Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(1), 1156-1165 | ISSN:2251-6727

Study the characteristics of natural zeolite ZK-5 collected from Sudan Country Regions

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(Received: 27 October 2023 Revised: 22 November Accepted: 26 December)

KEYWORDS

Atomic Absorption Spectrophotometer (AAS) X-ray diffraction investigation of natural**,** (XRD), Scanning Electron Microscopy (SEM), infraRed Spectroscopy (IR), thermal analysis by TPR, DSC

ABSTRACT:

Natural zeolites are necessary for many different uses. Recently, efforts have concentrated on the features of the ZK 5 type of natural zeolite.
Since geologists first discovered zeolite minerals, we have believed that they are enormous crystals that develop in the voids and vugs of basalt and other traprock formations. Sedimentary rocks formed by volcanoes contain natural zeolites. Natural zeolites come in a huge variety of shapes and sizes throughout Sudan. This study chose natural zeolite of one type (ZK-5) and assessed its characteristics in comparison to synthetic ones. It is a low-cost natural material that is equally important for the application of commercial zeolite. Natural zeolites have been used in employed as lightweight construction materials We chose Zk5 zeolite natural for the investigation in this situation [2].
Due to this, properties are now fully developed mineral commodities Samples of natural zeolite were gathered throughout Sudan in various locations. from Wad Kawly in Sudan's eastern Gadarief region.
A second sample was taken from the Northern region's Bayouda desert. The X-ray diffraction study (XRD) used to analyze the samples revealed that they were made up of natural zeolites such as Thomsonite, Scolecite, and ZK5 and option one (ZK-5) to ascertain their characteristics. Using a variety of techniques including TPR and DSC, we demonstrate several characteristics of natural zeolite in this work. and to determine chemical composition (the amount of additional elements), an atomic absorption spectrometer (AAS) is employed. The intrinsic structure of infrared materials is examined using scanning electron microscopy (SEM).

Introduction

Natural zeolites are suitable hydrated aluminosilicate minerals from an economic and environmental standpoint A rock made of silicon, oxygen, and aluminum is called zeolite.

It happens naturally in many parts wherein the globe a volcanic eruption occurs anywhere near water or where (it was Stilbite) produced steam when heated. The Greek word for "boiling stone" is zeolite capability.

Due to its crystal structure, which includes windows, cages, and supercars, zeolite naturally contains pores. The window size ("pore size") of natural zeolites is constrained, and they are invariably hydrophilic (having a preference for water). Some artificial zeolites are comparable Because both can adsorb organic vapors with molecules smaller than their own "pore size" and are hydrophobic (attract organics but lack or have a

there has been water for centuries as a result of the eruption. Zeolite was identified in 1756 by the Swedish mineralogist Baron Axel Fredrick Cronstedt. According in one instance, the stone was dug up by the dog, and the owner gave it the Swedish word "dog"-related name zeolite. He discovered in another story that the zeolite

reduced affinity for water), they are both effective at absorbing carbon. Both carbon and zeolite can adsorb water and organic molecules; however, the molecule for which it has an affinity will displace the other molecules.

Zeolite is referred to as a "molecular sieve" because of its uniform "pore size," in contrast to carbons, which seem to have pores that lead to smaller pores that lead to even smaller pores.

, and so on, indefinitely(22). Natural zeolites are hydrated aluminosilicate compounds that are acceptable from an economic and environmental standpoint in Greece. You will have to decide whether either the Swedish or the Greek account is true because I no longer speak either language. We can say with certainty that (1,3,5)

Inorganic salts or organic surfactants that have been deposited on the surface of zeolites can change their chemical composition. .zeolite was found

Inorganic salts or organic surfactants that have been deposited on the surface of zeolites can change their chemical composition. produce positively charged oxyhydroxide or surfactant micelles, allowing the zeolite to bind anions like arsenates or chromates in stable or less stable complexes. having outstanding sorption and ion exchange capabilities. Their ability to participate effectively in many technological processes depends on their physical qualities, which are intimately connected to their geological deposits. Natural zeolites' unusual three-dimensional porous structure lends itself to a wide range of uses. (3) The excess of the terrible cost on the surface of natural zeolites, which results from the isomorphic substitution of aluminum for silicon in the basic structural units, places them in the category .of cationic exchangers. Numerous studies have demonstrated their excellent effectiveness in the elimination of metal cations derived from wastewater.".

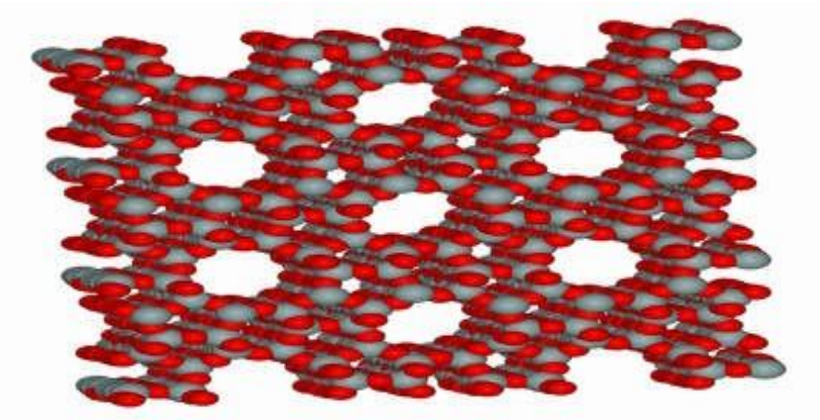

Figure (1) zeolite framework

The fact that there are numerous and diverse zeolite structure types should be made abundantly known. There were 27 known frameworks according to the Atlas of Zeolite Framework Types from 1970. Sincere disclaimer: There are many different types of zeolite frameworks growing and this is just one of them. There were 27 recognized frameworks in the Atlas of Zeolite Framework Types in 1970; by 2003, there were 134.

