



## CHEMICALLY TREATED SISAL FIBER DOPED WITH ALUMINUM NITRATE COMPOSITE

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**Keywords:** Al<sub>2</sub>O<sub>3</sub>, sintering method, SEM and XRD

### Abstract

The current study shows the effect of chemical treatment on the structure and morphology of sisal fibre. In the present study sisal fibre is treated with aluminum nitrate salt. The treatment is done at 1000°C temperature using annealing method. X ray diffraction of the treated sisal fibre reveals the crystalline nature of the fibre. Change in morphology has been found in sisal fibre when subjected to Scanning Electron Microscopy.

### Introduction

The development of new methods for preparation of aluminum oxide with controlled structural properties has always been important, because active aluminum oxide is of great practical significance. Special demands are made of aluminum oxide as an adsorbent for chromatography [1–3] and as a carrier for catalysts. These materials are usually called ‘active aluminum oxide’. For these applications it is very important to obtain aluminum oxide with reproducible porosity and reproducible adsorption and catalytic properties. The adsorptive and catalytic properties of aluminum oxide have been investigated in depth, and have been shown to depend on the method used to obtain the aluminum hydroxide from which the oxide is prepared [4,5]. Each stage of the synthesis of aluminum hydroxide has an important effect on the properties of active aluminum oxide. Natural fiber reinforced polymer composites have to face many challenges in order to be commonly used as an engineering materials [6]. As natural fibers are renewable in nature so it can be a probable substitute for synthetic fibers in many applications where high strengths are not needed [7]. Natural fibers are mainly required (next to cloth making) in the manufacture of composites. Further, these do not leave any by product at the time of fabrication of composites because they are bio degradable in nature. In addition, these fibers can be processed at low temperature and therefore play a crucial role in energy investments for the production of composites [8-15].

Aluminum hydroxide is usually obtained by hydrolysis of aluminum salts, aluminates, and alcoholates, and from metallic aluminum. Methods of precipitation from salts by treatment with ammonia [16-18] and from sodium aluminates by treatment with acids or aluminum salt are most often used [19-22]. Precipitation of aluminum hydroxide from sodium aluminates has also been achieved by passing carbon dioxide through aluminate solutions or by priming the aluminate solution with particles of aluminum hydroxide [23-25].

In the present study the main objective was to find effect of chemical treatment of sisal fibre and see changes on the structure and morphology of fibre. It desired result is obtained the use the chemically treated sisal fibre.

### Process

Aluminum Nitrate ( Al(NO<sub>3</sub>)<sub>3</sub>. 9H<sub>2</sub>O) and ammonium chloride (NH<sub>4</sub>Cl) was taken in the ratio 10:4 in 500 ml of distilled water. The mixture was stirred till a homogenous solution was obtained. In this mixture 10g of processed sisal fiber was added and then 1:1 solution of NH<sub>4</sub>OH (liquid ammonia) was added to it and left the solution for one hour. Again the mixture thus obtained was dried and then annealed in muffle furnace at 1000°C and kept it at that temperature for different time duration sample 1 (SP1) for 15 min, sample 2 (SP2) for 30 min and sample 3 (SP3) for 45 min.

The reaction may take place in this way



When aluminum nitrate reacts with ammonium chloride and ammonium hydroxide along with sisal fiber at 1000°C aluminum oxide is formed which is confirmed through XRD analysis and other by products like 6NH<sub>4</sub>NO<sub>3</sub> Ammonium nitrate and HOCl (hypochlorous acid) decomposed at such high temperature and only aluminum oxide is left .

### Result and discussion

#### X-Ray diffraction

XRD analysis shows that treated sisal fibre composites are crystalline in nature and shows the traces of Al<sub>2</sub>O<sub>3</sub>: fibre. The amorphous state of the sisal fiber composite was verified by XRD. The x-ray diffraction patterns of SP1 Al<sub>2</sub>O<sub>3</sub> doped with sisal



fiber shown in fig 1. The main peaks for Al<sub>2</sub>O<sub>3</sub> are observed at 2θ=10.789 (d=8.19980 Å), 2θ=45.574 (d=1.98885 Å), 2θ=66.865 (d=1.39813 Å) and 2θ=37.324 (d=2.40728 Å) corresponding to (416), (132), (164), and (132) reflections.

