ELEMENTAL ANALYSIS OF RICE HUSK ASH OBTAINED FROM DIFFERENT VARIETIES OF RICE GROWN IN POLONNARUWA DISTRICT

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INTRODUCTION

Rice husk is one of the most widely available agricultural wastes in many rice producing countries around the world. Approximately 600 million tons of rice is produced globally each year. On average 20% of the paddy is rice husk (RH), giving an annual total production of 120 million tones (Giddel and. Jivan, 2007). In majority of rice producing countries much of the husk produced by processing rice is either burnt or dumped as waste. Burning RH in atmospheric conditions leaves a residue, called rice husk ash (RHA) and it is approximately 25% of the rice husk.

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, commercial use of rice husk and its ash is an alternative solution to the disposal problem. There are many uses in rice husk.

According to Basha *etal*. 2005, there are possibilities of improving residual soil properties by mixing RHA and cement in suitable proportions as stabilizing agents. Indian Space Research Organization has successfully developed a technology for producing high purity silica from RHA that can be used to manufacture silicon chips for industry. Attempts have been made to utilize RHA in vulcanizing rubber (Saha *etal*. 2001). RHA has been found to be effective as an oil spill absorbent, and for use in waterproofing chemicals, flame retardants, and as a carrier for pesticides and insecticides.

Presently, RH usually ends up being burnt in open space, thus causing environmental pollution. To conserve energy and resources, efforts have been made to burn the husk under controlled conditions and to utilize the resultant ash in building, semiconductor, composite, and abrasive materials (Siqueira *etal*. 2009). Also, ash is an active catalyst and a good material for catalyst support because of its high surface area (Rafiee *etal*. 2012). Rice husks are known to have a relatively high content of inorganic compounds. Depending on the soil content, some hazardous metal elements may also be included in them (Junko *etal.,* 2008). Combustion is the conventional technique for rice husk to exploit the calorific value and to obtain silica for commercial use, but cations such as K^{+}, Al^{3+}, P^{5+}, Fe^{3+} and Mn^{2+} can remain in RHA as oxides, decreasing its purity and further limiting its use. Moreover, in the direct combustion process of rice husk, the obtained rice husk ash consists of many black particles, which are very difficult to be fully burnt off. The high impurity level of potassium is generally recognized to be the cause (Krishnarao *etal.* 2001). Burning RH produces high ash content, varying from 13% to 29% depending on the rice variety, climate and geographical location. The ash is largely composed of silica (80-90%) with small amounts of inorganic salts. Therefore this research is carried out to identify the metal content in various types of rice husk ash and also to calculate the percentage of silica that exists in different varieties.

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METHODOLOGY

The rice husk samples of Kuruluthuda, Pokuru samba, Red samba, White samba, B.G.359, Suwandal and Mavee collected from Polonnaruwa district were used in this research for elemental analysis and determination of silicon content.

Rice husk samples of different varieties were washed with ample of water followed by distilled water and dried well at a temperature of 120 ºC in an oven to remove the moisture. Then it is grinded to reduce the volume and burnt under temperature of 450 ºC for 6 hours to get the black ash. The black ash was grinned again and burnt in a furnace at 700 ºC for 6 hours until it becomes white colour. White ash is analyzed for different elements using Energy Dispersive X-ray Diffraction and Atomic Absorption Spectroscopy.

Hitachi SU6600 Analytical Variable Pressure FE-SEM was used to get the Energy Dispersive X-ray Diffraction (EDX) and Atomic Absorption Spectroscopy (AAS) was used to quantitatively analyze the elements in different varieties of rice husk ash.

RESULTS AND DISCUSSION

Energy Dispersive X-ray Diffraction or EDX is a technique used in the elemental analysis of solid samples. This is a reliable method to realize the elements in a sample and the following results were obtained for B.G.359 RHA by analyzing with EDX.

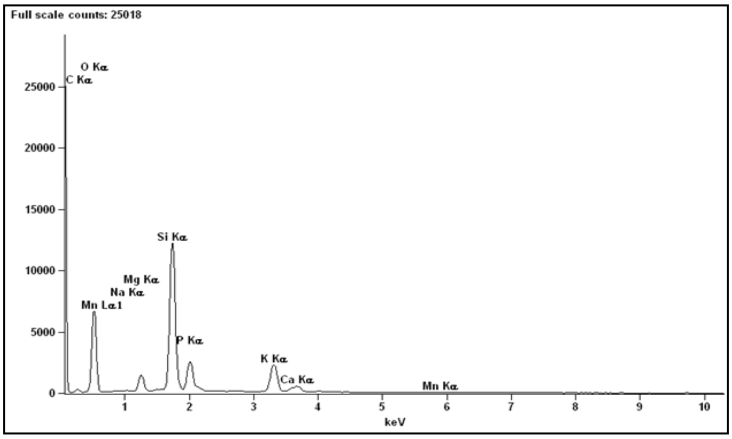

Figure 1. EDX analysis of BG 359 RHA for different elements

Presence of the elements such as carbon, oxygen, sodium, magnesium, silicon, phosphorous, potassium, calcium, magnesium and aluminium could be detectable from the EDX analysis in the BG359 rice husk ash sample (figure 1). Therefore EDX is very useful to identify the elements present in an unknown sample. However EDX is not suitable to calculate the percentages of elements at low levels because it fails to give accurately results when the percentage of elementsare less than 3% by weight. Table 1 gives the analyzed results of different elements in BG359 rice variety by EDX with the percentage error.

