

Enhancement the octane number of gasoline petroleum fraction using synthetic zeolite

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ABSTRACT

The main aim of this work is to enhance the octane number of the gasoline portion of the Sudanese petroleum using synthetic zeolite. The octane number measures the degree of the gasoline resist to self ignition prior to combustion. Gasoline with higher octane number has higher tendency to resist self ignition. Gasoline containing branched and aromatic hydrocarbons resists self ignition rather than gasoline containing straight chain hydrocarbons. 2, 2, 4 tri methyl pentane named iso octane (has octane number 100) and n-heptane (has octane number 0) are used to measure the octane number of the oil under the test. Two types of octane numbers were used, those are the research octane number (RON) which measures the octane number of an engine with a normal speed (600 rpm) and the motor octane number (MON) which measures the octane number of an engine with high speed (900 rpm). Zeolites are frame work of tetrahedral silicates (TO_4), with a net negative charge balanced by a positive cation. Zeolite /Li indicating that the Li cation is used to neutralized the framework. Four synthetic zeolites were prepared: Zeolite /Li , Zeolite /Na , Zeolite /Cu and Zeolite /Bi. Equal amount of the above zeolites (in grams) were mixed separately with the same amounts(in liter) of the gasoline portion of the Sudanese petroleum. The gasoline portion used before the addition of zeolites is considered to be a standard and is called a blank. The octane number of the blank and the four mixtures were measured (ASTM 2296) and compared . Zeolite/Li enhanced both the RON and the MON compared with the blank, it is considered to be the best among the other zeolites and subjected to further analysis. Physical properties (distillation , density , S.G@15°C , Reid vapor pressure and the degree of corrosion) were carried out for the blank , the mixture of zeolite /Li with the gasoline. The main analytical techniques used were X Ray Diffraction (XRD) , X Ray Fluorescent (XRF) and Infra red Spectroscopy (IR). XRD is made to the solid zeolite/Li to predict the type of crystallographic structure and type of the zeolite. Zeolite /Li was found to be zeolite type Y with the name Albite referenced and compared with the (ICCD). XRF was made to zeolite/Li to find the elements embedding within the zeolite structure. The type of elements and their concentrations were found and compared. IR is made for zeolite/Li to estimate the functional groups. zeolite/Li was found to contain TO_4 (where T is Si or Al) and T-O bond in addition to hydroxyl group which may act as bridge within the framework structure. We consider this work and the data so obtained are of industrial importance for enhancing the quality of gasoline under the test and environmental importance for substituting the Lead added to the gasoline with the zeolite which is harmless to the environment and causing no pollution.

Key Words: Octane number, zeolite , XRD , XRF a IR

INTRODUCTION

2.1.Gasoline

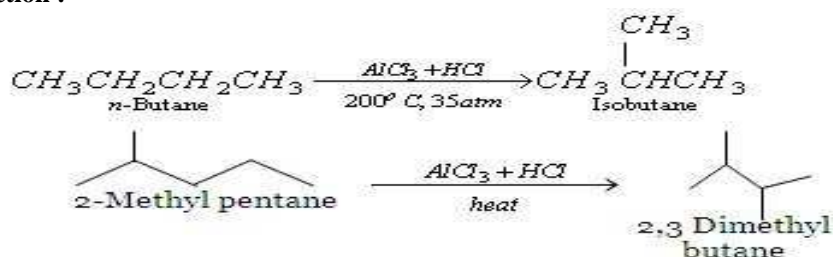
Gasoline or petrol is a fuel, derived from petroleum crude oil, for use in spark-ignited internal combustion engines. Conventional gasoline is mostly a blended mixture of more than 200 different hydrocarbon liquids ranging from those containing 4 carbon atoms to those containing 11 or 12 carbon atoms. It has an initial boiling point at atmospheric pressure of about 35 °C (95 °F) and a final boiling point of about 200 °C (395 °F).^[1] Gasoline is used primarily as fuel for the internal combustion engines in automotive vehicles as well in some small airplanes.

2.3. Cracking

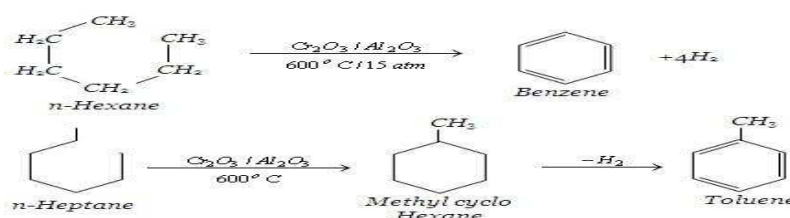
This processes break down heavier hydrocarbon molecules (high boiling point oils) into lighter products such as petrol and diesel. These processes include catalytic cracking, thermal cracking and hydro cracking. In addition to cracked naphtha for making petrol, hydro cracking yields light gases useful for refinery fuel, or alkylation as well as components for high quality fuel oils, lube oils and petrochemical feedstocks. Following the cracking processes it is necessary to build or rearrange some of the lighter hydrocarbon molecules into high quality petrol or jet fuel blending components or into petrochemicals. The former can be achieved by several chemical processes such as alkylation and isomerisation. ⁽²⁾ (fig. 1).