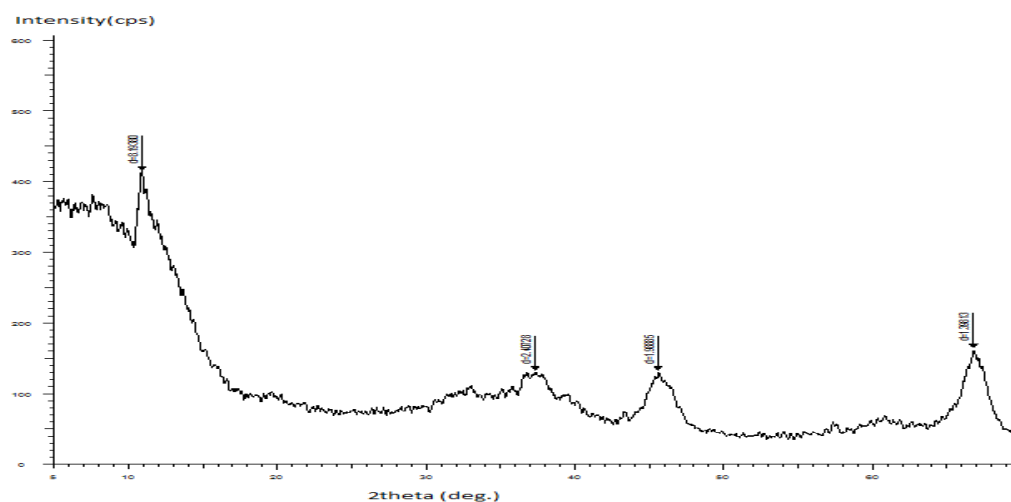


Fig 1

The peaks present in Al<sub>2</sub>O<sub>3</sub> were also observed in the composition of sisal fiber with Al<sub>2</sub>O<sub>3</sub> which indicates the presence of Alumina particle. The entire pattern indicates about the small dimensions of the Aluminum oxide particles. The changes in peaks occur due to the presence of composition of sisal fiber [26].

The x-ray diffraction patterns of SP2 Al<sub>2</sub>O<sub>3</sub> doped with sisal fiber shown in fig 2. The main peaks for Al<sub>2</sub>O<sub>3</sub> are observed at 2θ=25.285 (d=3.5194 Å), 2θ=29.540 (d=3.0214 Å), 2θ=34.845 (d=2.5726 Å), 2θ=37.460 (d=2.3988 Å), 2θ=43.025 (d=2.1006 Å), 2θ=52.200 (d=1.7509 Å), 2θ=57.180 (d=1.6097 Å), 2θ=66.170 (d=1.4111 Å), 2θ=67.845 (d=1.3803 Å), 2θ=76.520 (d=1.2439 Å) corresponding to (914), (269), (1629), (930), (1980), (888), (1725), (936), (1161) and (289) reflections.

