ELEMENTAL ANALYSIS OF RICE HUSK ASH USING EELEMENTAL ANALYSIS OF RICE HUSK ASH USING EDXRF METHOD

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Abstract

In this paper, the effect of the different calcinating temperature of rice husk ash (RHA) was studied. Especially the silica content in the RHA was investigated. Rice Husk was collected from rice milling plants of Hlae Gu township, Yangon Region and Pathein township, Ayeyarwaddy Region. For obtaining the pure rice husk, the sieve analysis was done for removing the sand and other impurities. After that the RHA is obtained by calcinating of rice husk at 500 °C, 600°C, 700°C and 800°C respectively for two hours. After that the calcined mass of the different RHA samples was weighted by electronic scientific balance. It was shown that the decreases in mass with increasing calcinating temperature from 500°C to 800°C. Then, each calcinated samples were taken for EDXRF analysis to measure the elemental concentration. According to the results, it was found that the major element, silicon (Si) was contained nearly 80% in each sample at different temperature. The formed rice husk ash is treated with Sodium hydroxide (NaOH) and Hydrochloric acid (HCl) to produce silica. The percentage of extracted silicon lies around 60 %.

Keywords : Rice Husk, Rice husk ash, Sodium Hydroxide, Silica , EDXRF

Introduction

Rice is an important staple food for approximately half of the world population. Rice husk is one of the most widely available agricultural wastes in much rice producing countries around the world. Rice husk (Rice hull) is the hard protecting coverings of grains of rice and removed from rice seed as a by-product during the milling process. Globally, approximately 600 million tons of rice paddies are produced each year. On average 20 % of the rice paddy is husk, giving an annual total production of 120 million ton.

In majority of rice producing countries much of the husk produced from processing of rice is either burnt or dumped as waste. Burning of RH in

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ambient atmosphere leaves a residue, called rice husk ash. For every 1000 kg of paddy milled, about 220 kg (22%) of husk is produced, and when this husk is burnt in the boilers, about 55 kg (25%) of RHA is generated.

Rice husk removal during rice refining creates disposal problem due to less commercial interest. Also, handling and transportation of RH is problematic due to its low density. RHA is a great environment threat causing damage to land and surrounding area where it is dumped.

Therefore, Utilization of rice husk could solve the problem and reduce the cost of waste treatment. Rice Husk and its ash are used directly for manufacturing and synthesizing new materials. It is used as a fuel, fertilizer, substrate and it also used in preparation of activated carbon, pet food fiber, silica and silicon compounds, bricks etc. Rice husk ash used in steel, cement and construction industries. Multiple benefits of rice husks and rice husk ash can be achieved by future critical research efforts to provide new impetus for local and regional sustainable development.

Rice husk ash (RHA) is a term describing all types of ash produce from burning rice husks which vary considerably according to burning techniques. The silica in the ash undergoes structural transformations depending on conditions (time, temperature etc.) of combustion. At 550 to 800°C amorphous ash is formed and at temperature greater than this, crystalline ash is formed.

The change from amorphous to crystalline ash occurs at approximately 800°C, although the process is often 'incomplete' until 900°C is achieved. All the combustion processes devised to burn rice husks remain below 1440°C, which is the rice husk melting point. The rice husk ash obtained at 1000°C will exhibit excellent chemical activities and will be white in colour. These types of silica have different properties and it is important to produce ash of the correct specification for the particular end use. Rice husk ash has so many applications due to its various properties.

Experimental Procedure

Sample collection

Two samples of the rice husk were obtained each from rice milling plants in different places. Sample 1 was sourced from Pathein, Ayeyarwaddy Region (Delta Region) and Sample 2 was from Hlegu, Yangon Region. (Fig: 1) They are different in colour and size due to the difference in soil chemistry of the locations of collection and paddy variety.