Fig (2.1) Main reactions involving enhancement of the octane number

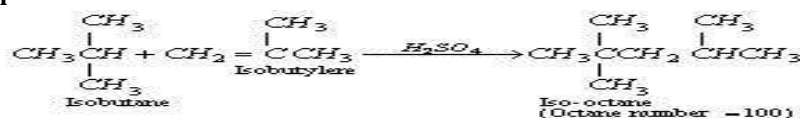
Isomerization reaction :-



Aromatization of benzene



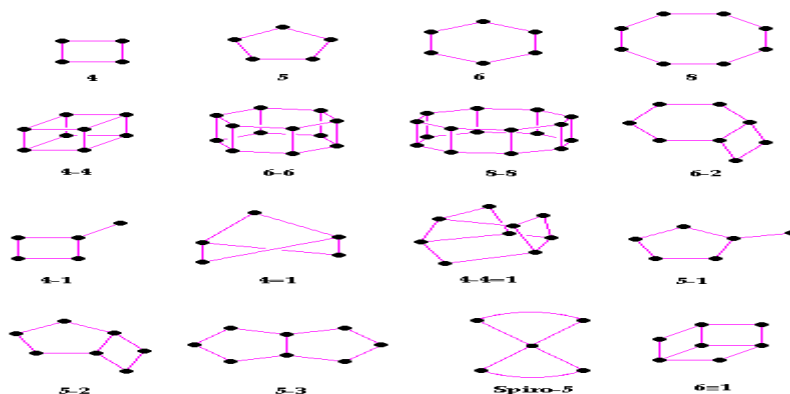
Alkylation reaction



2.4 The Zeolite Group of Minerals

Zeolites are a large group of natural and synthetic hydrated aluminum silicates. The framework silicates consisting of interlocking tetrahedrons of SiO₄ and AlO₄. In order to be a zeolite the ratio (Si + Al)/O must equal 1/2. The aluminum-silicate structure is negatively charged and attracts the positive cations that reside within. They are characterized by complex three-dimensional structures with large, cage like cavities that can accommodate sodium, calcium, or other cations (positively charged atoms or atomic clusters); water molecules; and even small organic molecules.

Fig (2) zeolite secondary building units



The atomic structures of zeolites are based on three-dimensional frame works of silica and alumina tetrahedral, that is, silicon or aluminum ions surrounded by four oxygen ions in a tetrahedral configuration. Each oxygen is bonded to two adjacent silicon or aluminum ions, linking them together. Clusters of tetrahedra form boxlike polyhedral units that are further linked to build up the entire framework. In different zeolites the polyhedral units may be equidimensional, sheet like, or chainlike.⁽³⁾

The T atom of the TO₄ tetrahedron is located at each of the corners, and the oxygens are located towards the mid-points of the lines joining each T atom (the oxygens are not shown to aid clarity). These secondary building units (SBU's) (Fig.2.2) (the primary building units being the TO₄ tetrahedra) can contain up to 16 T atoms.

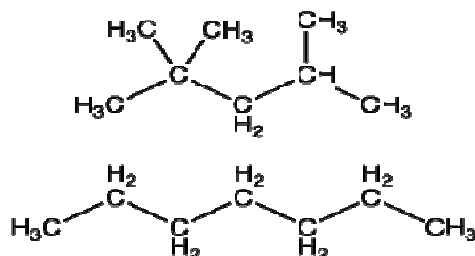
2.6. Faujasite Zeolite Y

Zeolite Y exhibits the FAU (faujasite) structure. It has a 3-dimensional pore structure with pores running perpendicular to each other in the x, y, and z planes, and is made of secondary building units 4, 6, and 6-6. The pore diameter is large at 7.4 Å since the aperture is defined by a 12 member oxygen ring, and leads into a larger cavity of diameter 12Å. The cavity is surrounded by ten sodalite cages (truncated octahedra) connected on their hexagonal faces. The unit cell is cubic (a = 24.7Å) with Fd-3m symmetry. Zeolite Y has a void volume fraction of 0.48, with a Si/Al ratio of 2.43. It thermally decomposes at 793°C.⁽⁴⁾

2.7 The octane rating :-

Octane rating number is defined as a value used to indicate the resistance of a motor fuel to knock. Octane numbers are based on a scale on which isooctane is 100 (minimal knock) and heptane is 0 (bad knock). A gasoline with an octane number of 92 has the same knock as a mixture of 92% isooctane and 8% heptane.⁽⁴⁷⁾ Typical "octane booster" gasoline additives include MTBE(methyl tetra butyl ether), ETBE (ethyl tetra butyl ether), isooctane and toluene. Lead in the form of tetraethyllead was once a common additive, but its use for fuels for road vehicles has been progressively phased-out worldwide.⁽⁵⁾

In internal combustion engines, the compressed gasoline-air mixtures have a tendency to ignite prematurely rather than burning smoothly. This creates engine knock, a characteristic rattling or pinging sound in one or more cylinders. The octane number of gasoline is a measure of its resistance to knock. The octane number is determined by comparing the characteristics of a gasoline to isooctane (2,2,4-trimethylpentane) and heptane.



