Synthesis and characterization of cellulose zeolite composites from coconut fiber

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Abstract. The purpose of this study was to synthesize and characterize zeolite-cellulose composites from coconut fiber. Characterize zeolite-cellulose composites from coconut fiber was carried out to determine the structural changes in the composite. The subject of this research was the synthesis of zeolite cellulose composites from coconut fiber. The object of this research is the characterization of cellulose zeolite composites from coconut fiber. The tests carried out include functional group characterization using FTIR. Coconut coir was obtained from coconut ice traders and prepared until it became a powder measuring 200 mesh. Zeolite was obtained from GunungKidul and preparations were made up to 200 mesh in size and then prepared using HCl variations in concentration of 0.5 M. FTIR results of natural zeolite showed typical absorption at wave number 1041.56 cm^{-1} which is stretching vibration of Si-O-Si group and absorption at wave number 447, 49 cm^{-1} which is a Si-O bending vibration, besides that wave number in the area of 794.67 cm^{-1} which is a symmetry flow vibration $(SiO_4)^{4+}$. FTIR results of coconut husk cellulose showed similar absorption with cellulose sold in the market. That is the presence of typical absorption at wave number 3410.15 cm^{-1} which is stretching vibration of O-H and absorption at wave number 2924.09 cm-1. Characterization of cellulose zeolite composites showed similarity in wave numbers from zeolite and cellulose and the presence of wave number shows that the composite was successfully synthesized..

1. Introduction

Indonesia is a country that is rich in local potential, one of the local potentials that is rarely utilized is zeolite. Gunungkidul is a zeolite producing area and rarely used. Zeolites are porous silica tetrahydrate alumina crystalline minerals that have a three-dimensional skeletal structure, formed by tetrahedral $(SiO_4)^{4+}$and $[AlO_4]^{4+}$ that are interconnected by oxygen atoms in such a way that they form an open three-dimensional framework containing canals–and cavities, which are filled with metal ions usually are alkali or alkaline earth metals. Zeolite is one of the ingredients that can be used as filler in paint. Zeolite is a material that has many uses. Zeolite has been widely applied as an adsorbent, ion exchanger, and as a catalyst (Lestari, 2010).Coconut fiber is a by-product of coconut which is rich in fiber. Generally the parts of the coconut fruit are only shell, endosperm, and coconut water. Coir has a greater proportion of 35% than the proportion of other components of coconuts (Saleh et al., 2009).

Previous research on the manufacture and activation of natural zeolite by Fitriana (2019) results from FTIR characterization showed OH functional groups at wavelengths of 3425.69 cm^{-1} Si-OH or Al-OH functional groups at wavelengths of 1639.55 cm-1 and clusters the functions of Si-O-Si or Al-O-Al at wavelengths of 1087.89 cm^{-1} and 794.7 cm^{-1}. The study conducted by Istianda (2018) about the manufacture of nanocellulose from pineapple leaf fibers showed the presence of functional groups OH, H-C-H, H-O-C and C-O-C.This study uses coconut fiber from coconut ice traders located on the roadside of the coconut fiber which tend to be discarded and not utilized. Zeolite used in this study came from Gunungkidul where zeolite utilization tended to be less Through research on the utilization of natural zeolite and cellulose from coconut fiber, it is hoped that it can increase the natural zeolite use value derived from Gunungkidul and increase the value of coconut fiber waste which has not been optimized so far.

2. Methodology

Reagent that used were coconut coir, natural zeolite, distilled water (H_2O), sodium hypochlorite (NaOCl), hydrochloric acid (HCl) (pa), acetone (pa), sodium hydroxide (NaOH), acrylix, nitric acid (HNO_3), sodium nitrite ($NaNO_2$), disodium sulfite (Na_2SO_3), microcrystalline commercial cellulose. Natural zeolites in the form of chunks are then crushed and powdered Followed by sifting using a 200 mesh sieve. The sieved Zeolite was then activated using HCl with a variation of 0.5 M concentration then characterization using FTIR

The coconut husk that has been obtained is dried and prepared so that it becomes as crusty and sifted using a 200 mesh sieve. The powder is then delignified and nanocellulose extraction. The extraction results were characterized using FTIR and compared with commercial cellulose. The result of activation of zeolite and nanocellulose coconut husk extracted were then synthesized nanocellulose zeolite composites. 2.5 grams of cellulose is dissolved in 10 ml of acetone, and added 2.5 grams of zeolite to homogeneous. Variation of zeolite-cellulose concentration using percent b / b is 50%: 50%. The synthesis results were then characterized using FTIR to determine their functional groups.

3. Results and Discussion

Natural zeolite is crushed and prepared until it becomes a 200 mesh powder, The initial stage of activation is to add 50 mL HCl with a concentration of 0.5 M and then stir for 1 hour.

