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Extracting Silica from Rice Husk

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***Abstract*: Silicon dioxide (SiO2), also known as silica, is a widely used chemical compound. To manufacture this compound, the process usually is energy intensive and expensive. We aim to solve both problems in our project. The method that we will use involves using a non-conventional raw material, rice husk, to produce almost pure silica. Rice husk ash is the most silica rich raw material containing about 90-95% silica after complete combustion. The residue in our experiment can be used to make good quality bricks. In our experiment, we will attempt to extract silica from the rice husk ash by using a simple and effective method that would give us a high percentage yield of silica. Our goal is to help farmers with the disposal of rice husk ash which currently is a waste that can cause major disposal problems, while at the same time obtaining a valuable product which can be used to improve the quality of bricks, and mainly to be sold as an in-demand substance i.e. silica. In this process silica is manufactured using rice husk ash as a source of silicate. White clear rice husk is first obtained by heating rice husk in a furnace, and this ash is then reacted with sodium hydroxide (NaOH), which yields the sodium silicate (Na2SiO3). After further reacting with sulfuric acid, it produces silica along with by-product sodium sulphate (Na2SO4.) The purpose of this process is to get a high silica content from the rice husk. Extracting the silicate under controlled conditions of temperature will process all the silicate contents of the rice husk.**

***Keywords*: Rice husk, Rice husk ash, Sodium silicate, Silica gel**

1. Introduction

Rice husk (RH) is one of the by-products obtained during milling of rice. This surrounds the paddy grain. It is reported that approximately 0.23 tons of rice husk (rice hull) is formed from every ton of rice produced. Annual total production of 120 million tons World rice production is approximately 645 million tons. Asian farmers produce rice about 90% of total production of 100,000 tons or more, with two countries, China and India, growing more than half of the total crop. In certain countries, it is sometimes used as a fuel for parboiling paddy in the rice mills and to power steam engines. This husk issued as fuel to generate process steam. Rice husk contain 74% other matter and 26% weight of husk is converted in ash during firing process. The partially burnt rice husk in turn contributes to environmental pollution. It would be beneficial to the environment to recycle the waste to produce eco-material having high end value. End use of any material including wastes depends on its structure, properties mainly on chemical composition. Chemical compositions of rice husk vary from sample to sample. This variation is due to differences in climatic and geographical conditions, SiO2 is found to be 22.12%, the organic material and water content is 74% and(A12O3+Fe2O3+CaO+MgO) constitute about 4%. The percentage of SiO2 varies from 15 to 22%. Analyzed all the reported data on organic constituents of rice husk after excluding silica and gave an average composition. Silica in amorphous form is obtained from RHA produced when Rice Husk is burnt in controlled temperatures below 700 ^{o}C. While crystalline silica is used in ceramic and in cement industry, amorphous silica has many uses. to obtain silica, RHA is treated with sodium hydroxide forming sodium silicate. Sodium silicate is then process with sulphuric acid. After that the white precipitated silica is obtained the sodium sulphate formed remains in solution. Crystallization of sodium sulphate from the aqueous solution is energy intensive and hence uneconomical. use carbon dioxide gas for neutralisation generating sodium bi -carbonate and silica.

2. Need for the project

A. Objectives

- Silicon dioxide (SiO2), also known as silica, is a widely used chemical compound. It can exist in amorphous, gel and crystalline form. It is the most abundant material on Earth's crust. However, to manufacture this compound, the process would have to be energy intensive and expensive. We aim to solve both problems in our project. The method that we will use involves using a non-conventional raw material, rice husk, to produce almost pure silica.
- Rice husk ash is the most silica rich raw material containing about 90-95% silica after complete combustion. It is also a popular boiler fuel and the ash produced causes major disposal problems. The residue in our experiment can be used to make good quality bricks.
- In our experiment, we will attempt to extract silica from the rice husk ash by using a simple and effective method that would give us a high percentage yield of silica. Our goal is to accommodate farmers with the disposal of rice husk ash which are wastes that can cause major disposal problems, while at the same time obtaining a valuable product which can be used to improve the quality of bricks, and mainly to be sold as an in-demand substance.

3. Experimental process

The initial step is extraction of silica from ash as sodium silicate using caustic soda. This reaction is carried out at a temperature in the range 180°C-200°C, however, high reaction temperature and pressure can be avoided if ash obtained by burning rice husk at 650ºC is used. This ash is mostly amorphous silica which is reactive around 100ºC with sodium hydroxide solution at atmospheric pressure to yield sodium silicate.

$SiO2 + 2NaOH\ (80\text{-}90C) \rightarrow Na2SiO3 + H2O$

(Ash) (Caustic Soda) (Sodium silicate).

A viscous, transparent, colorless sodium silicate solution is obtained after filtration of the reacted slurry (consisting of residue digested ash, sodium silicate, water and free sodium hydroxide). In the second step of the process, silica is precipitated from sodium silicate using sulfuric acid. This step requires controlled conditions of addition rate of sulfuric acid and temperature of reacting mass in a neutralizer. The temperature is in the range of 80-90ºC and pressure is the normal atmospheric pressure.

The reaction is as follows:

$Na2SiO3+H2SO4\ (85C) \rightarrow SiO2+Na2SO4+H2O.$

The addition of sulfuric acid is done very slowly (otherwise the chemistry of such mass may change along with physical properties) until acidic conditions are reached. The acidic conditions indicate approximately complete precipitation of silica from sodium silicate. A white precipitate of silica in solution of sodium sulfate is obtained. The silica (wet impure silica) obtained above is filtered. Purification of this silica for removal of sulfate impurities constitutes the third step of process. For this successive demineralized water washings are given in the filter process itself. The conductivity of the effluent follows a decreasing trend owing to removal of sodium sulfate. Thus, conductivity can be used as the criteria to decide the number of washings for obtaining silica of desired purity. Silica after removal of sulfates (wet silica) is generally spray dried to obtain the amorphous powder form in the final step of the process. The purification and drying produce silica in while amorphous powder form. Sodium sulfate from the effluent water and good quality bricks from ash residue are other recoveries.

4. Results

Fig. 1. Extracted silica

5. Conclusion

Extracting silica from rice husk is the next step in waste management and economical production of silica, is an important industrial material and the biggest advantage of the project is that it will help farmers to become financially free.

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