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OPTIMIZATION OF SILICA RECOVERY FROM RICE HUSK ASH BY THE ALKALINE HYDROLYSIS - THE SOLUTION TO ENVIRONMENTAL ISSUES

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ABSTRACT

The study was conducted to recover SiO_2 from rice husk ash (RHA) by the hydrolysis of RHA in an alkaline environment. The parameters of the alkaline hydrolysis including NaOH concentration, heating temperature, and heating time were also assessed to develop a more efficient SiO_2 reclamation method. The concentrations of NaOH were varied from 1.0 mol/l - 5.0 mol/l while the heating temperatures were changed from 60^0C - 100^0C, and the heating time was ranged from 1 hour - 5 hours. Research results show that the optimization was found at 4.0 mol/l NaOH, 100^0C, and 3 hours. The specific surface area of the final SiO_2 product according to data obtained from BET surface area analysis was 152.6711 m^2/g, and SiO_2 existed in the amorphous form.

KEYWORDS: ***Rice husk ash, silica.***

I. INTRODUCTION

Silica materials are known for a long time with many applications such as catalyst materials, dielectric materials, gas adsorbents, heavy metal ion adsorbents, inorganic carriers [1], [2]. Fabrication of this material can be done by various methods such as sol-gel, chemical precipitation, microemulsion and hydrothermal techniques [3], [4]. However, most of the above studies often use the pure, expensive silicon source and only stop at the experimental scale, thus limiting the practical application of Silica [5]. Therefore, finding an available, cheap, and silicon-rich source of materials is of great interest to scientists.

This study was carried out to obtain the Silica reclamation process from rice husk ash considered as the promising material. It was implemented not only to solve the economic problem but also to solve the environmental problems.

II. PROCESS OF RECOVERING SILICA FROM RICE HUSK ASH

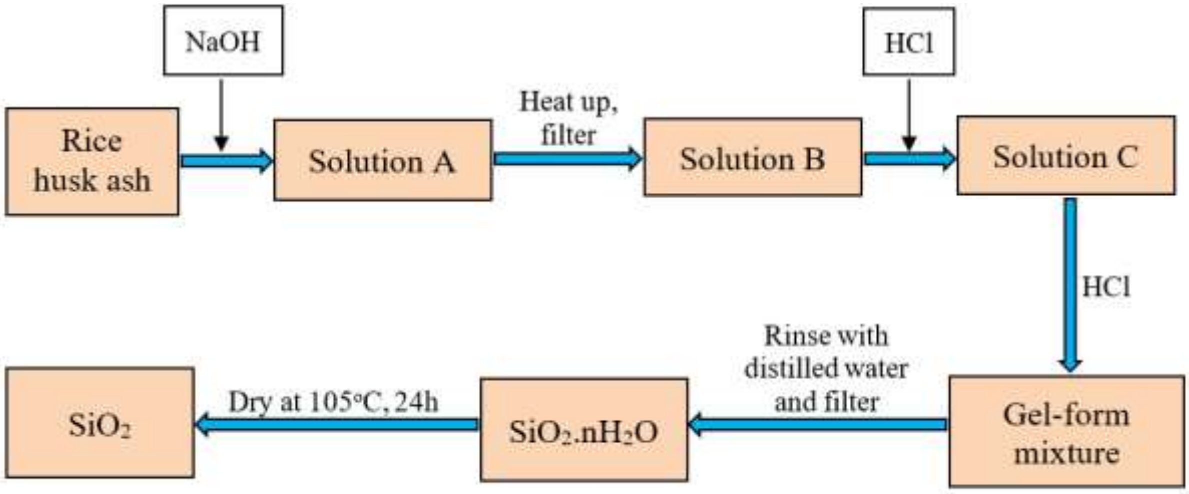

Figure 1: Process diagram for recovering Silica from rice husk ash

III. RESULTS

3.1. Features of obtained Silica products

The results of BET analysis: The obtained SiO_2 exhibitied a BET surface area of 152.6711 m^2/g. SiO_2 reclaimed from RHA proved its relatively high surface area [6], [7].