Isooctane is assigned an octane number of 100. It is a highly branched compound that burns smoothly, with little knock. On the other hand, heptane is given an octane rating of zero. It is an unbranched compound and knocks badly. Cracking, isomerization, and other processes can be used to increase the octane rating of gasoline. Anti-knock agents may be added to further increase the octane rating. Tetraethyl lead, Pb(C₂H₅)₄, was one such agent.

Gasoline pumps typically post octane numbers as an average of two different values. Often you may see the octane rating quoted as (R+M)/2. One value is the research octane number (RON), which is determined with a test engine running at a low speed of 600 rpm. The other value is the motor octane number (MON), which is determined with a test engine running at a higher speed of 900 rpm.⁽⁶⁾ If, for example, a gasoline has an RON of 98 and a MON of 90, then the posted octane number would be the average of the two values or 94. Sometimes RONC and MONC are used instead of RON and MON. C stands for clear which means that the fuel does not contain lead or manganese additives.

MATERIALS AND METHODS

3- Experimental

3.1. Zeolite/X preparation :

Clay : K Falicpar: Na₂CO₃ : XCl_n were mixed well with the ratio 2:2:2:1 by weight respectively. The mixture was then crushed to a fine powder and transferred to an oven and exposed to a temperature of 1200 °C for 6 hours. The mixture was then allowed to cool gently and collected for further use.

3.2 Mixing zeolite with gasoline fraction :-

25 grams of the zeolite was mixed with 100 ml of gasoline fraction . The mixture was boiled gently and allowed to stand overnight. The mixture was then collected and subjected to further analysis.

3.3 Standard Test Method for Research Octane number and motor octane number of Spark-Ignition Engine Fuel .⁽⁷⁾

3.3.1. Sample Fuel:

The sample fuel was introduced to an empty fuel reservoir using research octane number test engine. The fuel-selector valve was positioned to operate the engine on the sample fuel and The maximum K.I. (knock intensity), reading was recorded.

3.3.2 Reference Fuel No. 1:

A fresh batch of a *reference* blend that has an O.N. estimated to be close to that of the sample fuel was Prepared. Reference Fuel No. 1 was introduced to one of the unused fuel reservoirs. The fuel-selector valve was Position to operate the engine on Reference Fuel No. 1, the maximum K.I. was recorded.

3.3.3 Reference Fuel No. 2:

A fresh batch of the selected *reference* blend was prepared and Introduced to one of the unused fuel reservoirs .The fuel-selector valve was Positioned to operate the engine on Reference Fuel No. 2 . the maximum K.I. was recorded .

3.3.4 Calculation of O.N.(Bracketing Procedures)

Calculate the O.N. by interpolation of these average knock meter readings proportioned to the O.N. values of the bracketing PRF (petroleum reference fuel) blends in accordance with the equation below :

$$O.N._S = O.N._LRF + \left(\frac{K.I._LRF - K.I._S}{K.I._LRF - K.I._HRF} \right) (O.N._HRF - O.N._LRF)$$

where:.

- O.N._S = octane number of the sample fuel,
- O.N._{LRF} = octane number of the low PRF,
- O.N._{HRF} = octane number of the high PRF,
- K.I._S = knock intensity (knockmeter reading) of the sample fuel,
- K.I._{LRF} = knock intensity of the low PRF, and
- K.I._{HRF} = knock intensity of the high PRF.

3.5 A.S.T.M. 86 atmospheric distillation of petroleum products(8)

The distillation characteristics are critically important for both automotive and aviation gasoline, affecting starting, warm-up, and tendency to vapor lock at high operating temperature or at high altitude, or both. The presence of high boiling point components in these and other fuels can significantly affect the degree of formation of solid combustion deposits.

3.5.1 Procedure

A low range thermometer provided with stopper of silicone rubber, was Fitted tightly into the neck of the sample container and bring the temperature of the sample to a specified temperature .The specimen precisely was poured to the 100-mL mark of the receiving cylinder, and the contents of the receiving cylinder was transferred as completely as practical into the distillation flask. The temperature sensor was Fitted through a snug-fitting device, centered in the neck of the inner wall of the vapor tube. The flask vapor tube, provided rubber stopper of silicone, was fitted tightly into the condenser tube. The receiving cylinder was placed.