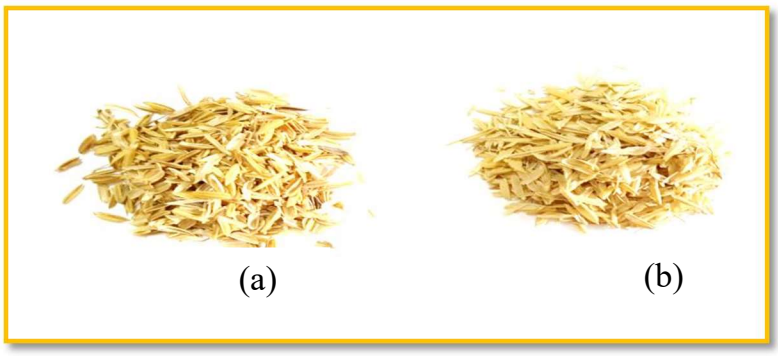

Figure 1: Different Rice Husk (a) in Pathein (b) in Hlae Gu

Sample preparation

At first, all of the samples were burnt in the open air under atmospheric pressure for three days to reduce the carbon content of the rice husk. And then, one of the rice husk samples was washed with water and dried through direct sunlight to remove the sand and other impurities. Fig (2)

Figure 2: The rice husk with sand and other impurities

Sieve Analysis

For obtaining the unnecessary materials and uniform size of rice husk, sieve analysis was done by using mesh. Place a small amount of rice husk is the first mesh. Then do the sieve analysis twice and take the pure rice husk. Fig (3)

Figure 3: Sieve analysis of RHA using with plastic mesh

Figure 4: The obtained pure rice hush after doing seive analysis

Preparation of Rice Husk Ash

5 g of rice husk from each sample was loaded by electronic balance. Each is taken in the crucible and place it in the muffle furnace at a set temperature of 500°C. After reaching 500°C, place it for 2 hours inside the

furnace itself. Then, switch off the furnace. And take the sample out by using tongs. The RHA was left in the furnace to cool for 48 hours. Check the amount of ash retained by using weighing balance. The procedure is repeated for 600°C, 700°C and 800°C respectively. After calcinating, it was found that the more heat it get, the more whitish it is. Therefore, the most whitish RHA include the higher the concentration of the silicon content. And the content of carbon is very low at a higher temperature in calcinating of RHA. Then the weight of the each RHA samples was measured by using an electronic single pan scientific balance. Fig (5).After that X-ray fluorescence method is used to determine the composition of elements in each sample. Fig (7)

Figure 5 : The weight of rice husk is measured by an electronic single pan scientific balance

Figure 6: (i) Before calcinating of Rice Husk

Figure 6: (ii) After calcinating of Rice Husk

Figure 7: Shinmadzu EDX-720 X-ray spectrometer

Production of silica

(i) Preparation of sodium silicate from rice husk ash

2 grams of NaOH pellets is taken and put in a 50 ml of water. This solution is stirred till the pellets get dissolved in water. 1 gram of ash and put in the NaOH solution is taken and mixed it thoroughly by using glass rod. It is placedin the hot air oven at temperature of 100°C. After 1 hour, it is taken from the hot air oven and took the obtained precipitate by using filter paper. Again the residue is dried at 60°C in the hot air oven for half an hour. The obtained product is sodium silicate.

$$SiO_2 + 2\ NaOH \rightarrow Na_2SiO_3 + H_2O$$

(ii) Preparation of Silica from Sodium Silicate

300ml 1 N HCl solution is prepared and added to sodium silicate. The residue is taken out and dried it in a hot air oven at about 60°C. The obtained product is called silica , the partial replacement of cement.

$$Na_2SiO_3 + HCl \rightarrow SiO_2 + 2NaCl + H_2O$$

Results and Discussions

In this present work, the weight for Rice Husk Ash of Hlae Gu calcined at 500°,600°,700° and 800°C were 1.156 g, 1.075 g , 1.04 g and

1.029 g respectively and that of Pathein were 0.912 g, 0.848 g, 0.8291g and 0.8273 g respectively. The result is plotted in Table 1 and Fig (8). It can be seen that the weight of RHA decreases with increasing temperature at all calcinating temperature.

Besides, two kind of Rice Husk Ash were analyzed by the EDXRF technique. The concentration of elements contained in the samples were measured by using the SHIMADZU Energy Dispersive X-ray Spectrometer (EDX-720 system). The results are shown in Table (2) and (3). According to the result, it was found that the major elements silicon contained in two sample of rice husk ash at different temperature were shown in Table(4) and Fig(9). From the information as shown in fig (10-17), the concentration of silicon (Si) contained in these all samples are not much different and nearly the same level of quantitative result of RHA.

Moreover, Different normalities of sodium hydroxide are used for different time periods and the weight of sodium silicate has been found and shown in table (5).The pure silica (SiO_2) is obtained by adding 1N Hydrochloric acid. It was shown in table(6) and the extracted silica is 60.2%.