Zeolites are produced by a variety of pore structures that come in different sizes and form catalytic activity that is crucial to the petrochemical sector

The framework's net low cost, which has to be offset when positively charged cations are present, is a second effect of its construction with negatively charged units. The sodium ion, which predominates in the environment, is a loosely bonded counter ion in the majority of naturally occurring zeolites. Zeolites have extensive ion trading features since they can be easily replaced by ions with substantially higher affinity for a particular framework (6.8)

Although other elements have been used in the synthesis in place of silicon or aluminum to produce zeolite-like crystal formations, the zeolite that we shall examine here is just an aluminosilicate more than 600 zeolites have been identified, 40 naturally occurring zeolites have been found, 118 zeolites have been cataloged by the International Zeolite Association's Structure Committee, and the number would continue to rise if you included zeolite-like crystal structures made using other elements. No longer are any two zeolites identical to one another wide variety of strategies and businesses use zeolites, which is a well-established science. Stilbite and natrolite were first identified as zeolites in the 1750s, however, zeolites have been studied for more than two and a half centuries.

Catalysis has several uses in the fields of horticulture, agriculture, gas separation, residential water treatment, and nuclear waste processing, among other industrial applications, such as the petroleum sector. Zeolite catalysis adds a lovely $200 billion to the price of petroleum cracking. More than 150 artificial zeolites have been structured and studied.

over 50 naturally occurring zeolites have been discovered, and there are hundreds of framework and composition combinations accessible.

Due to their capabilities as ion exchangers, zeolites have been utilized in the nuclear industry for a very long time. The decision to choose Yucca Mountain in Nevada as

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JCHR (2024) 14(1), 1156-1165 | ISSN:2251-6727

the first deep geologic repository for radioactive waste was influenced significantly by the abundance of the natural zeolites mordenite and clinoptilolite in the region, both of which have significant cationic change capacities. The original sketch philosophy called for both engineered and natural zeolites to be used in the repository limitations to stop the transfer of any radionuclides that might be leaking.

Description

In terms of composition, Zeolites, which resemble clay minerals in their crystalline aluminosilicate composition, are distinguishable from them due to their well-defined defined three-dimensional nano- and micro-porous structure. Aluminum, silicon, and oxygen are arranged in a typical configuration of [SiO4] and [AlO4] tetrahedral devices, which create a framework with microscopic holes (also known as tunnels, channels, or cavities) snaking through the substance. These apertures have a diameter of between 0.1 and 2 nm.

Figure 1 depicts an example of a typical zeolite Natural zeolite is a boulder-sized herbal rock that can be found in nature. However, because zeolite crystals develop slowly, synthetic versions of the material are often much smaller than millimeters in size. In this century or millennium, zeolite is typically what we want.

The adsorbed molecule can be quickly transported to the adsorption location by these tiny grains. A large strain decrease is produced when airflow passes across a bed of zeolite powder. Recently, granular zeolites have been created with bigger airflow channels and decreased airflow resistance due to the bonding of the grains together) .16,17(

Zeolite morphology

The entire structure of a zeolite crystal is based on a tetrahedron made of four oxygen atoms joined to a silicon atom by four of its valence electrons. The oxygen "corners" of these tetrahedrons are united to form crystals. Aluminum atoms with just three valence electrons replace silicon when they are present during the crystallization process. Due to their frequent occurrence in the hydrating water, hydrogen, and sodium are frequently used to provide the last valence electron. The tetrahedron is distorted as a result, creating an "acid site" where different ions can interchange. This further increases the structure's hydrophilicity. If a carbon-based cation (an organic cation) is included in the mixture used to make the zeolite As a result, silicon-rich hydrophobic zeolites with a sufficient "pore size" (or window size) to let all but the largest petroleum molecules developed to pass through have been created.

A zeolite's crystal structure is made up of windows, cages, and extraordinary cages. Through the windows, molecules are allowed to enter cages and empty cages where they will be adsorbed or catalyzed. Cages are the smallest crystallographic units that make up the structure. Remarkable cages, which are cells in the crystal structure that are bigger than cages and may even include cages, are present (1,3,5).

A chemical Composition M_x D_y[Alx+2ySin (x+2y)O_2n] is a common formula. mH_2O.Where monovalent cations are M and divalent cations are D . The element enclosed A tetrahedral framework is indicated by square brackets, and it is identified by a typical negative cost that increases as the Si/Al ratio decreases. The replaceable cations counteract the structure's negative charge. (m) Molecules of water are present (1,3,22).

