Extraction of Silica from Burnt Paddy Husk

Shabaz khan[1], Raj Katrapwar[2], Aishwarya Naik[3], Prof. Gajanan Kumbhar[4]
[1,2,3] *Department of Chemical Engineering, Bharati Vidyapeeth College of Engineering, Navi Mumbai*

***Abstract*— On Burning the fuel, rice husk to get energy, leads to the stuff called rice husk ash (RHA). RHA is an abundant agricultural by product. It's highly rich in silica and may be made into economically viable material which might be used for wide production of silica gels and powders. The current work deals with the assembly of silica. Acid washing before extraction resulted in silica with a lower concentration of minerals. Synthesis was done by precipitation using different acids namely, hydroxide which yielded nanosilica. The effect of various acids on different size and degree of agglomeration of the silica particles were studied, and therefore the formed silica is then sorted out for various uses. This process is kind of inexpensive, sustainable, environment friendly and also suitable for giant scale production.**

Index Terms: **Extraction, Silica, Rice husk, Filter press.**

I.INTRODUCTION

Waste in India may be a major problem from a really very long time. During a year, billions of waste is generated. Among which a number of them are successfully recycled. Plastic paper rubber tire, etc. may be easily recycled. Coming to our topic which could be a quite material. We tried to extract best out of waste. The name of our topic which we have performed is Extraction of silica from burnt Rice husk. During the last two centuries, thanks to involvement of human activities like the assembly and consumption of fossil fuels, furthermore as agricultural and industrial activities have caused a tremendous increase within the atmospheric concentration of greenhouse gases. Shortage of fuel and environmental issues have created the urgency for the exploitation of unpolluted renewable energy. Many countries have implied different plans to scale back carbon dioxide emissions and energy consumption. Biomass is one among the foremost promising energy-carrying agents and plays a very important role in environmentally friendly energy utilization. Rice husk (RH) is a very significant agricultural residue. Most of RH burns as fuel to come up with energy leading to the material called rice husk ash (RHA). If these RHA isn't utilized, it'll lead to tremendous waste generation, energy loss and environmental pollution. Therefore, it's very necessary to search out new ways to utilize RHA comprehensively. RHA generally contains quite 60% silica (SiO_2), 10–40% carbon with small mineral composition. Rice husk ash incorporates a relatively high content of inorganic compounds, representing approximately 20% of the dry weight of the husk. Silica represents 90% of the whole while the remaining 10% are K_2O, CaO, MgO, Al_2O_3, and P_2O_5 in decreasing concentrations. Silica (SiO_2) could be a basic staple that's widely utilized in ceramics, electronics and polymer material industries. Due to its particle's diameter, ultrafine silica powders have many technological applications, like thixotropic agents, composite fillers, thermal insulators etc. Silica has also been used as a significant precursor for a spread of inorganic and organometallic materials that have applications in synthetic chemistry as catalysts, and in thin coatings or films for electronic and optical materials. Silica gel from rice husk ash often broadly prepared by two ways, that's by the thermal treatment with temperatures starting from 500-1400, that's this method requires warmth. The second way of preparation is treating with acid or basic solutions then neutralization by acid to supply silica. The latter consumes low energy, and is cost-effective compared to the present melting method. Besides this advantage, the method may decrease CO_2 emission thanks to the present manufacture of glass from the reaction of Na_2CO_3 and SiO_2

II.WHY DO WE SELECT SILICA

In the housing industry, extensive research goes on to enhance the standard and performance of varied building materials and also the development of durable and sustainable concrete is one in all them.

Among all the nanomaterials, nano-silica is that the most generally used material within the cement and concrete to enhance the tensile and mechanical strength of concrete thanks to its pozzolanic reactivity besides the pore-filling effect. Nano-silica incorporation into cement concrete is that the direct application approach of nanomaterials. Researchers have worked on the mechanical and sturdiness properties and microstructure analysis of concrete with nano-silica as discussed below. Reduced setting times were observed by various researchers on incorporation of nano-silica in concrete which is same as observed for mortar and pastes. Also, the decrease in initial and final setting time was observed on incorporation of n-S in various quantities, with a rise in viscosity and yield stress reported.

