Coconut Husk as Potential Sources for Silica Production

Muhammad Fahmi bin Anuar[a], Yap Wing Fen[a,b,*], Mohd Hafiz Mohd Zaid[a]

[a]*Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[b]*Institute of Advanced Technology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
**Corresponding Author's Email: yapwingfen@gmail.com*

Abstract: Silica can be extracted from agriculture waste. In this study, the waste coconut husk (CH) burned in controlled environment inside electrical furnace at temperature of 700 ^{o}C. These ashes were chemically treated by using two different methods of extracting silica. XRF analysis of coconut husk ash revealed that the content of SiO_2 varies between 8-11 % and increased up to 90 % after chemical treatment. XRD analysis indicates that silica obtained after acid treatment was in crystalline state while by using alkali treatment it was in amorphous state.
***Keywords*:** Coconut husk ash, agricultural waste, silica, XRF, XRD

INTRODUCTION

Coconuts often use in traditional ways, as food and even in cosmetic products [1-3]. About 35 % of the coconut is husk and acts as the mesocarp of the coconut fruit. Nowadays, CH are used as source of fuels for coconut processing, domestic fuel and as fiber sources for ropes and mats [4]. Research nowadays focus more on using CH as activated carbon which have the potential as absorbent materials [5,6]. These utilizations of agricultural waste product so far has proved to be economically viable. Yet, not many studies are conducted on coconut husk as a source of silica.

MATERIALS AND METHODS

CH collected were cleaned and dried to remove impurities and moisture. The fibers of coconut husk were separated from the outer coat of the coconut and stored in drying. The clean coconut fibers were placed in alumina crucible and subjected to heat at temperature of 700 ^{o}C for 2 hours in electrical furnace at constant heating rate to get coconut husk ash (CHA).

Acid Treatment

CHA was added into 5 N sulphuric acid in a beaker. The solution was heated up to 50 ^{o}C and stirred continuously for 1 hour. After the leaching process, the solution was filtered, and the residue were rinsed to remove excess acid content. The ash was dried for 2 hours in the oven.

Alkali Treatment

CHA was added into 2.5 N NaOH. The solution was boiled and stirred for 1 hour. The solution was filteter and the filtrate were cooled before carefully titrated with 5 N of H_2SO_4 under constant stirring. Silica gel started to precipitate. White precipitate obtained will be washed with deionized water and filtered to remove sulphate impurities and dried in electrical oven to obtain amorphous silica.

RESULTS AND DISCUSSION

Energy Dispersive X-ray fluorescence (XRF)

After the chemical treatment, the percentage of SiO_2 increased to 90% while the percentage of other elements decreases which indicates that chemical treatment method is viable to be used in extraction of silica from CHA.

Table 1. Elements composition of CHA.

Elements	Percentage of Compositions (%)		
	Before Treatment	Acid Treatment	Alkali Treatment
SiO_2	9.24	91.76	90.01
CaO	31.10	0.71	1.47
K_2O	18.4	0.96	1.01
Al_2O_3	0.84	4.68	3.17
SO_3	2.67	0.42	1.87
Fe_2O_3	0.89	0.25	0.21
P_2O_5	0.06	0.99	0.73
Cl	36.17	0.00	0.51
Others	0.63	0.23	1.02

X-Ray Diffraction (XRD)

Based on the XRD spectra below (Fig. 1), the silica obtained after acid treatment (a) was in crystalline form as there are few major peaks exists. No peaks detected on silica after alkali treatment (b) that indicated amorphous state of the silica.

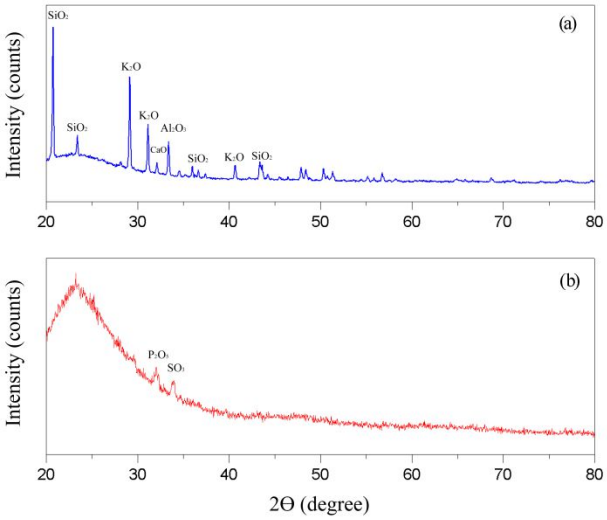

Fig. 1. XRD spectra of silica (a) after acid treatment (b) after alkali treatment.

CONCLUSIONS

SiO_2 was successfully extracted from CHA with less cost of production. After the chemical treatment, the percentage of silica obtained effectively increased from 9.24 % up to 90.00 % which then indicates that both chemical treatments is viable to be use in silica extraction. XRD analysis shows that the structure and properties of silica depends on the method used in silica extraction.

REFERENCES

[1] Nurjannah, Nurilmala M, Hidayat T, Sudirdjo F. *Aquat. Procedia*. 2016, **7**, 177.
[2] Yuh SH, Tzu HC, Yu MH. *Process Biochem*., 2005, **40**, 119.
[3] Baqueiro-Pena I, Guerrero-Beltran JA. *J. Appl. Res. Med. Aromat. Plants*, 2017, **6**, 1.
[4] Tan IAW, Ahmad AL, Hameed BH. *J. Hazard. Mater.*, 2008, **153**, 709.
[5] Tan IAW, Ahmad AL, Hameed BH. *J. Hazard. Mater.*, 2007, **154**, 337.
[6] Kumar, S. A., Gautam, B., and Leena, M. *Ind. Crops Prod.*, 2018, **117**, 20.