ZK-5 structure:

$Na_{24}Al_{24}Si_{72}O_{192}.H_2O$ =12 Na_2O . Al_2O_3+72 SiO_2+ 90 H_2O

Zeolite ZK-5 structures

The main constituent of the zeolite ZK5 crystal lattice is the 26-hedron (icosihexahedron) (or-cage), which is geometrically equivalent to the largest cage of zeolite A [1]. Tetrahedron (hexagonal prism) six-membered double rings, which collectively make several smaller 18-hadrons, are used to connect the icosihexahedrons structures called Deca octahedrons, or cages (3,). They are given access to each of the two or three cages, which are surrounded by six oxygen rings with eight members. All of the rings in our cages are identical and just minimally distorted. Two 8-membered rings and two cages make up each cage. The four different eight-membered rings are all severely distorted and unite the three central ones with the four nearby ones (14,30).

In zeolite ZK5, the Si/A1 ratio typically ranges from 2.0 to 3.5 [2, 3]. Although it was allowed silica zeolite, ZK5, was produced from a Li_{20}-Na_{20}-AI_{203} -SiO_2-H_20 system with a Si/A1 value of 1.5-1.7. described in [4]. The intercrystalline united amount of low silica zeolite is impermeable to hexane molecules at 291 K and to nitrogen molecules at 77 K, demonstrating that the characteristics of the molecular sieve are significantly affected by a lower Si/AI ratio.
(3,16).

Properties and applications of zeolites :

Include the separation and catalytic modification of natural molecules. Zeolites are significant industrial materials. Because the zeolite micropores' diameters are the same as the little organic molecules trapped in them, zeolites have unique adsorption and catalytic properties. Because of this, The diffusivity and reactivity of molecules trapped in zeolites can significantly vary depending on minute modifications in the geometry, composition, variety, and identity of extra framework cations. In layman's words, the interactions between the zeolite structure and natural chemicals dictate the catalytic residences and diffusivity of these blocked

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molecules. Additionally significant in terms of the synthesis of zeolites and structural direction are these organic-inorganic interactions (7,10). ,
What material is used depends greatly on the interactions between the inorganic section and the organic shape-directing agent (SDA), generated from synthesis, even if a thorough knowledge of the mechanics of shape formation is still lacking. Occluded molecules may experience a variety of forces, such as strong hydrogen bonds or electrostatic contacts, weak dispersive van der Waal interactions with the zeolite framework, and quadrupolar interactions with extra framework cations all occur between the natural molecule and the inorganic framework. Priority, These pressures are challenging to quantify in advance. but is frequently deduced from understanding the rotating, frequently anisotropic, modes of action demonstrated by the inhibited organic molecule. The mobility of occluded organic molecules in zeolites has been the subject of numerous studies during the past few years (8,16,30).

The important characteristics of Zeolite use

• If molecules can get through the windows, zeolite can adsorb them on its sizable interior surface .
• Zeolite is capable of selective ion exchange. Zeolite and carbon are both equivalent in this regard; the only difference is the location of adsorption that a vehicle can access particular moving molecules via their corresponding "pores."".
•Zeolite has the potential to be a stable acid catalyst. It can behave as a strong acid (even if it remains solid) when hydration has replaced the excess valence electron with hydrogen or when an isoelectronic transition with aluminum occurs Zeolite's homogeneous window (or pore) size makes it suitable for use as an molecular filter
• Zeolite is metastable, meaning it is safe as long as the temperature and pH are right. It is unaffected by large fluctuations in temperature, pressure, and ionizing radiation within this range
• Using zeolites to reduce air pollution
• Because they may be employed over a wider temperature range, zeolites are frequently preferred to carbon as an adsorber for the separation of carbon dioxide from flue gas. Zeolite has been used as a molecular filter to extract sulfur dioxide from flue gas. Sulfur oxides are another consequence of refining various ores. Sulfur dioxide is a component of acid rain. . The environment should benefit greatly from reducing their emissions Ammonia from wastewater can be disposed of using a natural zeolite. It has been utilized in "kitty litter" and horse stables
to regulate ammonia from urine. Additionally, it is utilized to absorb VOC that are responsible for odors from carpets, foot fungus, and mildew. Sunlight and fresh air help it to regenerate. (8,11). a natural molecule that is obscured. Numerous studies have examined the mobility of occluded organic molecules in zeolites during the past few years(8,16,30)
When light is present, zeolite can even be used to catalyze the oxidation of hydrocarbons. However, the American Chemical Society reports in CHEMTECH, 1996, 26(6), 24-30 that • Notably, it can be quite selective in these reactions.
• Zeolite has been used for water softening. In order to change the calcium and magnesium ions and prevent them from producing the insoluble soaps that we describe to as "soap scum," challenging water needs to be run through a bed of zeolite. Zeolite may be renewed by pumping salt brine through it. Disposal is straightforward because the chlorides of the exchanged ions are water-soluble.
Although hydrophilic zeolite has been utilized for decades, stronger chemicals are now used because natural zeolites are destroyed by tap water's acidity (7,9,10,18).
• Zeolite has applications outside of reducing air pollution. In the process of treating radioactive wastes, zeolite is used to extract radioactive cesium and strontium from wastewater. Zeolite is used to alter and attract these ions because it is tightly closed to even high levels of radiation. When sodium is present at a concentration of 150,000 times that of radioactive strontium, it is successful in putting off the latter at an awareness of 1 microgram per liter. Zeolite is used as a filler in concrete in the form of powder or sand-sized grains. After that, the concrete is cast in barrels for disposal. Because this form of disposal is expected to be resistant to salt water leaching, it can be done at a landfill or by using the ocean.
•Zeolites are "builders" in detergents and are only utilized as soon as possible. The majority of sodium tripolyphosphate, a chemical that was once used and proved to be adversely detrimental, is replaced by zeolite, which is employed as a "builder". The zeolite again draws calcium and magnesium ions out of the water in this instance.
• The use of zeolite catalysts in "catalytic crackers" in oil refineries was established following the identification of a big window zeolite that was formerly hydrophobic. Our annual spending on petroleum imports is now $8 to $16 billion less because of zeolite catalysts
reduced carbon dioxide emissions from refineries' lower electricity needs are added to those savings.
• Compressed air is dried using zeolite. It functions to absorb moisture as a desiccant. It can maintain a quarter of its weight in water without experiencing a significant increase in vapor pressure(26).
•Drying out the refrigerant in refrigerators also involves the use of zeolite. By doing this, ice crystals that can