Table 1 : The different mass of RHA from rice husk calcined at different temperature

Samples	**Mass of husk(g)**	**Mass of ash (g)**			
		T = 500 °C	T = 600 °C	T = 700 °C	T = 800 °C
Hlae Gu	5	1.156	1.075	1.040	1.029
Pathein	5	0.912	0.848	0.8291	0.8273

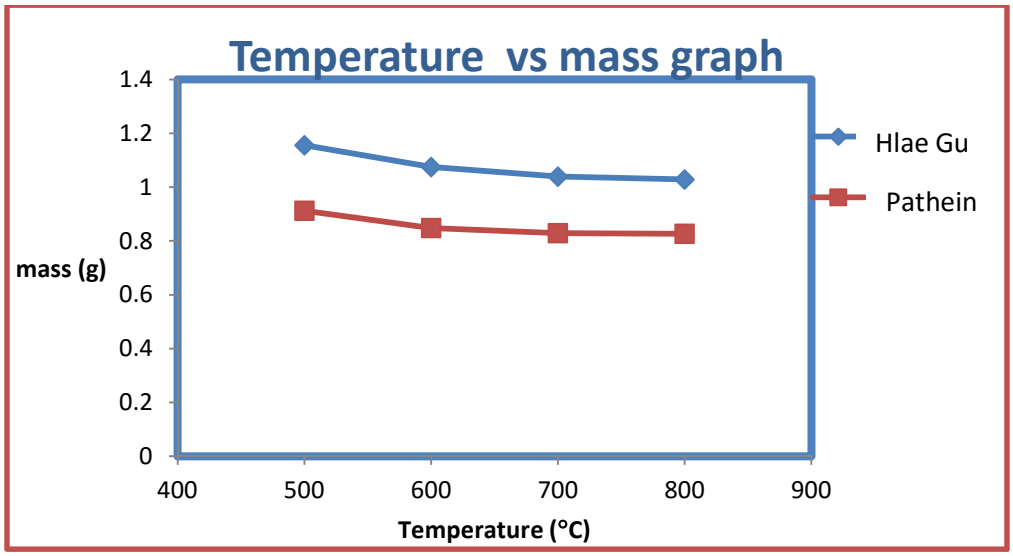

Figure 8: The different mass of RHA from rice husk calcined at different temperature

Table 2: The concentration of elements contained in RHA from Hlae Gu at different temperature

Temperature		500°C	600°C	700°C	800°C
Atomic number(Z)	**Elements**	**Relative concentration of elements (% Wt)**			
14	**Si**	77.156	78.810	79.698	76.728
19	**K**	14.838	13.149	12.644	12.868
20	**Ca**	4.130	4.675	3.648	4.818
25	**Mn**	1.690	1.628	1.543	3.204
26	**Fe**	1.6240	1.534	1.786	1.619
22	**Ti**	0.346	-	0.268	0.512
37	**Rb**	0.093	0.082	0.207	0.084
30	**Zn**	0.086	0.084	0.094	0.119
38	**Sr**	0.037	0.038	0.072	0.048
29	**Cu**	-	-	0.207	-

Table 3: The concentration of elements contained in RHA from Patheinat different temperature

Temperature		**500°C**	**600°C**	**700°C**	**800°C**
Atomic number(Z)	**Elements**	**Relative concentration of elements (% Wt)**			
14	**Si**	**79.586**	**79.411**	**80.305**	**80.801**
19	**K**	10.426	11.646	11.064	10.301
20	**Ca**	5.740	5.878	5.581	5.560
25	**Mn**	1.499	1.487	1.442	1.609
16	**S**	1.254	1.277	-	-
26	**Fe**	0.979	1.277	1.145	1.166
22	**Ti**	0.217	-	0.272	-
30	**Zn**	0.134	0.157	0.131	0.167
29	**Cu**	0.112	0.078	-	0.325
38	**Sr**	0.028	0.032	0.028	0.033
37	**Rb**	0.025	0.033	0.031	0.038

Table 4: Comparison of major element silicon in HlaeGu and Pathein samples at different temperature

Temperature (°C)	**Silicon content (% Wt)**	
	Hlae Gu	**Pathein**
500	77.156	79.586
600	78.810	79.411
700	79.698	80.305
800	76.728	80.801