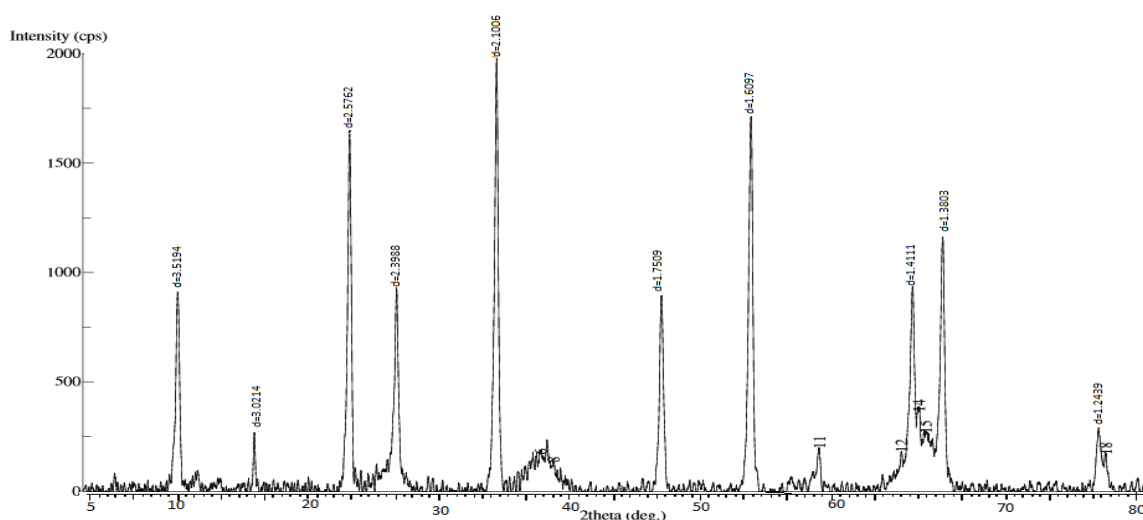


Fig 2

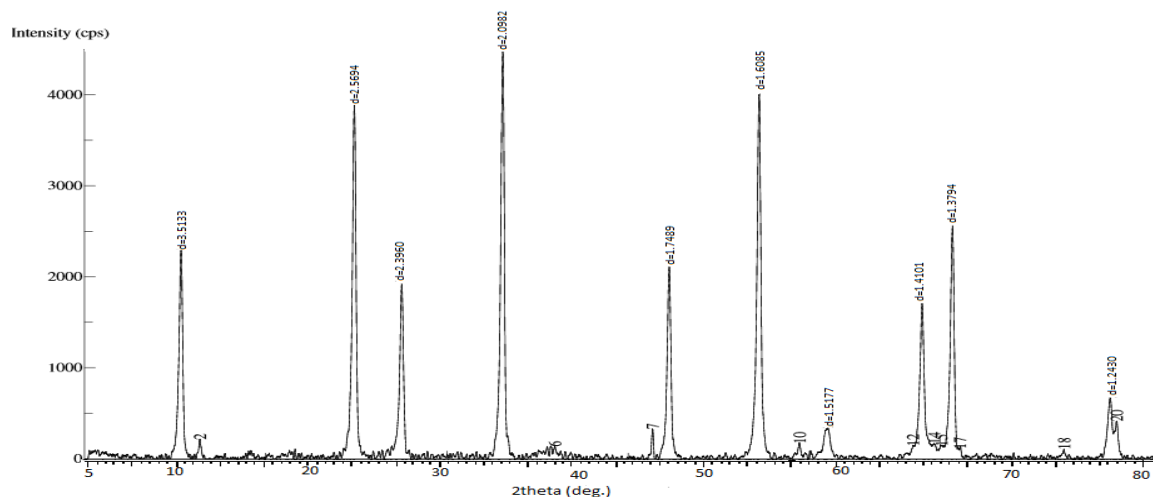
These radical cations through the coupling reaction lead to the ion of stable electrically conducting natural fiber. Reaction with the natural fiber generated by an internal redox reaction, which causes the reorganization of electronic structure to give the +ve and -ve nature of a radical is linked to its difference in reactivity towards lignin and cellulose/hemicelluloses [27].

The x-ray diffraction patterns of SP3 Al<sub>2</sub>O<sub>3</sub> doped with sisal fiber shown in fig 3. The main peaks for Al<sub>2</sub>O<sub>3</sub> are observed at 2θ=25.330 (d=3.5133 Å), 2θ=34.890 (d=2.5694 Å), 2θ=37.505 (d=2.3960 Å), 2θ=43.075 (d=2.0982 Å), 2θ=52.265 (d=1.7489



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Å), 2θ=57.225 (d=1.6085 Å), 2θ=61.000 (d=1.5177 Å), 2θ=66.220 (d=1.4101 Å), 2θ=67.895 (d=1.3794 Å), 2θ=76.585 (d=1.2430 Å) corresponding to (2296), (3887), (1915), (4481), (2112), (4019), (333), (1707), (2564) and (664) reflections.