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obstruct the gliding passageways and valves are prevented from forming.

- Zeolite is used to control the delivery of slow-release fertilizers into the soil. The bacteria in the soil convert urea to ammonia. The ammonia is absorbed by clinoptilolite, which also stops the soil microorganisms from turning it into nitrate. Over several months, this nitrification develops as a result of subsequent ammonia slowly draining. If not, a flood of nitrates would leach from the soil and contaminate every groundwater source and stream.
- To separate oxygen from nitrogen in the air, zeolite is utilized. A suitable zeolite, polarization, and the slight size difference between an oxygen and nitrogen molecule allow for the selective adsorption of oxygen from the air. The oxygen is then desorbed once the nitrogen has been released. This is done to produce oxygen for the flight crews (16,12,15).

MATERIAL AND METHODS

preparing a sample

Zeolite deposit samples In the past, the north and east of Sudan were used to collect natural zeolite. To create a premium powder, the zeolite crystals that had been removed from the rock pattern were cleaned, dried, crushed, and sieved.

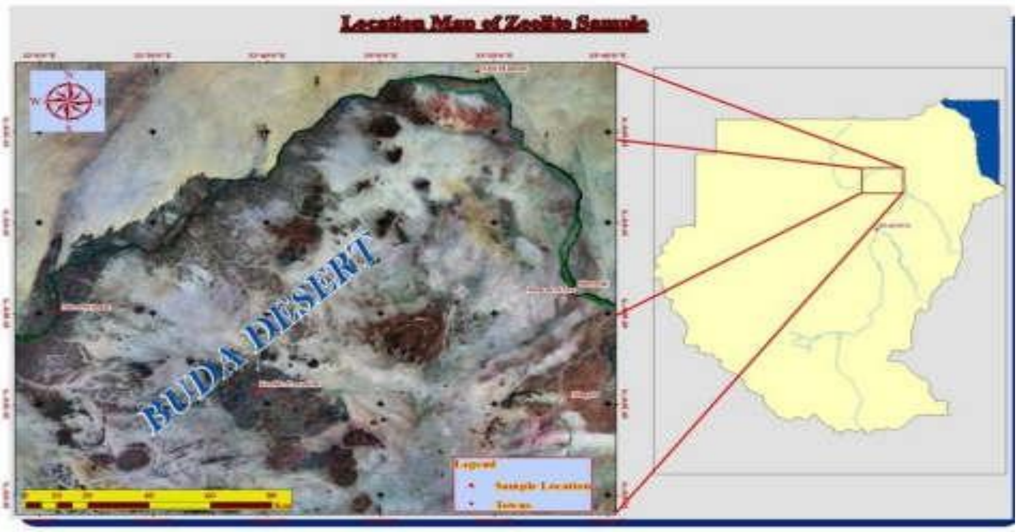

Figure (2) sample location

To eliminate soluble contaminants, the powder was refluxed with twice-distilled water. After that, it was decanted and dried for two hours in the oven. Natural zeolite is ground into a fine powder and utilized to improve and modify its properties (16,17,19,20).

Testing and Characterization

Different methods are employed to select the houses using analysis. There are many different methods for characterizing materials, but the one that is crucial in this work is the XRD (X-ray diffractogram) technique. An X-ray diffractometer (Rigaku, Miniflex) was used to measure the powder XRD patterns of the finished goods using Cu-Ka radiation at 40 kV and 20 mA. Model: Philips Xpert PRO stress XRD analyzer, Experiment The dwellings are determined through Analysis using a variety of methodologies. There are numerous ways to characterize materials, but X-ray diffractogram (XRD) analysis is crucial in this investigation.

The crystallization of the material is shown using Cu-target radiation. It is employed for the analysis of powder method to identify zeolite deposits. Flame double beam systems; Perkin Elmer Model 2380; Atomic Absorption Spectrophotometer (A.A.S.).

It used to be used to decide the chemical composition mentioned as oxides. (27,28,29).

The pattern is characterized via scanning electron microscopy (SEM) to take a look SEM (Hitachi, S-4500S, 13C analysis scanning Electron Microscopy (SEM): Model; TESCAN. Oxford Industrial Company, employing a power dispersive spectrometry (EDS) system) was used to look at the morphologies of dry gels and products. High-magnification micrographs are used to characterize it by illuminating internal structures (pores). (IR) infrared spectroscopy.

