

# Structural Analysis Of The Industrial Grade Feldspar

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**Abstract-** Structural analysis of industrial grade feldspar is studied in present investigation. Feldspar is aluminosilicates which contains various amounts of potassium aluminium and silicates.. Feldspar is subjected to structural studies.. EDAX is carried out to know the presence and weight percentage of the elements. According to this test, it is confirmed that unwanted elements are absent in the sample. Functional groups are identified by using Fourier Transform Infrared (FTIR) analysis. The Scanning Electron Microscopy (SEM) was carried out to know the internal structure of the feldspar. The structure of the feldspar was further studied by the powder X-ray Diffraction (XRD) analysis. The structure of the feldspar possesses confirmed by XRD analysis Furthermore, after completed the EDAX , FT-IR , XRD and SEM test, detailed analysis of the sample were done with help of various techniques and software. And structural facts were obtained of this industrial grade feldspar materials which are largely utilize in ceramic tiles industries as a flux. Above all characterization are discussed in detailed in this paper.

**Keywords-** Feldspar, EDAX, FT-IR, SEM, XRD

## I. INTRODUCTION

Feldspars ( $KAlSi_3O_8$ ) is one of vital minerals which contains rock-forming tectosilicate minerals group and it makes up about 41% of the Earth's continental crust by weight [1]. Feldspathic materials contain feldspar. On the base of composition of elements. Common feldspar can be state by three types as potassium feldspar (K-spar)  $KAlSi_3O_8$ ,  $NaAlSi_3O_8$  and  $CaAl_2Si_2O_8$ . Feldspar possesses T number of varieties which are used in ceramics industries. It has monoclinic crystal system. Hardness of feldspar is between 6.0 to 6.5, density is 2.56 and refractive index is between 1.5118 to 1.526. Feldspar is obtained in pick, white or brown colour [2].

In present investigation, there are K –feldspar is focused. There are some studies are done on k-feldspar. JF Banfield, RA Eggleton have done Analytical transmission electron microscope studies of k-feldspar [3]. Phengite geobarometry based on the limiting assemblage study of K-feldspar is carried out by Hans -Joachim Massonne and Werner Schreyer [4]. The study of Kinetics of the alteration of K-feldspar in buffered solutions at low temperature is completed by R Wollast [5]. Internal dose rate to K-

feldspar grains from radioactive elements other than potassium of k-feldspar is done by H Zhao, SH Li [6]. The study of Direct measurement of Ar diffusion profiles in a gem-quality Madagascar K-feldspar using the ultra-violet laser ablation microprobe (UVLAMP) is completed by JA Wartho, SP Kelley, RA Brooker, MR Carroll [7].

K-FELDSPAR STRUCTURAL STATES AS PETROGENETIC INDICATORS study is done By R. V. DIETRICH, Professor Department of Geological Science Virginia Polytechnic Institute Blacksburg, Virginia, U.S. A [8].

In the present investigation, k-feldspar is characterized using Energy dispersive x-ray (EDAX) test, scanning electron microscope (SEM) analysis, powder x-ray analysis and Fourier transform infrared spectroscopy (FTIR) analysis to determine structural analysis. Obtained results are described in the paper.

Structure of the feldspar shown in Fig:1

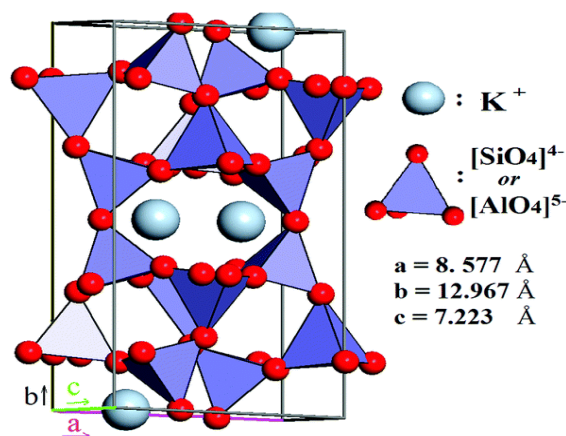


Fig:1 Structure of the Feldspar

Here we take sample of the from the glaze tiles manufacturing industries of the morbi Dist : Rajkot Gujarat India so this analysis directly used in industrial applications