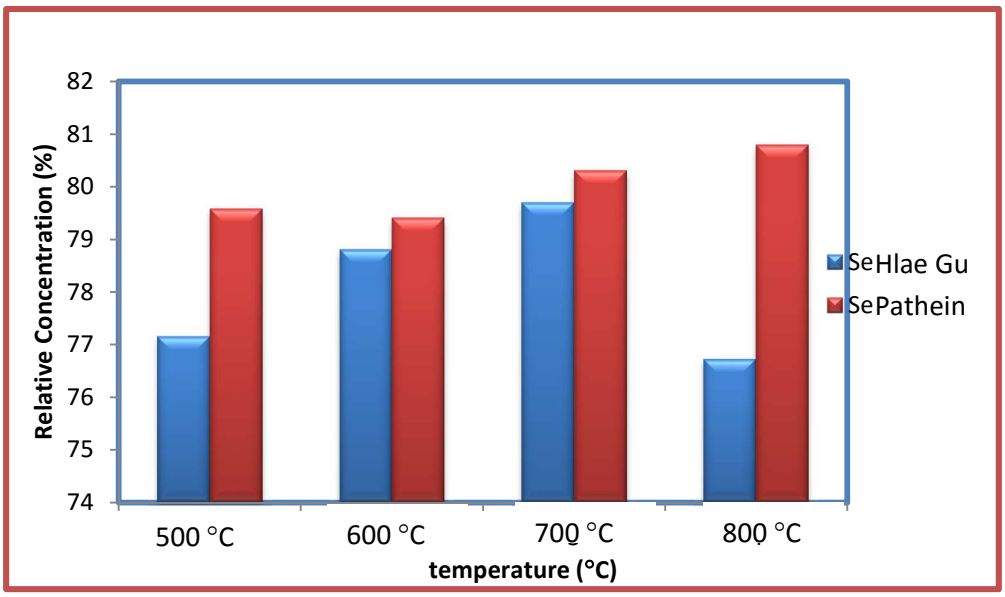

Figure 9 : The comparison of the relative concentration of silicon contents in the two kinds of four conditions of RHA

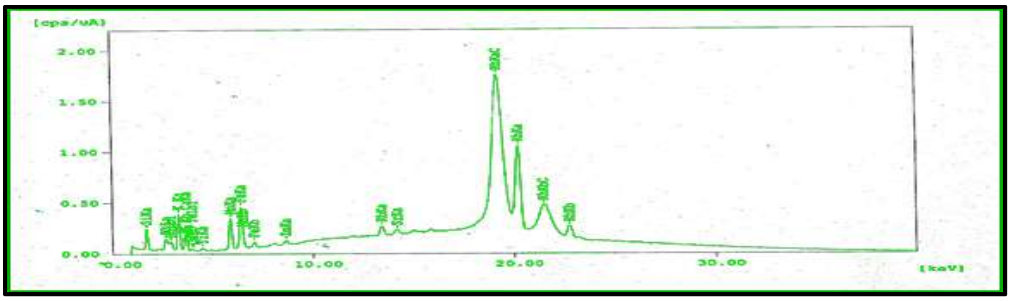

Figure10: The X-ray fluorescence analysis for Rice Husk Ash in Hlaegu for 2hours at 500°C

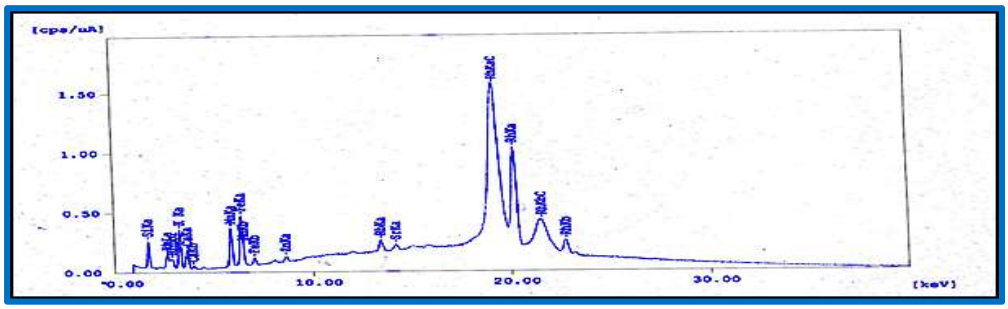

Figure 11: The X-ray fluorescence analysis for Rice Husk Ash in Hlaegu for 2 hours at 600°C