The temperature of zeolites was measured to determine the sample's thermal stability, and a simultaneous differential scanning calorimetric (DSC), thermal gravimetric analysis (TGA), TPD, and TPR device were also done on a Perkin Elmer Ta A-7 instrument, and a Perkin Elmer Data -17000 instrument with 1 m% of purity. The descriptions of each characterization technique are given below. (30,21,22).

RESULTS AND DISCUSSIONS

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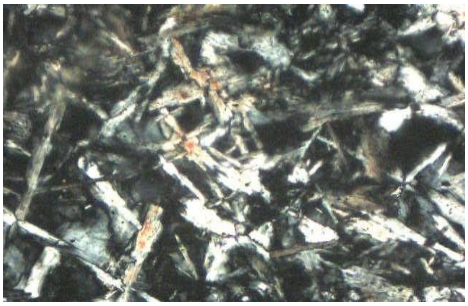
JCHR (2024) 14(1), 1156-1165 | ISSN:2251-6727

Zeolite zk5 was collected from the east of Sudan and its properties were all assigned, as shown in the figures below. Natural zeolites chosen from the Sudan were characterized in this study.

Properties of Zeolite Zk-5

Figures (2) and (3) show the same thin section of zeolite zk-5 in cross-polarized and plain cross-polarized light, respectively.



Figur e3 Thin section of z eolite zk-5 (pl ain cross-pol ari zed li ght)

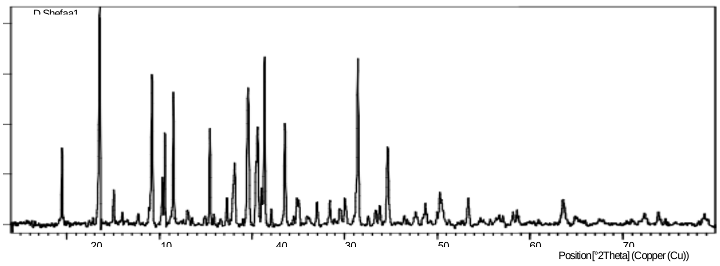
Table 1 Atom ic absorption analysis of natural zeolite zk-55

Sample	Natural ze lite
CaO%	- 24.1%
Al2O3%	57.5%
SiO2% Na2O%	24.8%
Moisture	4.6%

XRD Diffraction for ZK-5 Zeolite

Powder XRD (Siemens D500 (Figure 4) patterns, which demonstrate crystallization, were used to determine pattern structure and crystallinity using a diffractometer utilizing Cuka radiation.

When contrasting the diffractograms of the native sample and the reference ZK 5 Zeolite it was possible to demonstrate how the Z k 5 Zeolite phase formed. The initial top of the XRD, according to Treacy and Higgins m, will appear in the range (2 = 2 o). 6 10ofor the zeolite Z k 5, see Figure (4).



Position [°2Theta] (Copper (Cu))

Fig 4 X-ray diffraction of zk-5 zeolite

Characterization of ZK-5 zeolite using IR

The infrared spectrum of ZK-5 zeolite is shown in Figure (5), which was ground into a powder without any chemical modification. According to reports, these bands are in the following positions: I(Al)O is bent in 634,541 places, while O-Si(Al)-O+ Si-O- Al is stretched in 1411,80 cm and Si(Al)O is bent in 1733,89 cm and 3423.41 cm, respectively. the movement of OH brought on by a hydrogen bond.

Electron scanning microscopy Figures (3--5) and (3--6) illustrate the pictures and morphology of zeolite,

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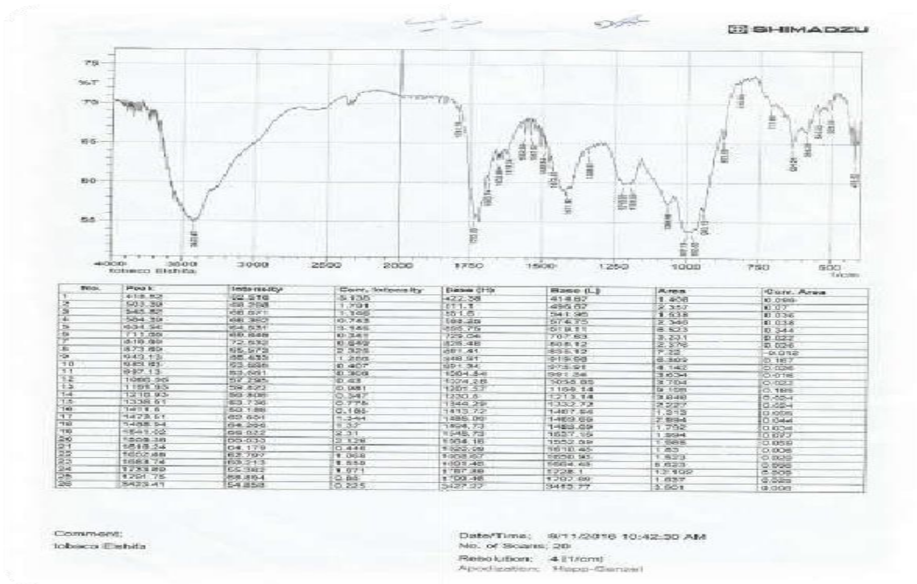
zk-5the result observed the smaller nano-particles in an amorphous of standard one.