## II. FTIR ANALYSIS

### 2.1 Instrument details

The FTIR test done at Uka Tarsadiya University ,Bardoli The test done using BRUKER ALPHA-T The

ALPHA is more than just a compact FTIR spectrometer:he ALPHA delivers excellent sensitivity,x-axis reproducibility and stability.The ALPHA is insensitive to vibrations so it is give us best result of sample Attenuated Total Reflection (ATR) is an easy-to-use FTIR sampling method that is ideal for both solids and liquids.

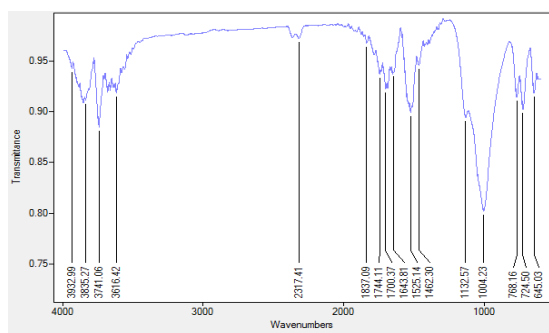
The Platinum-ATR is a single reflection ATR module with outstanding chemical and mechanical robustness. Its diamond crystal is brazed into tungsten carbide hard metal. This assembly allows the application of very high pressure so that even very hard samples can be measured. A variety of sampling options for temperature controlled measurements and liquid flow through analysis complete the versatility of the Platinum-ATR [9]

**2.2 FTIR ANALYSIS:**

It is highly recognized that the use of Fourier Transform Infrared Spectrometry (FTIR) for chemical substances identification it is not a trivial task to be fulfilled by analytical chemists.

The complexity of FTIR characterization comes mainly from the high degree of infrared absorption bands over lapping, that are difficult to be accurately ascribed, despite of the fact that up to date computer-searchable databases of spectra are currently available.

Regardless all these difficulties, FTIR analysis became the main used technique when specific analytical topics have to be addressed, mainly when non-destructive analysis is needed. FTIR analysis[10].The formation of the sample of functional groups was confirmed and identify by KBr pallet technology with the range between 500cm<sup>-1</sup> - 4000cm<sup>-1</sup> . FIG -2 shows the graph of wavenumber verses transmittance graph and major peaks details



**Fig-2 FTIR Spectrum of the Feldspar**

Feldspar: Sample analysis description with help of IR pal 2.0 software [11]

wave numbers (cm <sup>-1</sup> )	Peak Height	ASSIGNMNET
645.03	0.92	C-H BENDING
724.50	0.90	C-H ROCK
768.16	0.91	C-H ROCK
1004.23	0.80	C-O STRETCH
1132.57	0.89	C-O STRETCH
1462.30	0.95	C-O STRETCH
1643.81	0.94	C=C STRETCH
1700.37	0.92	C=O STRETCH
1744.11	0.94	C=O STRETCH
1837.09	0.97	UN IDENTIFIED
2317.41	0.97	Si-H SILANE
3616.42	0.92	O-H STREACHING SHARP
3741.06	0.88	O-H STREACHING SHARP

**TABLE :1 FTIR PEAK DETAIL**

**2.3 EDAX analysis :**

Energy Dispersive X-ray Diffraction (EDAX) test was carried out for the sample. The presented chemical was identified using this test. It is observed that required elements are present in the sample slight impurity due to industrial grade sample taken for the investigation. Also weight ratio of elements are observed individually in the Table no: 2. The EDAX spectra is shown in Fig-3