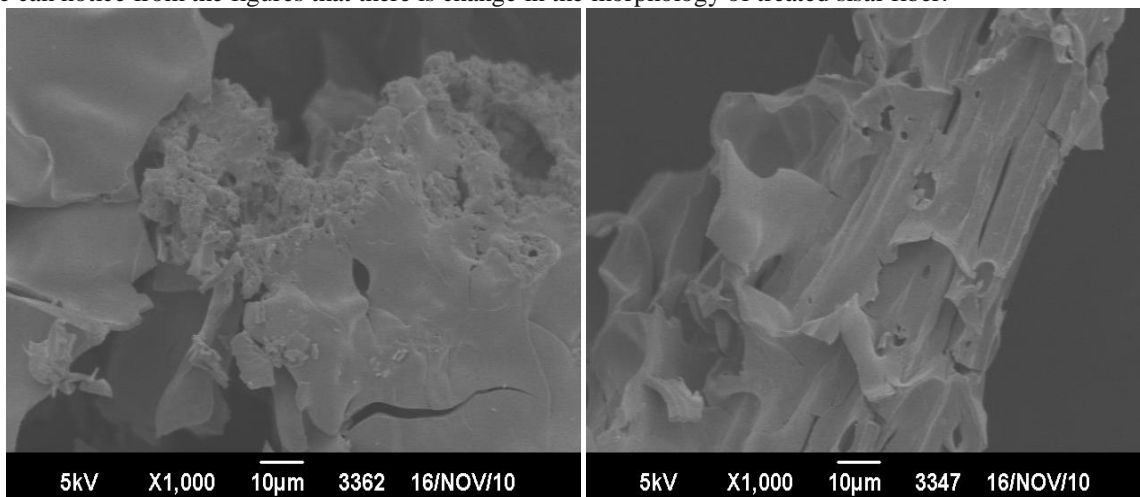
**Fig3**

Natural sisal fiber consists of proton H<sup>+</sup> molecule in its composition and deprotonation process is also occurred in natural fiber. Deprotonation is the removal of a proton (H<sup>+</sup>) from a molecule. Deprotonation of the radical cation is a major pathway and the proton removal decreases positive charge in the molecule and an increases negative charge. Deprotonation usually occurs from the donation of electrons or acceptance of the proton using a base, which forms its conjugate acid. [28]

Name	mbol	Classification	A	B
Cellulose	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>	C-H Deprotonation	C	H
Hemicelluloses	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	C-H Deprotonation	C	H
Lignin	C <sub>13</sub> H <sub>34</sub> O <sub>11</sub>	C-H Deprotonation	C	H

### SEM

Figures 4, 5 & 6 show the scanning electron microscopy of sisal fiber treated with aluminum oxide composites which were fired at 1000°C. We can notice from the figures that there is change in the morphology of treated sisal fiber.