III.MATERIALS AND METHODS

Materials - RHA was collected from a brick factory located at Arakkonam, Tamil Nadu, India. It's a residue from pyrolysis of rice husk. This pollution-carrying residue (RHA) was utilized as a stuff in our work. All chemicals are of analytical grade and used without further purification. The acid and other chemicals were obtained. H2O is applied for all synthesis and treatment processes. Method: Proposed Process This is a replacement process, silica is manufactured by using rice husk ash as a source of silica and this ash is then reacted with hydroxide which yields the water glass, which on further reacting with sulfuric acid gives silica together with by-product sulphate. The premise of the benefits for this proposed process is first the rice husk ash with higher silica content is obtained. The method to extract all the silicate contents from the rice husk is simply by burning the rice husk under controlled conditions of air and temperature by this condition we will get the clear white ash within the furnace. The fundamental steps within the production of precipitated silica are

- Obtaining silica from rice husk
- Dissolution of silica in alkali
- Preparation of silica from silicate solution.

IV.PROCESS DESCRIPTION

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 180ºC-200ºC and pressure ranging from 6-8 atmospheres. But high reaction temperature and pressure can be avoided if ash obtained by burning the rice husk at 650ºC is used. This ash is mostly amorphous silica which is reactive around 100ºC with NaOH solution at atmospheric pressure to yield sodium silicate.

$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$

A viscous, transparent, colorless sodium silicate solution (~15%w/w) 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 then precipitated from sodium silicate using sulphuric acid. This step requires controlled conditions of addition rate of sulphuric 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:

$Na_2SiO_3 + H_2O \rightarrow Na_2SO_4$

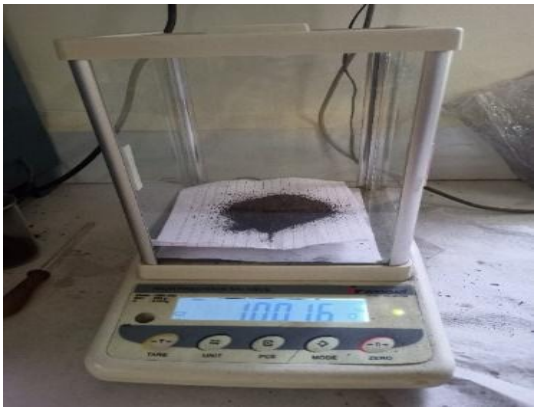
The addition of sulphuric acid is to be done very slowly (otherwise the chemistry of such mass may change along with the physical properties) until acidic conditions are reached. The acidic conditions indicate approximately a complete precipitation of silica from sodium silicate. A white precipitate of silica in solution of sodium sulphate is obtained.

The silica (wet and impure) obtained above is then filtered. Purification of the silica obtained, for removal of sulphate 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 sulphate. Thus, conductivity can be used as the criteria to decide the number of washings for obtaining silica of desired purity. Silica after the removal of sulphates (wet silica) is generally spray dried to obtained the amorphous powder form in the final step of the process. The purification and drying produce silica in amorphous powder form.

V.EXPERIMENTAL PROCEDURE

1. 100 grams of rice husk is taken as a feed to a muffle furnace.
2. It is burnt off, at a temperature range between 800-850ºC, with the help of digital temperature probe.

3. Heating is then continued till ash is formed.
4. Total time required for burning the husk is around 1.5 to 2 hrs.
5. Once, the white ash is formed, it is weighed, which is found to be ¼ of the mass of rice husk taken i.e. 25 gm.



Rice Husk Ash

6. Meanwhile, 12% caustic soda (NaOH) solution is prepared for this; 12 gm of NaOH is dissolved in 100 ml of distilled water.

NaOH solution

7. For our convenience and according to the requirements, we have dissolved 24 gm of NaOH in 200 ml of distilled water.
8. In a round bottom flask, we are adding ash and caustic soda in 1:7 ratio i.e. 25 gm of ash an175ml of NaOH (to make wet all ash by caustic soda).
9. This involves the digestion of the rice husk ash with caustic at specific conditions.
10. In this process the silica in the ash gets extracted with caustic to form sodium silicate solution
11. After the completion of the digestion the solution is filtered for the residual undigested ash present in the solution. The clear filtrate is taken for precipitation.