The start time was noted, and the IBP (initial boiling point) was observed and recorded to the nearest 0.5°C (1.0°F) , to keep the distillation rate as constant as possible throughout the test. In the interval between the IBP and the end of the distillation(final boiling point FBP) , data (temperature readings at prescribed percentages recovered , or both) necessary for the calculation was observed and recorded.

3.6 ASTM D 1298 ⁽⁹⁾

Standard

Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.

3.6.1 Procedure

The sample was transferred to the clean, temperature stabilized hydrometer cylinder without splashing, The cylinder containing the test portion was placed in a vertical position in a location free from air currents and where the temperature of the surrounding medium does not change more than 2°C during the time taken to complete the test. The appropriate thermometer or temperature measurement device was Inserted and the test portion. The test portion was stirred with a stirring rod, using a combination of vertical and rotational motions to ensure uniform temperature and density throughout the hydrometer cylinder, the temperature of the sample was Recorded to the nearest 0.1°C and the thermometer/temperature measuring device and stirring rod were removed from the hydrometer cylinder. The appropriate hydrometer was lowered into the liquid. The meniscus shape was observed when the hydrometer is pressed below the point of equilibrium about 1 to 2 mm and allowed to return to equilibrium. Experiment was repeated until the meniscus shape remains constant. Air bubbles were removed and the hydrometer scale was read to the nearest one-fifth of a full scale division.

Immediately after recording the hydrometer scale reading, carefully the hydrometer was lifted out of the liquid, the thermometer or temperature measurement device was inserted and the test portion was stirred vertically with the stirring rod. The temperature of the test portion was recorded to the nearest 0.1°C. The corrected hydrometer scale reading was Converted to density, relative density or API gravity using the appropriate parts of the Petroleum Measurement Tables .

3.7 ASTM D 323 Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method) (10)

3.7.1 Procedure

The sample was removed from the cooling bath, uncapped, and the chilled transfer tube was inserted. The liquid chamber was removed from the cooling bath, and placed in an inverted position over the top of the transfer tube. The entire system was Inverted the rapidly so that the liquid chamber is upright with the end of the transfer tube approximately 6 mm (0.25 in.) from the bottom of the liquid chamber. The transfer tube was removed from the liquid chamber while allowing the sample to continue flowing up. The vapor chamber was Immediately removed from the water bath and coupled with the filled liquid as quickly as possible without spillage. The assembled apparatus was turned upside down and allowed all the sample in the liquid chamber to drain into the vapor chamber. The apparatus (still inverted) , was shacked vigorously eight times up and down. The assembled apparatus was immersed in the bath, maintained at 37.8 +/- 0.1°C (100 +/-0.2°F), in an inclined position so that the connection of the liquid and vapor chambers is below the water level .

3.7.2 Measurement of Vapor Pressure

After the assembled apparatus has been in the water bath for at least 5 min, the pressure gage was tapped lightly and the reading was observed. The apparatus was withdrawn from the bath and the above procedure was repeated at intervals of not less than 2 min, until the last two consecutive gage readings are the same. The final gage pressure was read to the nearest 0.25 kPa (0.05 psi) and recorded as the uncorrected vapor pressure of the sample. Without undue delay, the pressure gage was removed from the apparatus, its reading was checked. The difference observed between the pressure measuring device and the pressure gage readings, was added to the uncorrected vapor pressure and the resulting value recorded as the Reid vapor pressure of the sample.

3.8 I.R Spectroscopy

On the immediate high energy side of the visible spectrum lies the ultraviolet, and on the low energy side is the infrared. The portion of the infrared region most useful for analysis of organic compounds is not immediately adjacent to the visible spectrum, but is that having a wavelength range from 2,500 to 16,000 nm, with a corresponding frequency range from 1.9×10^{13} to 1.2×10^{14} Hz. ⁽¹¹⁾

3.8.1 procedure

The samples were grinded and milled to form a fine powder. This powder was then compressed into a thin pellet under 7 tons for 5 minutes. The sample was then analyzed using characterized of Fourier Transform Infrared (Shimadzu 8300) spectrometer and the spectrum was recorded in a spectral range of 400-4000 cm^{-1} .

3.9.X-ray Diffraction

The X-ray diffraction pattern of a pure substance is, therefore, like a fingerprint of the substance. The powder diffraction method is thus ideally suited for characterization and identification of polycrystalline phases.

If we use the three dimensional diffraction grating as a mathematical model, the three indices h, k, l become the order of diffraction along the unit cell axes a, b and c respectively.

We can express this relationship mathematically in Bragg's law.

$$n \lambda = 2d \sin \Theta$$

where n (an integer) is the "order" of reflection, λ is the wavelength of the incident X-rays, d is the inter planar spacing of the crystal and Θ is the angle of incidence.