Standard :EDAX TEST

- O SiO<sub>2</sub>
- Na Albite
- Al Al<sub>2</sub>O<sub>3</sub>
- Si SiO<sub>2</sub>
- K MAD-10 Feldspar
- CaWollastonite

Element	Weight %	Atomic %
O K	52.13	66.43
Na K	2.02	1.79
Al K	8.28	6.26
Si K	29.01	21.06
K K	8.38	4.37
Ca K	0.19	0.10
<b>Totals</b>	<b>100.00</b>	

**TABLE : 2**



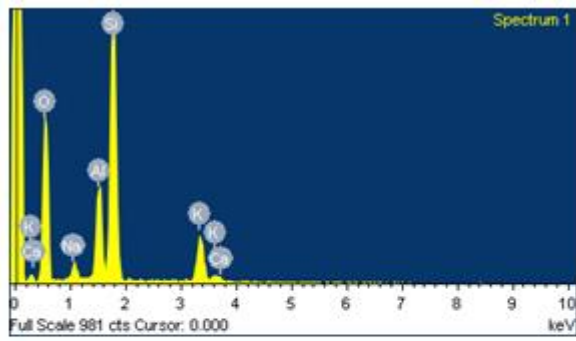
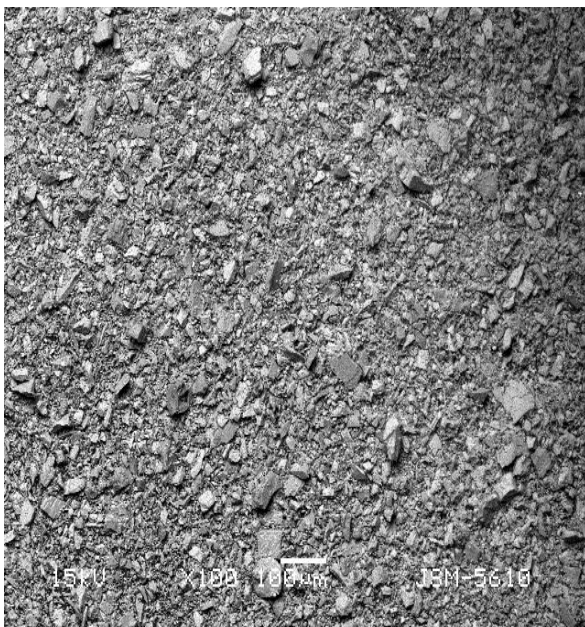
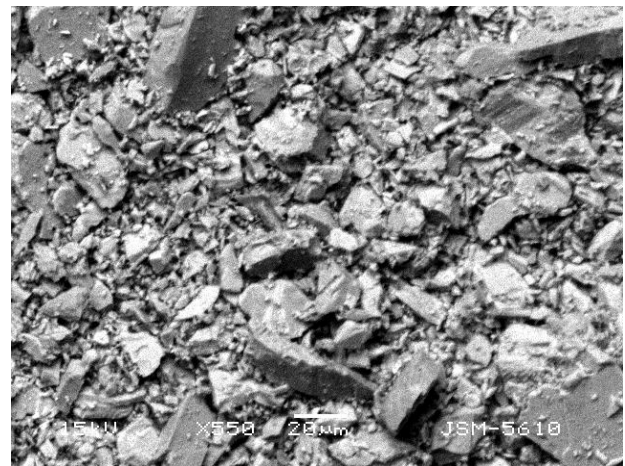
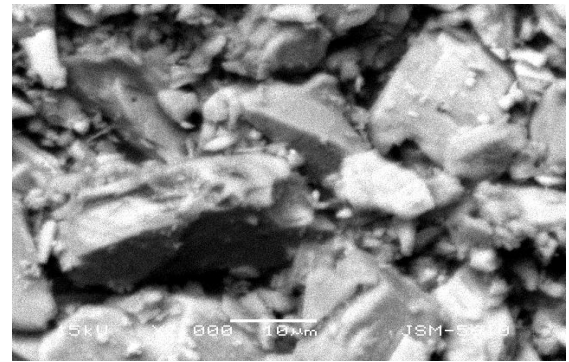


