Restorative dental materials.10th ed. Mosby Co; Pp: 127–136, 500–5403

ملائمة الجبس من تكوين الفتحة لإنتاج مواد البناء في منطقة بازيان – التكية شمال شرق العراق

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الملخص

تعتبر منتجات الجبس من أكثر المواد المستخدمة على نطاق واسع في الصناعة. الاستخدام الواسع للجبس كمادة بناء على مدى فترة زمنية طويلة جدًا. يقدم عدد من الشركات المصنعة محاجر مهنية مختلفة ، لكن خواصها الفيزيائية والكيميائية لا تزال موضع شك. تم أخذ خمس عينات من الجبس للتحليل الكيميائي والفيزيائي. يظهر التحليل الكيميائي أن الجبس ذو نقاوة عالية ، أكثر من 95.25٪ مع كمية متفاوتة من الشوائب ٪SiO2 (1.49-1.87) ، ٪Na2O (0.17-1.00) ، ٪MgO (0.03-0.13) ٪Al2O3 (0.06-0.23) و يمكن استخدام هذا مع بلاستر باريس بدون أي تنقية الجبس. أظهرت نسبة. ٪Fe2O3 (0.05-0.09)(٪ SO3) و CaO

أن جميع العينات المدروسة مناسبة لإنتاج الجبس كطلاء نهائي وجبس البناء. أظهر التحليل الفيزيائي أن ألوان عينات الجبس مناسبة للبناء ، وجص باريس, والطلاء النهائي ، والجوس حسب مخطط ألوان المعادن والمواصفات القياسية العراقية. نسبة النقاوة أقل من 8٪ وبالتالي فإن مواصفات جميع العينات هي اتفاقيات للمواصفات القياسية لألواح الجبس. من حيث ضبط الوقت ، فإن العينة 1 و 2 مناسبة لبناء الجبس والجص في باريس وتصنف على أنها البورق ,ومع ذلك ، فإن العينات 3 و 4 و 5 مناسبة للجبس المكلس اللامائي – الطبقة النهائية وتصنف على أنها أسمنت الركبة. علاوة على ذلك ، زاد وقت الإعداد لجميع العينات مع زيادة نسبة مسحوق الماء.