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	418.52	52.516	5.135	422.38	414.87	1.408	0.099
2	503.39	68.298	1.791	511.1	495.67	2.357	0.07
3	545.82	68.671	1.195	551.6	541.95	1.538	0.036
4	584.39	68.382	0.743	588.25	574.75	2.346	0.038
5	634.54	64.631	3.145	655.76	619.11	6.523	0.344
6	711.69	69.848	0.341	729.04	707.83	3.231	0.022
7	819.69	72.632	0.649	825.48	808.12	2.378	0.026
8	873.69	65.573	2.325	881.41	835.12	7.22	-0.012
9	943.13	55.435	1.256	948.91	919.98	6.309	0.167
10	983.81	53.686	0.407	991.34	973.91	4.142	0.026
11	997.13	53.691	0.309	1064.54	991.34	3.634	0.016
12	1066.95	57.295	0.43	1074.28	1056.85	3.704	0.022
13	1195.93	59.822	0.981	1201.57	1159.14	9.156	0.185
14	1218.93	59.806	0.347	1230.5	1213.14	3.848	0.054
15	1338.51	63.736	0.776	1344.29	1332.72	2.227	0.224
16	1411.8	60.188	0.185	1413.72	1407.94	1.313	0.006
17	1473.51	62.651	1.344	1485.09	1469.66	2.894	0.044
18	1488.94	64.266	1.37	1494.73	1483.69	1.792	0.034
19	1541.02	66.022	2.31	1545.73	1527.15	1.394	0.077
20	1558.38	65.033	2.128	1564.16	1552.59	1.565	0.059
21	1618.24	64.179	0.448	1622.09	1610.45	1.63	0.006
22	1652.88	62.797	1.068	1658.67	1650.95	1.523	0.029
23	1683.74	63.213	1.559	1691.45	1664.45	5.623	0.596
24	1733.89	55.382	1.071	1787.38	1728.1	12.102	6.509
25	1791.75	69.464	0.88	1799.46	1787.89	1.837	0.029
26	3423.41	54.858	0.225	3427.27	3415.77	3.501	0.006

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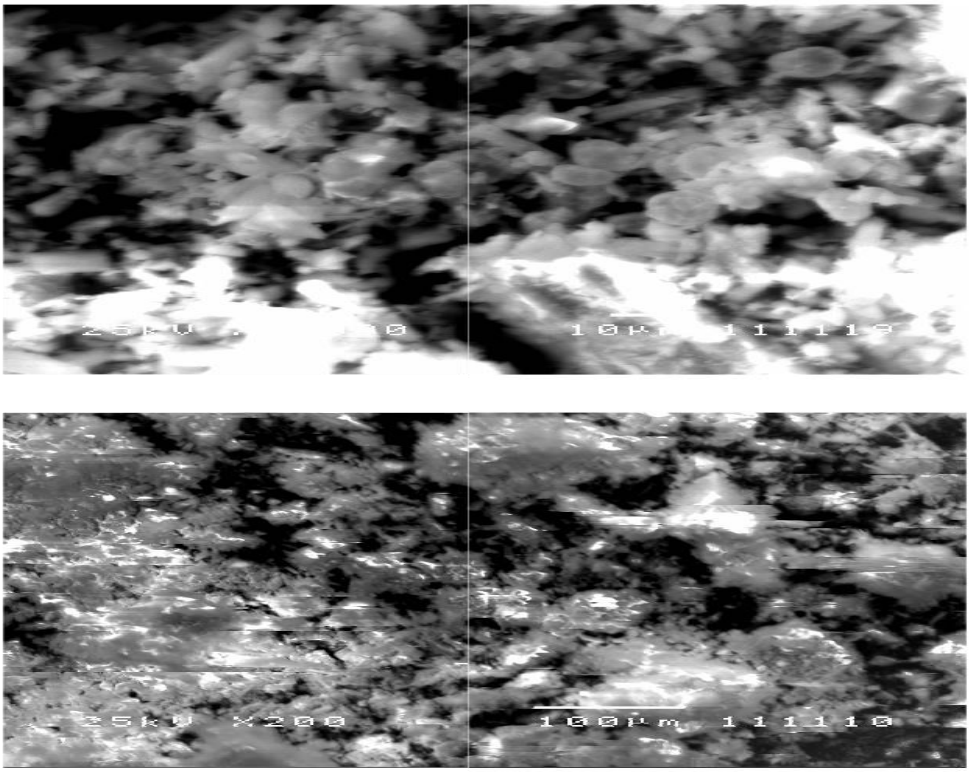

Figure (3-5) Scan electron of zk-5

Thermal evaluation

Figure (3-7) illustrates thermal analysis using TGA and DSC:

The result of the thermal analysis shows that the Z K -5 zeolite is stable for temperature and is capable of many applications.