Table 1. Weight % of different elements present in the BG359 RHS

Element	Weight %	Weight % error
Si	22.83	± 0.11
O	46.33	± 0.24
C	10.36	± 0.23
Na	0.18	± 0.04
Mg	2.45	± 0.05
P	6.29	± 0.11
K	9.18	± 0.11
Ca	1.96	± 0.09
Mn	0.43	± 0.07
Al	0.18	± 0.02

Atomic absorption spectroscopy is a process involved in the absorption of light by free atoms of element at a wavelength specific to that element, or it means a technique by which the concentration of metals can be measured in a sample. In Atomic Absorption Spectrometry, emission, absorption and fluorescence, energy is put into the atom population by thermal, electromagnetic, chemical and electrical forms of energy and is converted to light energy by various atomic and electronic processes before the measurement. Atomic Absorption Spectrometry is useful not only for the identification but also for the quantitative determination of many elements present in a sample. The technique is specific, in that individual elements in each sample which can be reliably identified and it is sensitive, enabling small amount of an element to be detected up to 1μg l^{-1} (1ppm) i.e. one part in one million using straightforward flame procedures.

Table 2 shows the weight % of some minute elements in different varieties of RHA (white ash) calculated using AAS.

Table 2. Weight % of some minute elements in different varieties of RHA

Elements	Rice variety						
	Mavee	B.G. 359	Red samba	White samba	Pokuru Samba	Kuruluthuda	Suwandal
Ca % by mass	0.56	1.25	0.86	0.65	1.72	1.15	0.59
Mg % by mass	0.74	1.52	0.01	0.44	0.01	1.43	0.61
Fe % by mass	0.11	0.28	0.27	0.18	0.18	0.21	0.21
Cd % by mass	0.004	0.003	1.05	0.005	0.63	0.002	0.004

The result shows the weight % of Calcium, Magnesium, ferrous and Cadmium in different varieties of rice husk ash. When analyzing the data, it shows that Pokuru samba contains 1.72 % calcium and it is the highest percentage that is recorded. B.G.359, Kuruluthuda, Red samba, White samba, Suwandal and Mavee also contain calcium in order. Magnesium is the other element that was analyzed. B.G.359 contains highest amount of magnesium comparing with other samples. Then Kuruluthuda, Mavee, Suwandal, Pokuru Samba and Red samba contain magnesium next in order. But both Pokuru Samba and Red samba have a similar percentage of 0.01 %. It is a less amount comparing with B.G.359 which has 1.52 %. Mavee contains 0.11 % of Ferrous which is the least amount in the studied samples and other samples also have more or less a similar amount. Because these samples were collected from Polonnaruwa district, curiosity aroused to check for the cadmium level in these samples which is suspected to cause chronic kidney disease. The amount of Cadmium in red samba RHA and pokuru samba RHA is comparatively very high compared to othersamples given in table 02. All other samples also contained reasonable amount of cadmium as can be seen.

As Cadmium is a poisonous heavy metal which should not contain in food, even the lower level of cadmium in the diet for long-term can cause various chronic diseases. It can also lead to the formation of kidney stones and affect the skeleton, which can be painful and debilitating. The U.S. Department of Health and Human Services determined that cadmium and certain cadmium compounds are probable or suspected carcinogens (Agency for Toxic Substances and Disease Registry 1989).

Table 3. Percentage of silica in different varieties of RHA

Rice variety	% of SiO_2 by mass.
1.Mavee	14.31%
2.B.G.359	24.87%
3.Red samba	16.70%
4.White samba	13.87%
5.Pokuru samba	12.43%
6.Kuruluthda	09.23%
7.Suwandal	11.68%

White ash of rice husk contains the industrially important element Silicon as silica. When compared the silica percentage, the maximum is recorded in B.G.359 (24.87%) and the other rice varieties also follow the order as Red samba, Mavee, White samba, Pokuru samba, Suwandal and Kuruluthda (Table 3).

CONCLUSIONS/RECOMMENDATIONS

It is evident from this study that the EDX measurement is useful to identify the elements in different rice varieties but to analyze the elements in low concentration AAS is more reliable. The above study intended to identify the elements present in different varieties of rice husk ash, and the amount of silica which is an industrially important in pure form. Silica content is highest in the BG359 and other elements such as calcium, magnesium and ferrous are also comparatively higher in this variety except cadmium. The RHA of red samba grown in the Polonnaruwa district had the highest percentage of cadmium which is at a risky level that suspects to cause chronic kidney disease.

Therefore it can be concluded that the amount of elements present in rice husk depends on the rice variety, soil and climatic conditions.

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