FIG:3 Energy Spectrum and SEM image

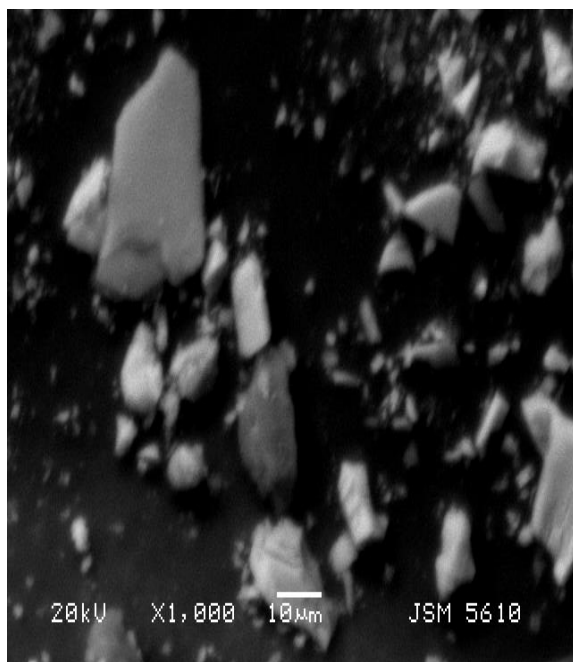
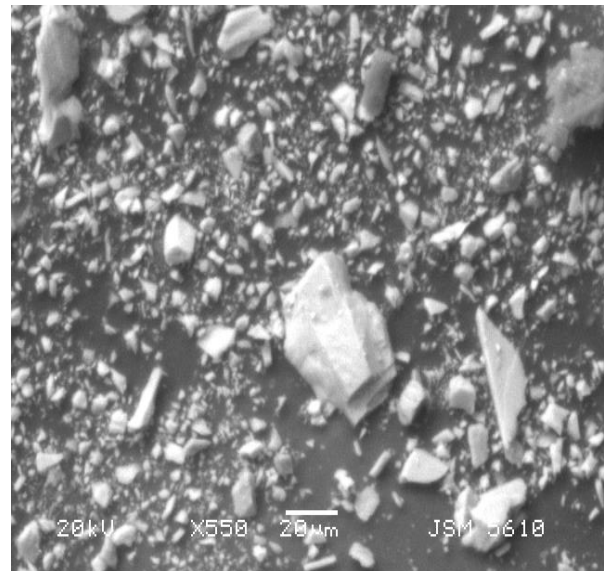
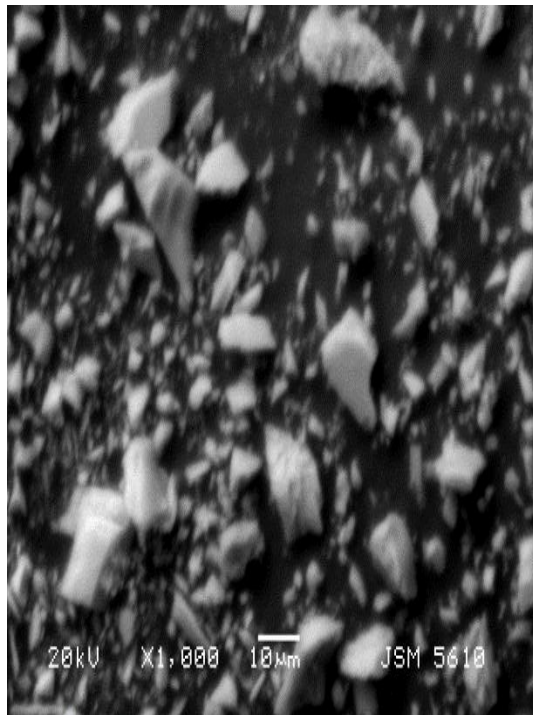
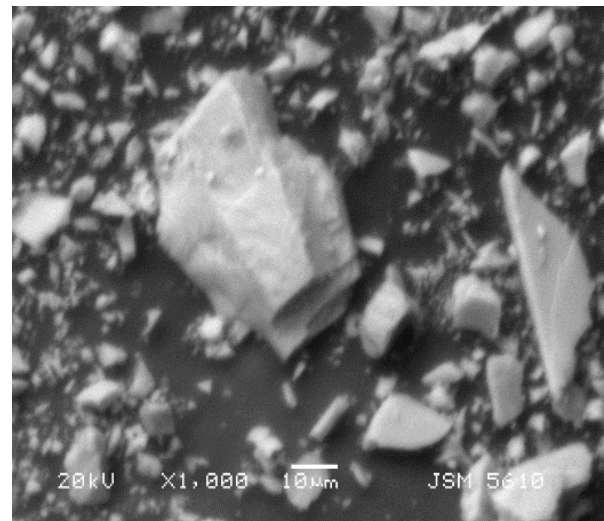
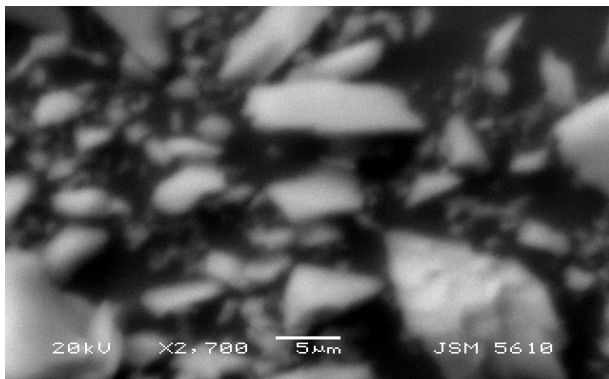
### III. SEM ANALYSIS