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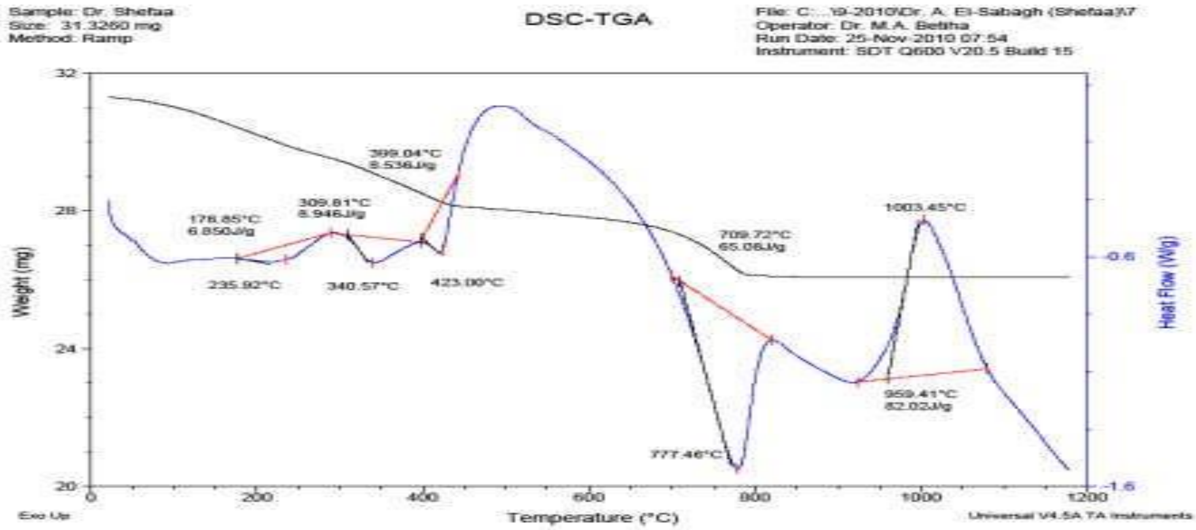

Figure (3-7) illustrates Zk5 zeolite's DSC and TGA analysis

RECOMMENDATION AND CONCLUSION

allow for simple and affordable protection in large-scale applications

The findings of this study phase demonstrate that the natural Z k - k zeolites from the Sudan region have been suitably processed for use in essential applications.

It is advised that future studies analyze The weight ratio of manganese to oxygen in the preparation to determine the total chemical composition of the advice and its pastime. Will

make the necessary changes and mention each additional larger zeolite ZK home. 5. The findings of the subsequent study will allow for an economically feasible examination of the entire technological process. Important commercial minerals known as zeolites are used to separate and catalyze the transformation of natural chemicals.

Generally speaking, it has been reported that the majority of the study into the use of herbal zeolites as a technique for remediating polluted soil has been done through laboratory and greenhouse studies. The long-term usage of natural zeolites in practical cleanup initiatives is not well supported by the literature. Additionally, it was once stated that field studies must be conducted as soon as possible to evaluate the effectiveness of Insite for these remediation goals and that further research is needed to determine whether using zeolites would be profitable in the future.

Zeolites are a well-known technology with numerous industrial applications, including catalysts, detergent builders, and building materials.

They are one of the earliest methods for separating radioactive components from aqueous waste streams. The capacity to be chemically "tailored" to particular target species and the adaptable tectonic structure both further encourage their development. Zeolites are one of the few substances with the potential to be a less expensive amendment to soils contaminated with radioactive species, in addition to their use as an "Endo pipe" therapy for aqueous streams. This is because the material can be designed to have extremely high species selectivity and binding electricity. Due to their catalytic capabilities, zeolites will likely continue to be studied; research in this area has Despite extensive work on their geological beginning maintenance factors, little research has been done on their fate and movement. As would be expected, specific details are established on the involved waste streams and behavior. Numerous information about the operation is available, and 700 million piles of zeolite are employed in this way each year. Zeolite rarely produces a bothersome amount of dust when it is in powder form, and it has no negative effects on the environment

Natural zeolites are inexpensive, exhibit excellent selectivity for specific cations at low temperatures, and release nontoxic exchangeable cations (K+, Na+, Ca2+, and Mg2+) into the environment, making them superior to other cation change materials like commonly used organic resins.-.

References

1. Allen, E. R. and D. W. Ming. Recent Progress in the Use of Natural Zeolites in Agronomy and Horticulture.Natural Zeolites '93, Occurrence, Properties, Use*;* D. W.Ming and F. A. Mumpton, (Eds.); International Committee on Natural Zeolites.Brockport, New York (1995).
2. Allen SJ, Ivanova E, KoumanovaB, Adsorption of sulfur dioxide on chemically modified natural clinoptilolite. Acid modification, *Chem.Engin.J*. 152:389-395(2009).
3. A. Dyer, An Introduction to Zeolite Molecular

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(1), 1156-1165 | ISSN:2251-6727

Sieves, Wiley, Chichester, (1988), p. 87.