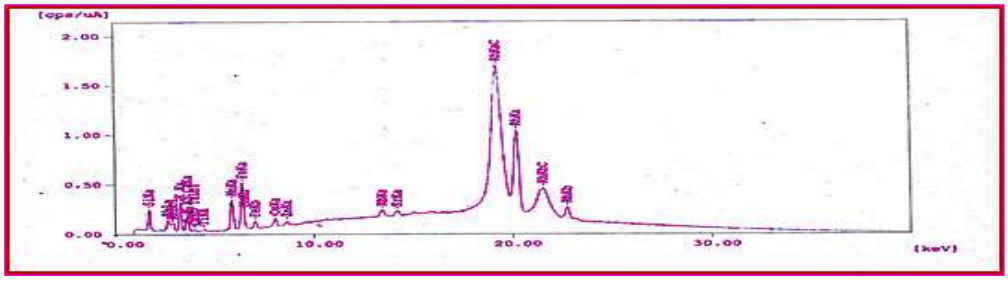

Figure 12: The X-ray fluorescence analysis for Rice Husk Ash in Hlaegu for 2 hours at 700°C

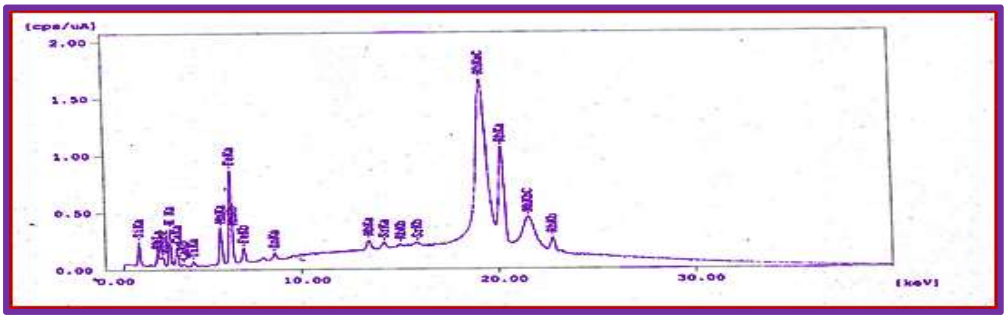

Figure 13: The X-ray fluorescence analysis for Rice Husk Ash in Hlaegu for 2 hours at 800°C

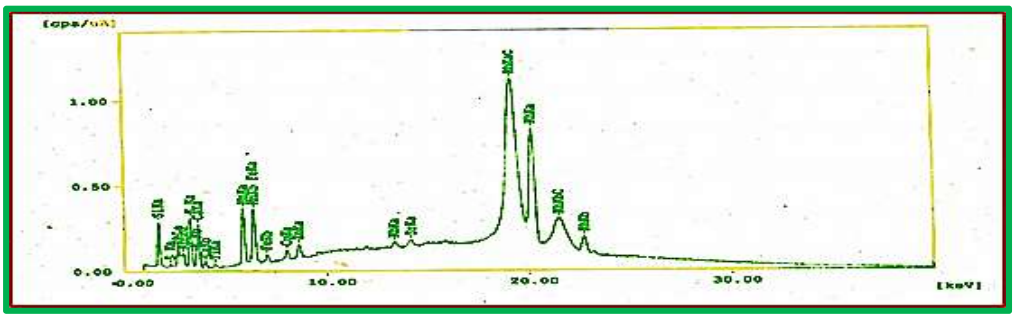

Figure 14: The X-ray Fluorescence analysis for Rice Husk Ash in Pathein for 2 hoursat 500°C

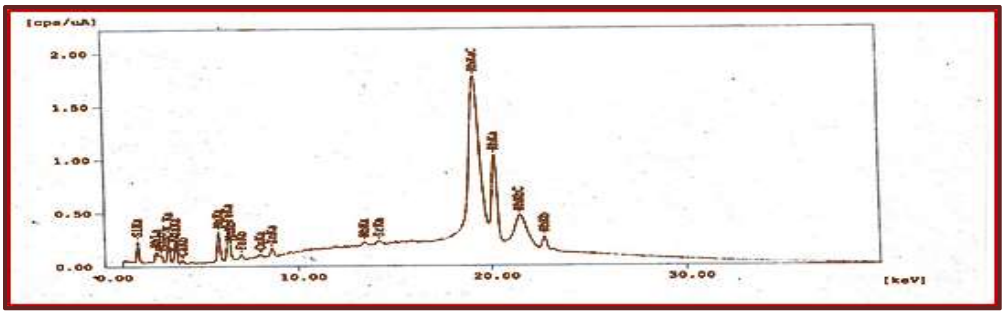

Figure 15: The X-ray Fluorescence analysis for Rice Husk Ash in Pathein for 2 hours at 600°C