A typical SEM instrument, have the electron column, sample chamber, EDS detector, electronics console, and visual display monitors. The **scanning electron microscope (SEM)** uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens.

EDAX -SEM combined instrument. Samples tested in Department of meteorology, Baroda Fig-4.1 to 4.10 shows different SEM images at different level of the magnification .It is clearly shows the morphology of the feldspar. From these images it is observed that the images sample has monoclinic structure







**FIG: 4.1 TO 4.10 SEM IMAGES OF THE FELDSPAR**

#### IV. XRD ANALYSIS

This method is non-destructive technique which was first used by Bragg in 1913. The Powder XRD equipment was individually developed in German by Peter Joseph William Debye, a Nobel Laureate, and P. Scherrer in 1916 and in United States by A. W. Hull in 1917. This technique is used for quantitative analysis, phase imperfections, determination of crystalline structure of material and the extraction of the three dimensional micro -structural

Properties, etc. [12-14]. XRD analysis done with help of Matched software. Analysis was carried out for the sample. The crystalline size micro strain and dislocation density of the feldspar sample are seen in Table-3 and XRD spectrum shown in Fig :5

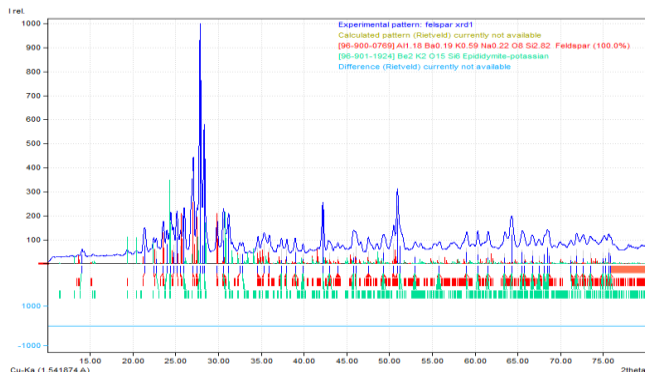


Fig:5 XRD pattern graph

Table: 3 XRD analysis

sr no	ob. space	D	2theta	I/I0	FWHM total	FWHM instr.	FWHM sample	Crystalline Size <b>D</b>	Micro Strains( $\epsilon$ )	Dislocation Density( $\rho$ )
1	3.5988		24.74	77.7	0.1885	0.1768	0.0117	4.51013E-06	8.03E-04	4.92E+10
2	3.5415		25.147	176.2	0.2343	0.1797	0.0546	3.63136E-06	9.98E-04	7.58E+10
3	3.4827		25.578	74.3	0.2221	0.1826	0.0395	3.83408E-06	9.45E-04	6.80E+10
4	3.4296		25.981	200.6	0.2714	0.1852	0.0862	3.14014E-06	1.15E-03	1.01E+11
5	3.3014		27.008	385.5	0.3278	0.1916	0.1362	2.60535E-06	1.39E-03	1.47E+11
6	3.2427		27.507	132	0.1844	0.1946	0.0412	4.63631E-06	7.82E-04	4.65E+10
7	3.2024		27.86	1000	0.2067	0.1966	0.0102	4.13926E-06	8.75E-04	5.84E+10