4. Auerback, S.M., K.M. Carrado, P.K. Dutta. Handbook of Zeolite Science and Technology .Marcel Dekker, Inc.,New York,(2003).
5. 5-Bish, D.L., Natural Zeolites and Nuclear Waste Management; The Case of YuccaMountain, Nevada, USA. In Natural Microporous Materials in Environmental Applications .P. Misaelides, F. Macasek, T.J. Pinnavaia, and C. Colella (Eds.). KluwerAcademic Publishers, The Netherlands (2000).
6. Brandt, H.L. 1970. B-plant recovery of cesium from Purex supernatant. Report ARH-1639. United States Atomic Energy Commission, Hanford,Washington.BRZ Zeolite. 2007. Website. Accessed October (2007). http://www. zeolite.ca/agriculture.htm
7. Bish DL, Meng DW, Editors**.** Reviews in Mineralogy and geochemistry, volume 45 Natural Zeolites: Occurrence, properties, Applications 69,77,78pp(2001).
8. Breck, D., W., "Zeolite Molecular Sieves" Wiley. Interscience publication, (1974).
9. Carlos Alberto Rios Reyes, Doctoral thesis synthesis ofzeolites from geological materials and industrial wastes for potential application in environmental problems (2008).
10. Chen, N.Y., T.F. Degnan, C.M. Smith. 1994. Molecular Transport and Reaction in Zeolites: Design and Application of Shape Selective Catalysis. Wiley, VCH, Hoboken, N J. Choppin, G.R. and M.K. Khankhasayev. Chemical Separation Technologies and Related Methods of Nuclear Waste Management: Applications, Problems, and Research,(1999).
11. Coruh S, Senel G, Nuri Ergun O, A comparison of the properties of natural clinoptilolite and their ion- exchange capacities for silver removal. *J.Hazard.Mater*. 180:486-492(2010).
12. Fu F, Wang Q, Removal of heavy metal ions from wastewaters: A review, *J.Environ.Manage*.92:407- 418(2011).
13. *Handbook of zeolite science and technology*, Scott M. Auerbach, Kathleen A. Carrado, Prabir K. Dutta, eds. CRC Press, (2003,) p. 16. ISBN 0824740203
14. J.Cejka.H.VanBekkum .A.Corma and F.schiith (Editors) Natural zeoletes and environment Diparimento d ingegneriadei material dellaproduzione, ,university Federico II,piazzaleV.Tecchio 80125 Napoli, Italy introduction to zeolite science and practice -3rd Revised Edition , published by Elservier B.V (PPN, 99 - 1004(2007).
15. Jens Wietkamp * Zeolites and Catalysis, Institute of Chemical Technology, University of Stuttgart, D- 70550 Stuttgart, Germany received solid state lonics 131 (2000) 175-188.
16. John Wiley &Sons, Zeolites molecular sieves, structure chemistry and use DONALD W. Breck Senior Research fellow, Union Carbide Corporation, Tarrytown, NewYork, Wiley – Interscience publication, NewYork. London. Sydney Toronto ppn N 445 – 459, (1974).
17. Kawamura, S. Integrated Design and Operation of Water Treatment Facilities, Wiley, Hoboken, NJ. (2000).
18. Kerry, F. GIndustrial Gas Handbook: Gas Separation and Purification. CRCPress, Boca Raton, FL. (2007).
19. Oliveira CR, Rubio J, New basis for adsorption of ionic pollutants onto modified zeolites. Mineral.Engin. 20:6:552-558(2007) (2000).
20. Ortega EA, CheesemanCh, Knight J, Loizidou M, Properties of alkali-activatedclinoptilolite. Cement.Concrete. Res. 30:10:1641-1646.
21. MisaelidesP, Application of natural zeolites in environmental remediation: A short review. Micropor.Mesopor.Mater. 144:15-18(2011).
22. *The role of natural and synthetic zeolites as feed additives on the prevention and/or the treatment of certain farm animal diseases: A review*. Microporous and Mesoporous Materials, Volume 84, Issues 1-3, 15 September 2005, Pages 161-170. D. Papaioannoua, P.D. Katsoulosa, N. Panousis.doi:10.1016/j.micromeso.2005.05.030
23. Rhee P, Brown C, Martin M, "QuikClot use in trauma for hemorrhage control: case series of 103 documented uses".*J Trauma* **64** (4): 1093–9. doi:10.1097/TA.0b013e31812f6dbc. PMID 18404080*et al.* (April 2008).
24. Roberto Millinicarloperego, The Role of Molecular Mechanic and Dynamic Method in Development of zeolite catalytic processes, published online January 2009 © Springer Science + Business Media, LLC (2009).PPN (43-49).
25. R.M. Barrer, Zeolites and Clay Minerals as Sorbents and MolecularSieves, Academic Press, London, 1978, p. 5.
26. Ruggieri F, Marín V, Gimeno D, Fernandez-Turiel JL, García-Valles M, Gutierrez L, Application of zeolitic volcanic rocks for arsenic removal from water.Engineering Geology. 101:3-4: 245-250(2008).
27. Wang S, Zhub ZH, Characterisation and environmentalapplication of an Australian natural zeolite for basic dye removal from aqueous solution.*J. Hazard. Mater*. 136:946-952(2006).
28. 28- Wang S, Peng Y, Natural zeolites as effective adsorbents in water and wastewater treatment. Chem. Engin.J. 156:11-24 (2010).
29. Zeolite catalysts in the reduction of NO_xin lean

automotive exhaust gas conditions Behaviour of catalysts in activity, DRIFT and TPD studies, Academic dissertation to be presented, with the assent of the faculty of technology of the University of Oulu, for public defense in auditorium TA105- linnanmaa, onDecember 1st, (2006), at noon.

30. Zhdanov, S.P. and Egorova, E.N., Khimiyatseolitov Asa conclusion, the investigated zeolites NaA(4A), (Zeolite Chemistry), Leningrad, NaX (13X), and Zk-5, obtained from natural inorganic (1968).