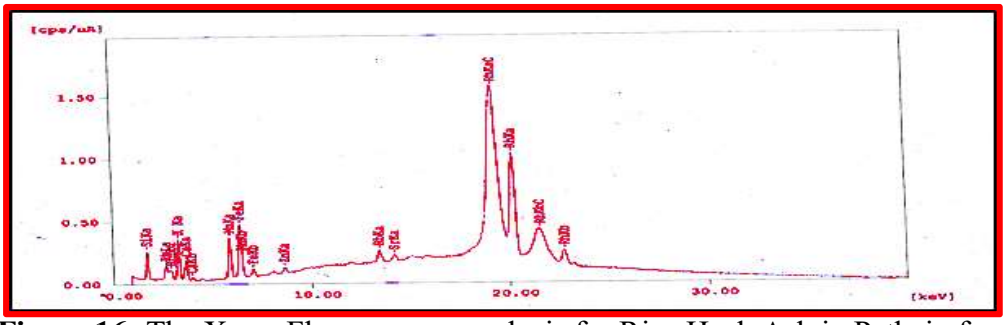

Figure 16: The X-ray Fluorescence analysis for Rice Husk Ash in Pathein for 2 hoursat 700°C

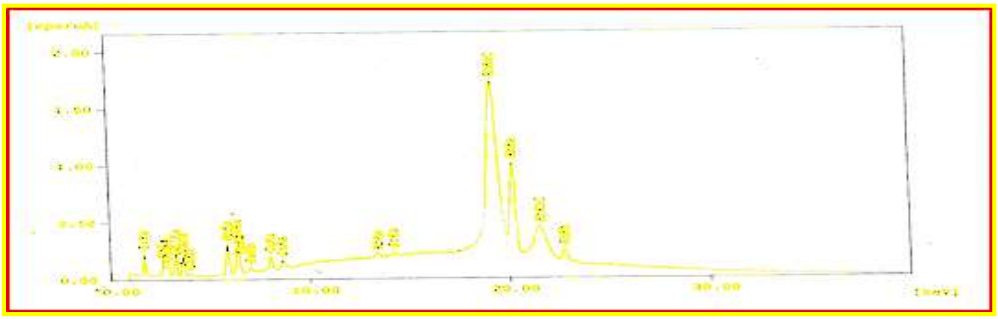

Figure 17: The X-ray Fluorescence analysis for Rice Husk Ash in Pathein for 2 hours at 800°C

Table 5 : Weight of sodium silicate produced for different concentration and time period.

Normality(N)	**Time (hour)**	Weight of $\mathbf{Na_2SiO_3}$
1	1	0.60
1	2	0.38
2	1	0.50
2	2	0.32

Table 6 : Weight of silica produced for 1N HCl

Normality(N)	**Time (hour)**	**% of Silica**
1	1	60.2

Conclusion

From the calcinating of RHS results, it can be observed that the weight of RHA is dependent on the calcinating temperature. The weight of RHA decreases with increasing calcinating temperature for RHA between the temperature 500°C and 800°C.

From the EDXRF results obtained, the major element of each RHA sample is silicon (Si) and the concentration of silicon at the same places in different temperature are nearly 80%. Therefore, the silicon content of RHA between 500°C and 800°C varies slightly with calcinating temperature. Silica has been produced by a two-step process and the percentage extraction lies around 60%.

As a whole, calcination improve the silica content of rice husk ash for use as a pozzolana as well as removes mineral impurities that may affect the pozzolanic properties of the rice husk ash. Moreover, proper utilization of it aims to save the environment, encourages the Government to find solutions regarding disposal to landfills of waste materials and provides new knowledge to the contractors and developers on how to improve the construction industry

by using rice husk, to sustain good product performance and to meet recycling goals.

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