

Conversion of Rice Husk Ash (RHA) to nano-silica for different end-use applications

With growing environmental consciousness at all levels of society, the pollution and health hazards especially associated with agricultural industries, are coming under intense scrutiny from environmentalists and the governments. These agricultural wastes are mostly the by-products of oil and coal burning by-products, slag, rice husk ash, bagasse, fly ash, cement dust, stone crusher dust, marble dust, brick dust, sewer sludge, glass, tires, etc. This material is available in abundance and is discarded in about millions of tons every year. Such waste materials pose a serious environmental threat and lead to air pollution. They pose environmental problems like air pollution and leaching of hazardous and toxic chemicals (arsenic, beryllium, boron, cadmium, chromium, chromium (VI), cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium, along with dioxins and polycyclic aromatic hydrocarbon compounds, etc.) when dumped in landfills, quarries, rivers and oceans. Consequently, air and water pollution have been inextricably linked to environmental problems and climate change. Increasing concerns for environmental protection, energy conservation with minimal impact on the economy have been

Motivating researchers to look for safer alternatives to put these waste products to use.



Every year approximately 20 million tones of paddy is produced in India. This gives around 24 million tones of rice husk and 4.4 million tones of Rice Husk Ash every year. Major three uses of Rice Husk Ash are in the steel, cement and refractory bricks industry. Besides this it can be utilized in several other applications. In India rice husk is used for cattle feeding, partition board manufacturing, many small-scale applications and rice husk ash is used in land filling, so many industrial applications. But these uses are not in a systematic manner and also rice husk has very low food value. Being fibrous it can prove to be fatal for the cattle feeding. Use of rice husk ash or rice husk in land filling is also an environmentally hazardous way of disposing waste.

Waste to Wealth - Rice Husk Ash as precursor for Nano-silica



Rice mills dump RHA

Rice is the staple food for more than half the population of world. About eighty countries including China, India and Indonesia are major producers of rice. 650 million tons of rice is being annually produced all around the globe. Major producer of rice is Asia, where China and India account for more than half the world production and supply of rice. In India, Tamil Nadu is the third ranking state in the production of paddy after Andhra Pradesh and West Bengal. The milling of rice leaves residue known as husk. It is the covering that surrounds the rice grain. During the milling process of paddy, approximately 75-78% of the weight is recovered as rice, broken rice, and bran.

The remaining 22-25% of paddy weight is received as rice husk. The husk obtained is used as fuel in the rice mills during the parboiling process to generate steam. On burning, 75% of the organic volatile matter present in this husk burns up leaving behind the residue ash of 25% weight. This ash thus obtained is known as rice husk ash (RHA) and it contains about 85-90% of amorphous silica content. Thus, it can be concluded that on milling 1000 kg of paddy, approximately 220kg of husk is received on being exposed to combustion process at 700-800°C in leaves about 55kg of rice husk ash (RHA).

Rice husk generated every year is approximately equal to one-fifth of the total rice production per annum globally, which is about 600 metric tons per annum. Utilization of rice husk could solve the disposal problem and reduce the cost of waste treatment. Rice husk and its ash are used directly for manufacturing and synthesizing new materials.

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It is used as a fuel, fertilizer, and substrate and is also used in the preparation of activated carbon, pet food fiber, silica and silicon compounds, bricks, etc. RHA used in steel, cement and construction industries. It also acts as an adsorbent for heavy metal removal from waste water. Easy availability and low price of rice husk in rice producing countries is an extra benefit towards the use of this material. Thus, it can serve as an easily available raw material and putting it to use for commercial applications is a viable solution. In the absence of its utilization, this huge quantity of RHA either goes waste or is burned in an open atmosphere, thereby becoming a great threat to the environment causing damage to the land and the surrounding areas in which it is dumped and burned.

Utilization of RHA could provide a solution to its effective disposal and lower the cost of waste treatment. To effectively conserve energy today rice husk is combusted under controlled conditions to form RHA, which due to its chemical composition and high silica content, is being widely used as filler in steel, cement and construction industries.