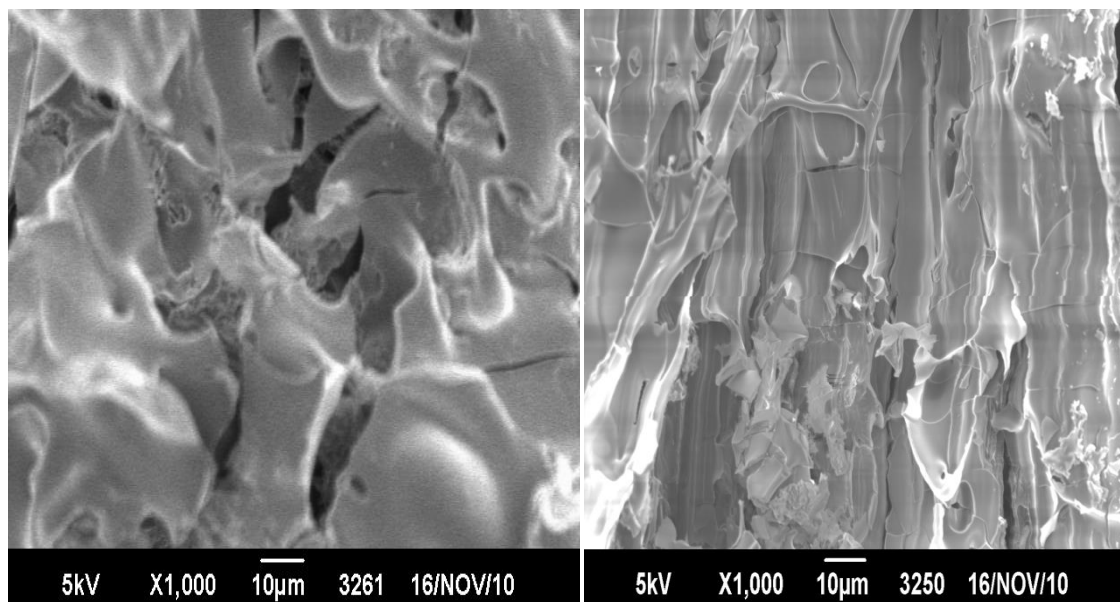


**Fig4 (a) & (b)**



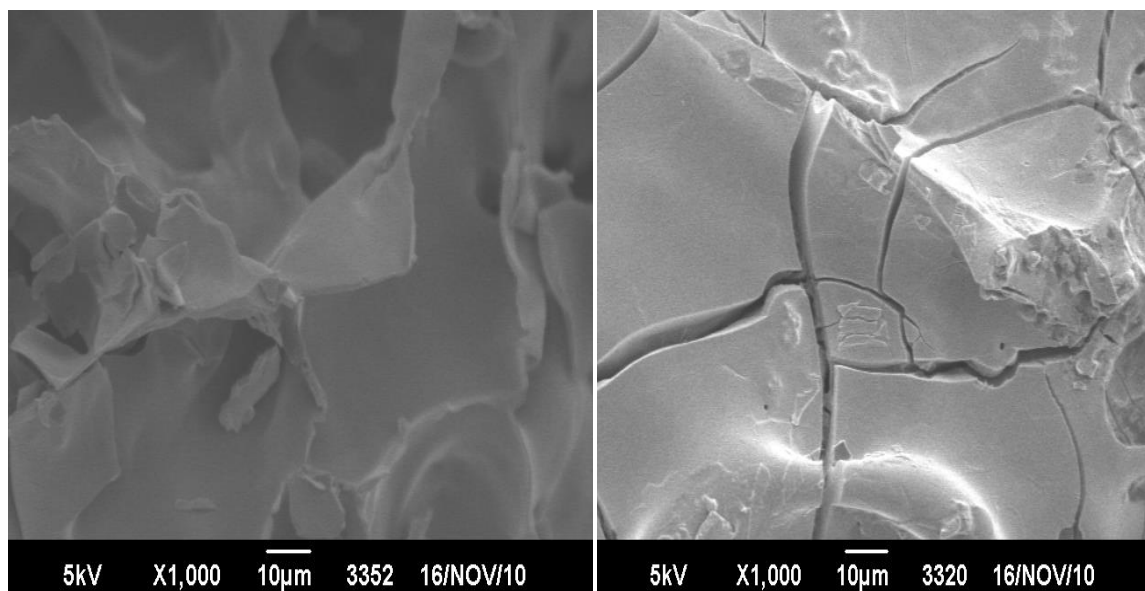
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A change in the morphology and structure has been found after the treatment of sisal fibre which is confirmed by SEM technique. Figure 4, 5 & 6 shows the morphology of Al<sub>2</sub>O<sub>3</sub>. The variations in specular optical transmittance against wavelength for pure and doped Aluminum oxide.



*Fig 5 (a) and (b)*

Uneven and cracked surface can be seen in the untreated samples which may be due to the presence of impurities in the fibre. The micrograph depicts the crystalline nature. This shows the typical micrograph of the clustering of well established randomly oriented nano rods which has compact, homogenous and well adherent growth onto the substrate.



*Fig 6 (a) and (b)*

There was change in the unevenness of the surface in contrast of treated fibre it may be due to the chemical treatment done on the fibre. All images show the morphology of material and fiber respectively. Figures have porosity, non uniform and inside hollow texture. Its upper surface is in crystalline, non linear, soft and spongy form. These figures fiber shows a crystalline, linear and smoky effect.



## Conclusion

From the above study it is clear that chemical treatment of sisal fibre is an effective method to modify the properties of fibre. Change in the morphology of sisal fibre has been seen through SEM analysis. An XRD study reveals the crystal structure of the samples.

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