The results of XRD analysis:

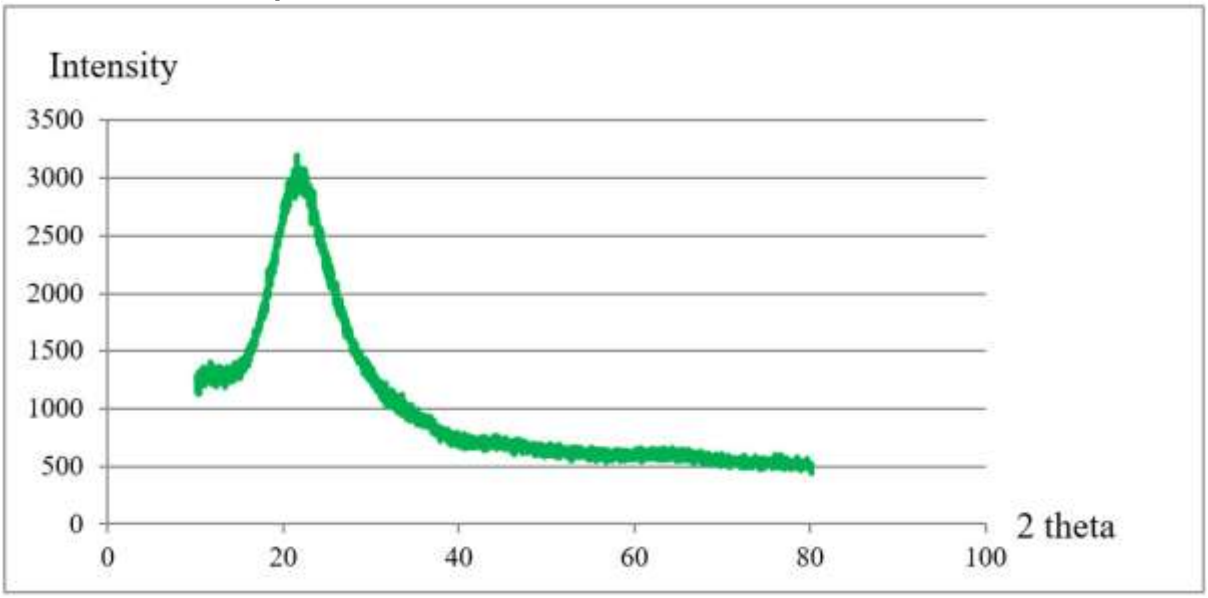

Figure 2: The results of XRD analysis

From the results of XRD analysis [8], it shows that SiO_2 recovered from RHA existed in amorphous form after the heating process, this amorphous SiO_2 has better adsorption capacity than crystalline SiO_2.

3.2. Factors affecting the reclamation of Silica from RHA

3.2.1. Effect of NaOH concentration

Table 1: Effect of NaOH concentration on SiO_2 recovery from RHA

Ash mass (g)	NaOH concentration (mol/l)	Mass of obtained SiO_2 (g)	SiO_2 recovery efficiency (H%)
10	1.0	2,35	23,5
10	2.0	4,11	41,1
10	3.0	5,87	58,7
10	4.0	7,28	72,8
10	5.0	6,73	67,3