Sodium silicate solution

12. So, for the proper digestion of RHA in caustic we take 12 gm of NaOH in 100 ml of water i.e., it become 3N solution of caustic.
13. The flask is then kept for heating on a heating mantle provide with a temperature probe..
14. Then sample is filtered out from any unburned, carbon impurities by using filter press.
15. The residue cake of filter is then weighed and noted down. Clear filtrate obtained is aqueous sodium silicate solution.
16. This solution is further concentrated in the oven by keeping temperature range between 100 to 150ºC for 60-90min.
17. The final concentrated solution is the gelatinous sodium silicate and its quantity is measured by using electronic weight balance.
18. For analysis of sodium silicate, we have carried out some preliminary test such as specific gravity, pH in our laboratory.
19. The concentrated solution is the gelatinous sodium silicate taken in 200ml beaker and concentrated sulphuric acid added until solution become acidic. Silica is precipitated from the solution, and sodium sulphate as a by-product remains at bottom. Little quantity of water is added to reduce high exothermic temperature Solution is kept as it is for half an hour to become cool.
20. Solution is filtered by using filter press by giving water wash. Cake formed is silica and filtered is sodium sulphate, both containing water, place it in different round bottom flask for evaporation of water. After halfan hour take it out and weigh.


Extracted silica

VI.ADVANTAGES

Rice husk ash is widely utilized in concrete construction as another of cement. The types, properties, advantage and uses of rice husk in construction is discussed. The field milling industries give the by-product rice husk. Because of the increasing rate of environmental pollution and also the consideration of sustainability factor have made the concept of utilizing rice husk. The explanations behind the usage of rice husk as another for cement in concrete manufacturing are explained within the following sections. To possess a correct idea on the performance of rice husk in concrete, a close study on its properties must be done. About 100 million a lot of rice husk manufacture by-products are obtained round the world. They need an awfully low bulk density of 90 to 150 kg /m3. This leads to a greater value of dry volume. The rice husk itself features a very rough surface which is abrasive in nature. These are hence immune to natural degradation. This could end in improper disposal problems. So, the simplest way to use these by-products to create a replacement product is that the best sustainable idea. Among all industries to reuse this product, cement, and concrete manufacturing industries are those who can use rice husk in a very better way.

VII.DISADVANTAGES:

The quality of ash to be utilized is incredibly important. Poor quality often encompasses a negative impact on the concrete. The poor quality can increase the permeability and thus damaging the building. Some ash, those are produced in station is typically compatible with concrete. Using rise husk ash, concrete progressively becomes unworkable. Hence, water-reducing admixtures should be accustomed obtain workable concrete for the benefit of usage and compaction of concrete.

VIII.USES

Some uses are listed below:

- Reinforcement of elastomeric products like shoe soles.
- Reinforcement of synthetic rubber. • As reinforcing material in tires.
- In sheathing compounds for cables. • Constituent of adhesives sure bonding of unvulcanized rubber to textiles or steel tire cord.
- In thermoplastics want to act as anti-blocking agents and to stop plate out effects in films and film production.
- To improve mechanical properties of PVC flooring.
- As carrier silica for materials and as free flow agents for powder formulation, particularly of hygroscopic and adhesive substances.
- As an adsorbent.
- In toothpaste to manage rheological properties and as a formulation.
- Hydrophobic precipitated silica is employed in oil and silicone oil antifoaming effect.
- Purification and stabilization of beer. • Analysis of blood.
- Cosmetics.
- Food industry as an anti-caking agent.
- Specially prepared silica gels from silica are used for making thermal insulation material.
- As a dehumidifying agent for air and other gases.
- As a filtering agent for clarification of juices.

IX.CONCLUSION

It was concluded from the study that; it absolutely was viable to extract the silica from Rice Husk Ash by Alkali extraction. Further, the results showed that, the share yield of extracted Silica is higher after we used acid washed in spite of unwashed RHA . And it absolutely was also found that, the moisture content within the silica is low when acid washed RHA is employed than in situ of unwashed RHA.

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