8	3.1716		28.136	75.1	0.24	0.1981	0.0419	3.56708E-06	1.02E-03	7.86E+10
9	3.149		28.342	505.3	0.24	0.1992	0.0408	3.56869E-06	1.02E-03	7.85E+10
10	2.9937		29.846	140.1	0.219	0.1309	0.0881	3.92424E-06	9.23E-04	6.49E+10
11	2.9211		30.605	186.9	0.2865	0.153	0.1335	3.00505E-06	1.21E-03	1.11E+11
12	2.8674		31.193	163.6	0.3552	0.16	0.1952	2.42728E-06	1.49E-03	1.70E+11
13	2.754		32.512	40.7	0.2753	0.1554	0.1199	3.14205E-06	1.15E-03	1.01E+11
14	2.7263		32.853	40.7	0.2406	0.1542	0.0864	3.59834E-06	1.01E-03	7.72E+10
15	2.5921		34.605	65.8	0.2564	0.1484	0.108	3.39229E-06	1.07E-03	8.69E+10
16	2.5396		35.344	84.9	0.5066	0.1462	0.3604	1.72039E-06	2.11E-03	3.38E+11
17	2.4978		35.956	65.8	0.3095	0.1444	0.1651	2.82084E-06	1.28E-03	1.26E+11
18	2.4064		37.371	61.4	0.2984	0.1409	0.1574	2.93776E-06	1.23E-03	1.16E+11
							AVG.	3.3667E-06	1.14E-03	1.05E+11

V. CONCLUSION

From this investigation of the structural characteristics of the industrial grade feldspar it is clearly seen that the functional groups are identified from FTIR analysis of the sample. In EDAX analysis all desired elements are presented in the sample which is confirmed from EDAX test. Due to industrial grade of sample, two impurities are presented. From SEM it's clearly seen the morphology and internal structure of the Feldspar and is also confirmed the monoclinic structure. Some structural information are obtained from XRD analysis. monoclinic structure is also confirmed from XRD analysis.

Lattice parameter A=8.5160 B=13.0230 C=7.2060, are calculated and Cal. Density =2.709 from XRD test [15], which is matched with the structure shown in Fig-1. Average particle size 3.3667 micron  $1.14 \times 10^3$  micro strain and  $1.05 \times 10^{11}$  Dislocation density are calculated from the XRD analysis. Feldspar is widely used in ceramics industries. Feldspar used as raw material of ceramics industries due to Si elements which is confirmed by EDAX. Thus feldspar is suitable as flux in all types of ceramics tiles industries

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