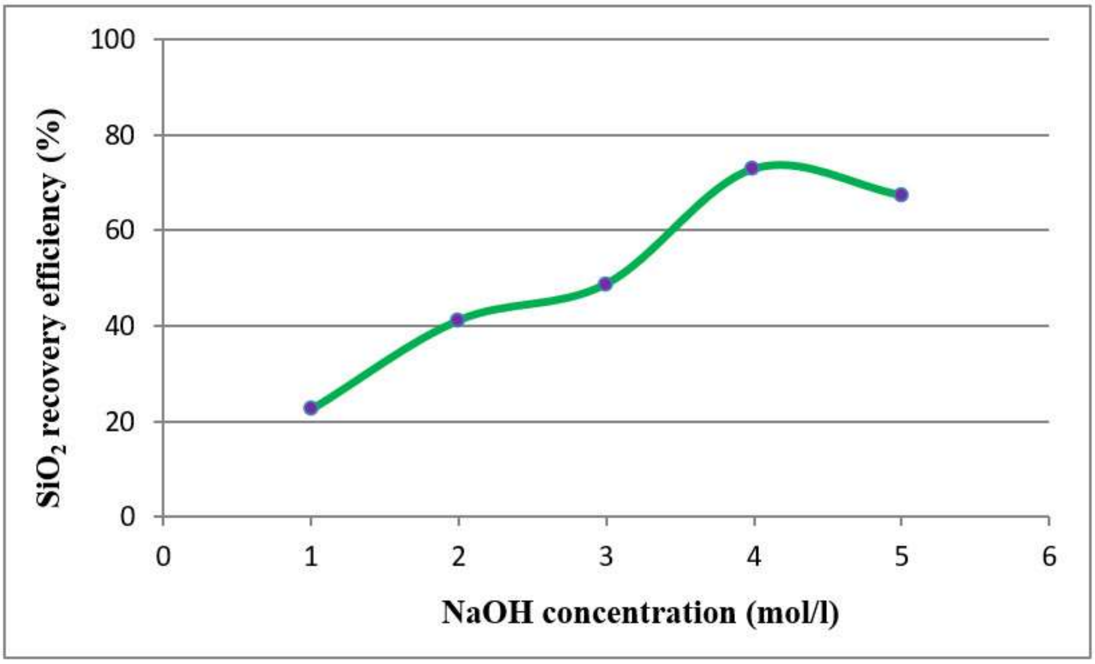

Figure 3: The effect of NaOH concentration on the SiO_2 recovery efficiency

Based on Table 1 and Figure 3, we see that the optimal NaOH concentration is 4.0 mol/l.

3.2.2. Effect of heating temperature

Table 2: Effect of heating temperature on SiO_2 recovery from RHA

Ash mass (g)	Heating temperature (^oC)	Mass of obtained SiO_2 (g)	SiO_2 recovery efficiency (H%)
10	60	2.49	24,9
10	70	3,27	32,7
10	80	3,65	36,5
10	90	5,16	51,6
10	100	7,28	72,8

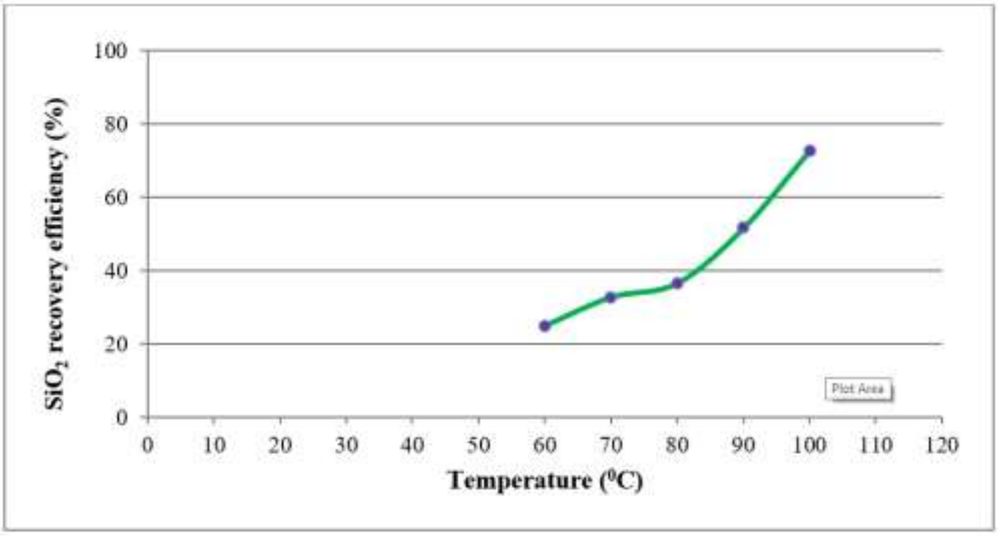

Figure 4: Effect of heating temperature on SiO_2 recovery from RHA

Based on Table 2 and Figure 4, we found that maintaining the optimal temperature at 100^0C was the most effective.