The process of reflection is described here in terms of incident and reflected (or diffracted) rays, each making an angle THETA with a fixed crystal plane. Reflections occurs from planes set at angle THETA with respect to the incident beam and generates a reflected beam at an angle 2-THETA from the incident beam. The possible d-spacing defined by the indices h, k, l are determined by the shape of the unit cell. Rewriting Bragg's law we get :

$$\sin \Theta = n \lambda / 2d$$

Therefore the possible 2-THETA values where we can have reflections are determined by the unit cell dimensions. However, the intensities of the reflections are determined by the distribution of the electrons in the unit cell..^[98]

3.9.1 Diffraction Spectra

A typical diffraction spectrum consists of a plot of reflected intensities versus the detector angle 2-THETA or THETA. The 2-THETA values for the peak depend on the wavelength of the anode material of the X-ray tube. It is therefore customary to reduce a peak position to the inter planar spacing d that corresponds to the h, k, l planes that caused the reflection. The value of the d-spacing depend only on the shape of the unit cell. We get the d-spacing as a function of 2-THETA from Bragg's law.

$$d = n \lambda / 2 \sin T$$

Each reflection is fully defined when we know the d-spacing, the intensity (area under the peak) and the indices h, k, l. If we know the d-spacing and the corresponding indices h, k, l we can calculate the dimension of the unit cell..^[99]

3.9.2 ICDD DATA BASE

International Center Diffraction Data (ICDD) or formerly known as (JCPDS) Joint Committee on Powder Diffraction Standards is the organization that maintains the data base of inorganic and organic spectras. The data base is available from the Diffraction equipment manufacturers or from ICDD direct.

3.9.3 The procedure

The sample was prepared using bulk mineralogy method given in Fauzi'S guide on X – ray diffraction mineralogy of sedimentary rock. The water was chilled at temperature 20°C and pressure 400 PSI. The XRD diffractometer Fig was switched on at initialization power 15 kV and 5mA. The sample was then analyzed using the xpert pro system

3.10 X.R.F

An X-ray fluorescence (XRF) spectrometer is an x-ray instrument used for routine, relatively non-destructive chemical analyses of rocks, minerals, sediments and fluids.

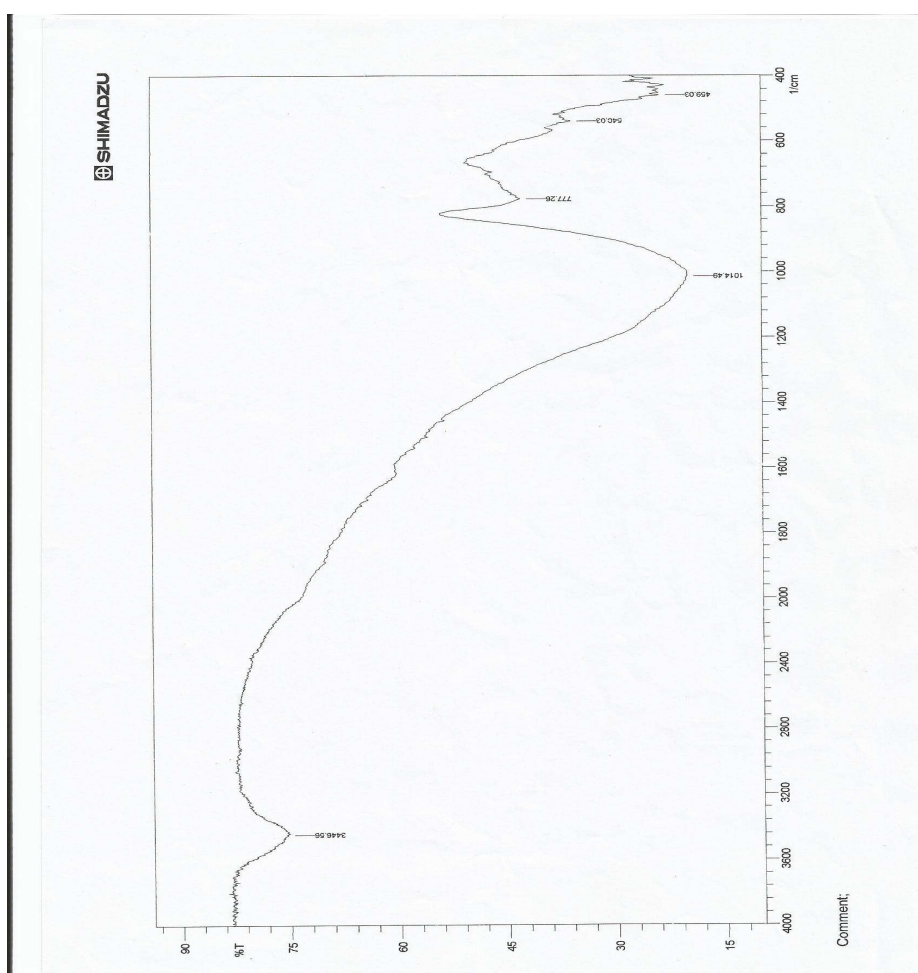
The XRF method depends on fundamental principles that are common to several other instrumental methods involving interactions between electron beams and x-rays. When materials are excited with high-energy, short wavelength radiation (e.g., X-rays), they can become ionized. If the energy of the radiation is sufficient to dislodge a tightly-held inner electron, the atom becomes unstable and an outer electron replaces the missing inner electron. When this happens, energy is released due to the decreased binding energy of the inner electron orbital compared with an outer one. The emitted radiation is of lower energy than the primary incident X-rays and is termed fluorescent radiation. Because the energy of the emitted photon is characteristic of a transition between specific electron orbitals in a particular element, the resulting fluorescent X-rays can be used to detect the abundances of elements that are present in the sample.