Figure 1. Zeolit After Activation

These results were then characterized using FTIR to determine the functional groups contained in the natural zeolite

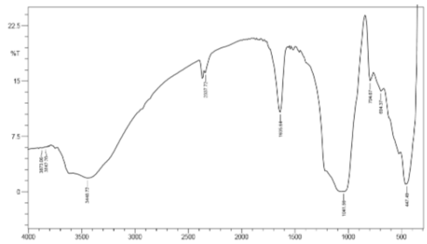

Figure 2. FTIR of Natural Zeolites

These results indicate a typical absorption at wave number 1041.56 cm^{-1} which is stretching vibration of Si-O-Si group and absorption at wave number 447.49 cm^{-1} which is a Si-O bending vibration, besides that there is a wave number in the area of 794.67 cm^{-1} which is a symmetric flow vibration $(SiO_4)^{4+}$. This result is in accordance with the research conducted by Syaputra (2015) that the presence of peaks that appear on natural zeolites at wavelength 789 (cm^{-1}) shows the presence of symmetrical flow vibrations$(SiO_4)^{4+}$. The coconut husk that was obtained was prepared and obtained a 200 mesh powder. The powder was delignified and extracted from nanocellulose. The results were then characterized using FTIR.

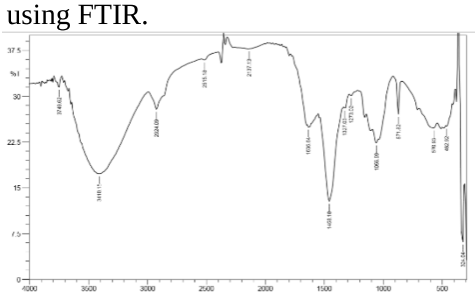

Figure 3. Results of FTIR coconut husk cellulose

These results show the presence of typical absorption at wave number 3410.15 cm^{-1} which is stretching vibration of O-H and absorption at wave number 2924.09 cm^{-1} is stretching vibration of C-H group. This is in accordance with the previous resesarch that O-H stretching at 3000-3700 cm^{-1}. The stretch calibration of C-H appears at wave number 2800-3300 cm^{-1}.

Cellulose from coconut fiber compared to commercial cellulose. The result is a similarity in wave number absorption

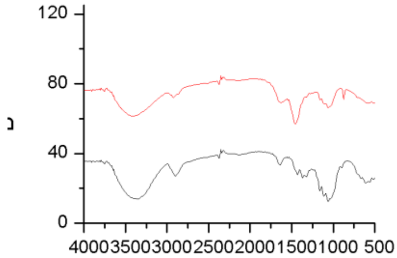

Figure 4. (a) FTIR Cellulose Pa. and (b) FTIR Coconut Husk Cellulose

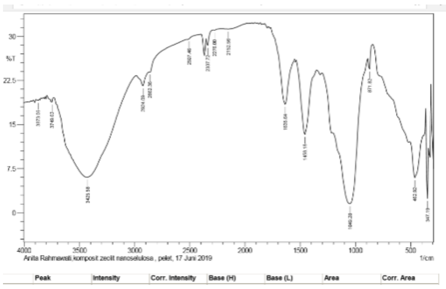

Figure 5. FTIR Of Composite Cellulose Zeolite From Coconut Fiber

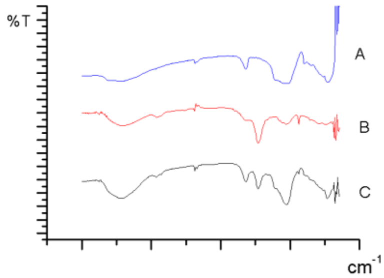

Figure 6. (A) Zeolite, (B) Coconut Husk Cellulose, (C) Zeolite-Cellulose Composite

FTIR characterization of zeolite-cellulose composites aims to determine the functional groups found in the compost. Based on the results showed the absorption at 3425.58 cm^{-1} and 2924.09 cm^{-1} wave numbers which showed the presence of O-H and C-H groups which interpreted the presence of cellulose in the composite. In addition, the absorption at 1049.28 cm^{-1} and 871.82 cm^{-1} which is functional group absorption $(SiO_4)^{4+}$shows that there is a zeolite content in the composite shown in Figure 5.

Composite successfully made is shown in Figure 6. Where there is a shift in the wavelength of natural zeolite, cellulose, and composite cellulose zeolite from coconut fiber.

4. Conclusion

The results of FTIR characterization of cellulose zeolite composites showed similarity of wave numbers from zeolite and nanocellulose and the presence of wave number shows that the composite was successfully synthesized.

5. References

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