3.2.3. Effect of heating time

Table 3: Effect of heating time on SiO_2 recovery from RHA

Ash mass (g)	Heating time (h)	Mass of obtained SiO_2 (g)	SiO_2 recovery efficiency (H%)
10	1,0	4,65	46,5
10	2,0	6,12	61,2
10	3,0	7,28	72,8
10	4,0	7,30	73,0
10	5,0	7,27	72,7

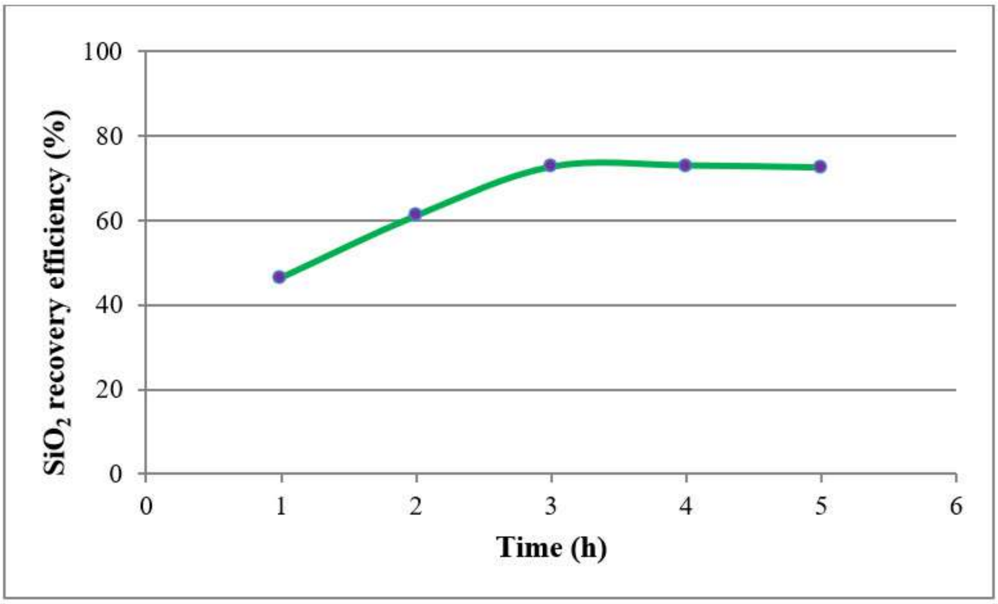

Figure 5: Effect of heating time on SiO_2 recovery from RHA

Based on Table 3 and Figure 5, the optimal heating time to recover SiO_2 from RHA was 3 hours.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

This study provided the optimal conditions for the recovery of Silica from RHA:
The optimal NaOH concentration was 4.0 mol/l.
The optimal heating temperature was 100^0C.
The optimal heating time was 3 hours.
The surface area of the obtained silica measured by the BET method was 152.6711 m^2/g.
The obtained silica structure examed by XRD method shows that the material existed in amorphous form.
Silica recovery efficiency from RHA is quite high, at 7.28 grams of material per 10 grams of RHA.

4.2. Recommendations

From the research results reached, thiș study recommends several upcoming developments as follows:
- Continuing to expand the research on agricultural waste to create Silica materials with high efficiency.
- Application of amorphous Silica reclaimed from RHA into practice to treat environmental pollution such as Silica adsorbents adsorb pollutants in many different types of wastewater.

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