3.10.1 Procedure :

1 gm of the sample was crushed into fine powder and pressed into pellet form using a 15 ton pressing machine. The diameter of the pellet was 2.5 cm and the mass was about 1 gm .The pellets were presented to the X.R.F. spectrometer system . The spectra obtained as a result of X- ray excitation using Cd 109 as a source of light were transferred to computer .The spectra were then analyzed and the concentration of each element present in a sample was obtained using the software available in the computer. A plant standard was used to ensure the reliability of the results.

RESULTS**Table 4-1 RON ,MON and AKI for the blank gasoline and the mixtures**

SAMPLE	RON	MON	Anti knock index AKI = (RON+MON)/2
Blank gasoline.	91.5	81.5	86.5
Mixture zeolite/Li with blank gasoline	92.5	82.0	87.25
Mixture zeolite/Na with blank gasoline	91.5	81.7	86.6
Mixture zeolite/Cu with blank gasoline	92.5	81.4	86.9
Mixture zeolite/Bi with blank asoline	91.5	82.0	86.7

Fig 4-1 IR analysis for zeolite/Li**Table 4-2 IR Functional group identification table for zeolite/Li**

NO	Wave number	Functional group
1	459.03	TO ₄ internal tetrahedral symmetric stretch
2	540.03	T-O bend (T = Al or Si)
3	777.26	C-H Bend
4	1014.49	C-O Stretch
5	3446.56	OH Stretch

Table 4-3 Physical properties of zeolite /Li mixed with the gasoline fraction (blank)

Lit:

Test Name	Test Method	Sudanese specifications	Results	Unit
*Distillation	ASTM D86			°C
IBP		Min 38	47.0	
10%Recovered		Max 70	67.0	
50%Recovered		Max 120	107.0	
90%Recovered		Max 190	167.0	
E.P		Max 205	197.0	
20% -10%		Min 8.0	0.90	ml
Residue		Max 2.0	1.40	ml
Recovery		-	97.0	ml
Density		ASTM D1298	Report	0.7470
S.G@15°C	ASTM D1298	Report	0.7549	kg/L
Reid vapor pressure (RVP)	ASTM D323	1Nov-31Mar (45 - 80) 1Apr - 31Oct (40 - 67)	35.5	Kpa
Copper strip corrosion	D130	2a	2c	ASTM

Done by :
Mona yousif
Signature: *Mona*

Mohammed morsy
Signature: *Morsy*

Reviewed by Lab Technical manager
Name: Alshima Ahmed
Signature: *Shima*

Approved by Lab manager
Name: Ibtisam Mohammed
Signature: *Ibtisam*

Page 3 of 3




Table 4-4 Physical properties of the blank gasoline

Test Results

BLANK:

Test Name	Test Method	Sudanese specifications	Results	Unit
*Distillation	ASTM D86			°C
IBP		Min 38	43.0	
10%Recovered		Max 70	61.0	
50%Recovered		Max 120	102.0	
90%Recovered		Max 190	165.0	
E.P		Max 205	196.0	
20% -10%		Min 8.0	0.90	ml
Residue		Max 2.0	1.2	ml
Recovery		-	97.0	ml
Density		ASTM D1298	Report	0.738
S.G@15°C	ASTM D1298	Report	0.7469	kg/L
Reid vapor pressure (RVP)	ASTM D323	1Nov-31Mar (45 - 80) 1Apr - 31Oct (40 - 67)	42.5	Kpa
Copper strip corrosion	ASTM D130	2a	1b	ASTM

Page 2 of 3

Fig 4-2 XRD analysis peak for zeolite/Li

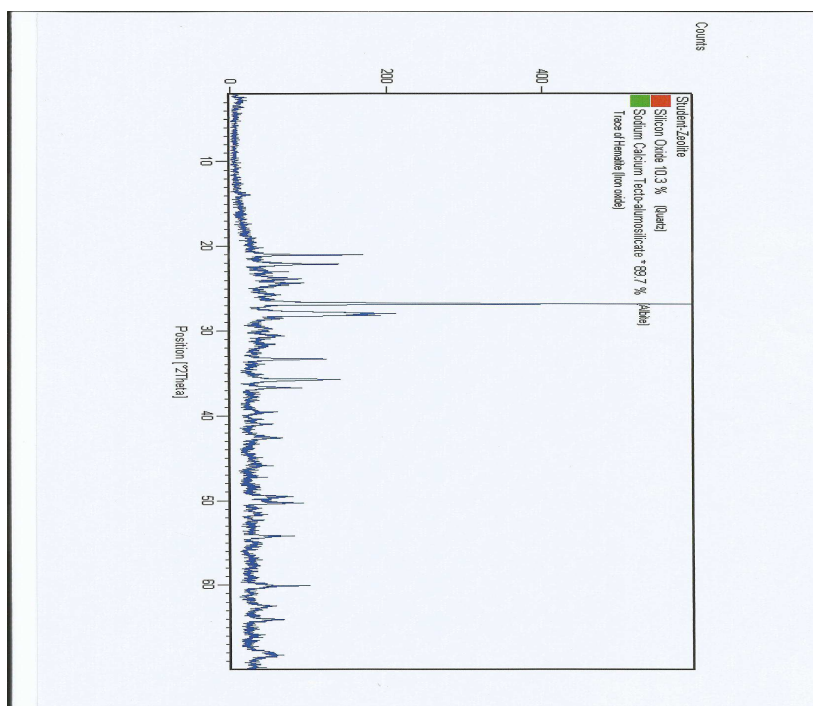


Fig 4-3 XRD analysis peak for reference albite zeolite

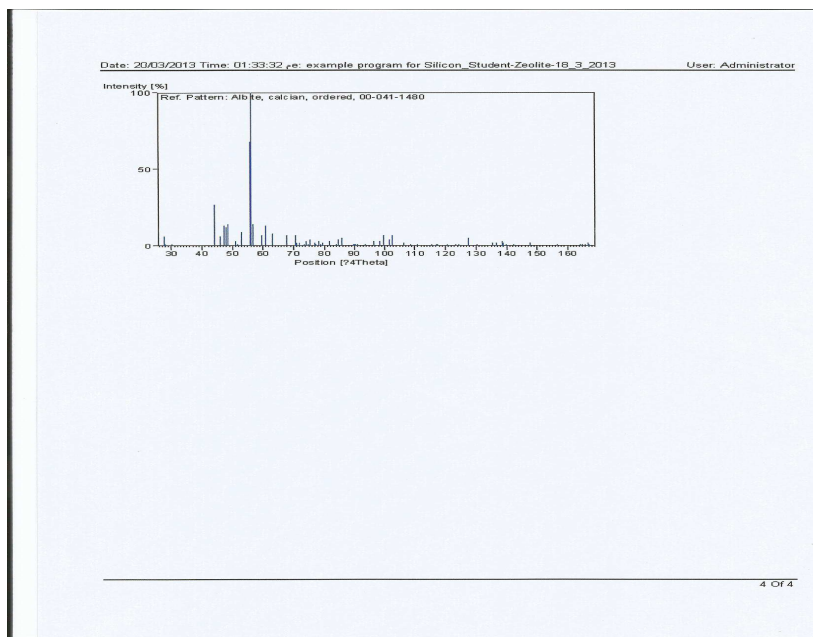
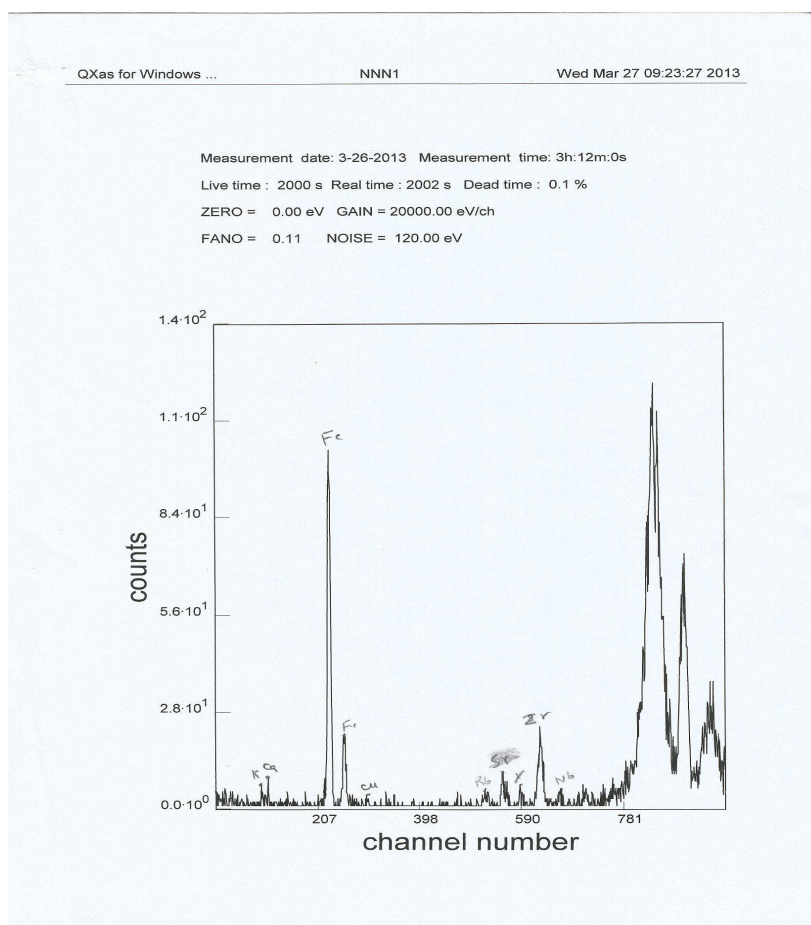


Fig 4-4 XRF analysis peak for zeolite/Li



DISCUSSION

The octane rating was developed by chemist Russell Marker at the Ethyl Corporation in 1926. The selection of *n*-heptane as the zero point of the scale was due to its availability in high purity. Other isomers of heptane produced from crude oil have greatly different ratings.

Four different synthetic zeolites were prepared, those are zeolite/Na, zeolite/Cu, zeolite/Li and zeolite/Bi. The zeolites above were mixed separately to a pure gasoline fraction, this gasoline fraction is considered to be a standard and named a blank. The research octane number (R.O.C.) and the motor octane numbers (M.O.C.) and the antiknock index (AKI) for the pure blank gasoline and the four mixtures above were found.

Zeolite /Li enhances both the (R.O.C.) from 91.5 for the blank to 92.5 for the mixture and the (M.O.C.) from 81.5 for the blank to 82 for the mixture and the (AKI) from 86.5 to 87.25 Table (4-1). Zeolite /Li is considered to be the best among the other four zeolites (as it enhanced both the ROC and the MOC) and subjected to further analysis.

The physical properties for the blank, zeolite/Li mixture were detected, those are:

- The density, it was found that the density of the zeolite/Li mixture increased comparing with the blank (Table 4-3 and Table 4-4), and this is expected since the zeolite added to the gasoline acts as a catalyst enhancing the alkylation and aromatization processes which transformed the straight chain hydrocarbons to branched and aromatic hydrocarbons with higher densities and higher octane numbers. Increase the density of the gasoline portion will lead to increase the combustion ratio of the oil which is a factor for enhancing the octane rating.
- The specific gravity S.G@150C, and this is intern showed the same observation above that the zeolite/Li has a higher value compared to that of the blank (Table 4-3 and Table 4-4), and this could also be explained in terms of the alkylation and aromatization rearrangements mentioned above.

- The distillate properties for zeolite/Li mixture was not found to change considerably compared with the blank gasoline solution, that is the initial boiling points (IBP) for the blank and the zeolite/Li mixture were 43°C, 47°C respectively and the final boiling point (FBP) for the blank, zeolite/Li mixture were 195°C and 197°C (Table 4-3 and table 4-4), and this is also expected and good since changing the distillates properties will lead to change the worm up time (initiating time) of the machine, which is a character affecting the gasoline/ mixture compression step leading to change in the performance of the machine.
- The Reid vapor pressure of the zeolite/Li mixture decreased compared to the blank (Table 4-3 and Table 4-4), and also this a good result since high vapor pressure is undesirable since starting up the machine at low temperature requires a gasoline mixture with a suitable volatility property and avoid vapor lock the machine. Zeolite/Li is analyzed by X Ray Diffraction (XRD) in order to predict the crystallographic structure and the zeolite type. The zeolite was found to be type Y (Fig 4-2) with the mineral name Albite calcian and PDF index name Sodium Calcium Aluminum Silicate with the empirical formula $Al_{1.2}Ca_{0.2}Na_{0.8}O_8Si_{2.8}$ and molecular formula $(Na, Ca)Al(Si, Al)_3O_8$ referring to the ICDD (international center for crystallographic data) records (Fig 4-3) . Zeolite/Li was also analyzed using X.R.F (x ray fluorescent) to find the elements embedding within the crystal structure, concentration of each cations were also calculated. Fe, Ca and K were found in a considerable amounts where as Cu, Rb, Sr, Y, Zr and Nb were found in trace amounts. (fig 4-4).

Infra red spectroscopy was made zeolite/Li (Fig 4-1). Functional group identification indicates the presence of TO4, T-O, and hydroxyl group in the samples. (Table 4-2) .

Finally we conclude mixing synthetic zeolite/Li with the gasoline fraction will produce a gasoline with an enhanced R.O.N and M.O.N, which is economically beneficial concerning the quality of the oil produced, pollution effect and the distance travelled by a specific amount of the gasoline.

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