Rice Husk and Nano silica from Rice husk and its Applications

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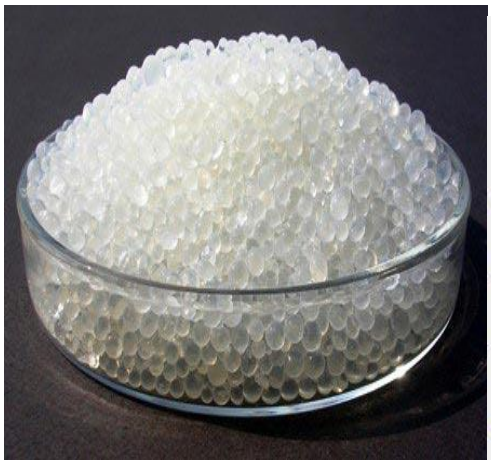
Rice husk, also known as rice hull, is the coating over seeder grain of rice. It is also used to synthesize Nano silica and this synthesized Nano silica has various applications. Among all the plant residues, the ash of the rice husk contains the highest proportion of silica. Rice husk is a potential material that can add value. The use of the rice husk, either in its raw form or in the form of ash is in various industries. The chemical composition of the rice husk is similar to that of many common organic fibers and contains 40-50% cellulose, 25-30% lignin, 15-20% ash and 8-15% moisture .After combustion, most of the evaporable components are slowly lost and the silicates are left behind. No any other plant, except rice husks, can maintain such a large proportion of silica in it. Plants absorb various minerals and silicates from the earth in their bodies. Inorganic materials, particularly silicates, are found in greater proportions in annual crops, such as rice, wheat, sunflower, etc., than in long-lived trees. Inorganic materials are in the form of free salts and particles of cationic groups combined with anionic groups of fibers in plants. The crystalline and amorphous forms of silica have different properties and it is important to produce with the correct specifications for a specific use. In general, the amorphous forms of silica are composed of tetrahedral silica arranged in a three-dimensional random network without regular grid structures. Due to the disordered arrangement, the structure is open with holes in the network where electrical neutrality is not met and the specific surface is also large. This helps to increase the reactivity because there is a large area available for the reaction . The structure of crystalline silica is constructed by repeating a basic unit: the silicon tetrahedron in a three-dimensional oriented frame. In the frame type structure (for example, quartz), the silicon tetrahedrons are joined by oxygen peaks, each of which is linked to two silicon atoms. The oxygen / silicon ratio is 2: 1, so electrical neutrality is achieved

. Silica has various forms in rice husks at the molecular level and is associated with water. In nature, silica polymorphs are quartz, cristobalite, tridymite, coestite, silica gel etc.



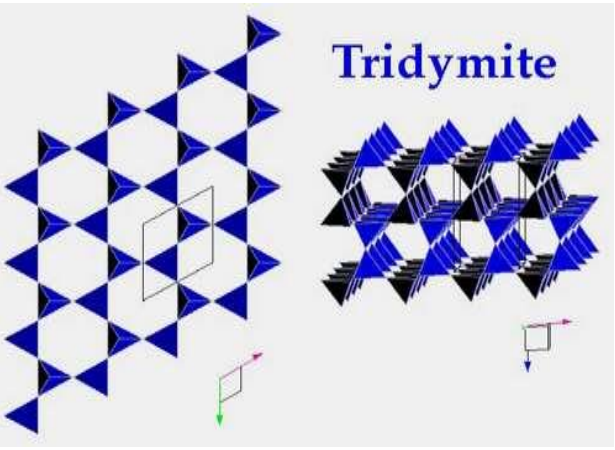


Fig. 1 Silica gel **Fig. 2Tridymite form of silica**

(Ref. www.silicagelmanufacturer.com) **(Ref. http://www.assignmentpoint.com)**

Application of Rice Husk Ash

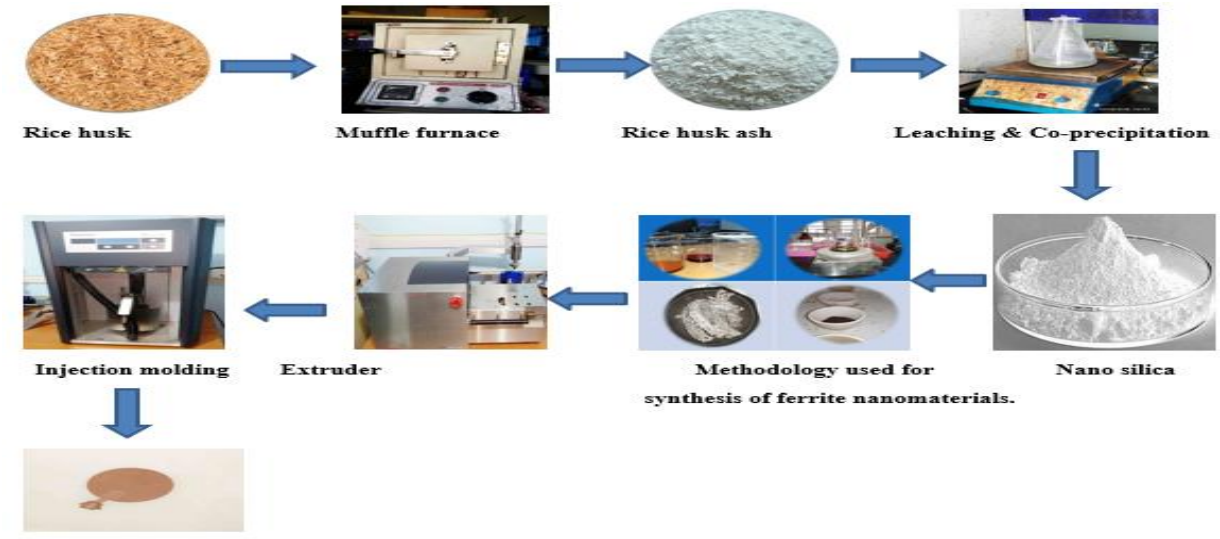
RHA has many applications in silicon-based industries. They have conducted extensive research on the use of RHA as a mineral additive in the manufacture of concrete. Amorphous RHA can be used as a partial substitute for Portland cement and as a high strength, high performance concrete mixture. A review of the use of RHA by the construction industry is particularly in the production of concrete.

Apart from these specific uses there are some other uses of RHA which are following

- Due to its refractory properties, crystalline RHA is more desirable than steel material and the ceramic industry for the manufacture of refractory bricks
- Improves the properties of soil and cement in adequate proportions by mixing RHA as a stabilizer

- There are possibilities of using RHA to make activated carbon and confirmed its utility in water purification
- Attempts have been made to use RHA in the vulcanization rubber. It has been shown that RHA offers advantages over silica as a curing agent for the ethylene-propylene-dieneterpolymer (EPDM), and is recommended as diluents for EPDM rubber
- Rice husk burnet for long periods has been used successfully as an oil absorber. The RHA produced by maintaining temperatures of 350-450°C for a prolonged period of time will be highly amorphous and porous. The high porosity of the RHA is essential to absorb the oil .
- There are many other uses of rice husk and its ashes, which are still in the research stage, such as tile manufacturing, as a free agent for fire extinguishing powder, abrasive materials, test component for fire retardant material, thinner for painting, production of sodium silicate films, etc.

Flow charge of preparation of Nano silica from Rice husk



Schematic diagram of process of synthesis of nano silica from rice husk and prepare its composite material

Ref- Atul Jyoti and Rakesh Kr Singh, M.Tech Project(2018), ACNN, AKU, Patna

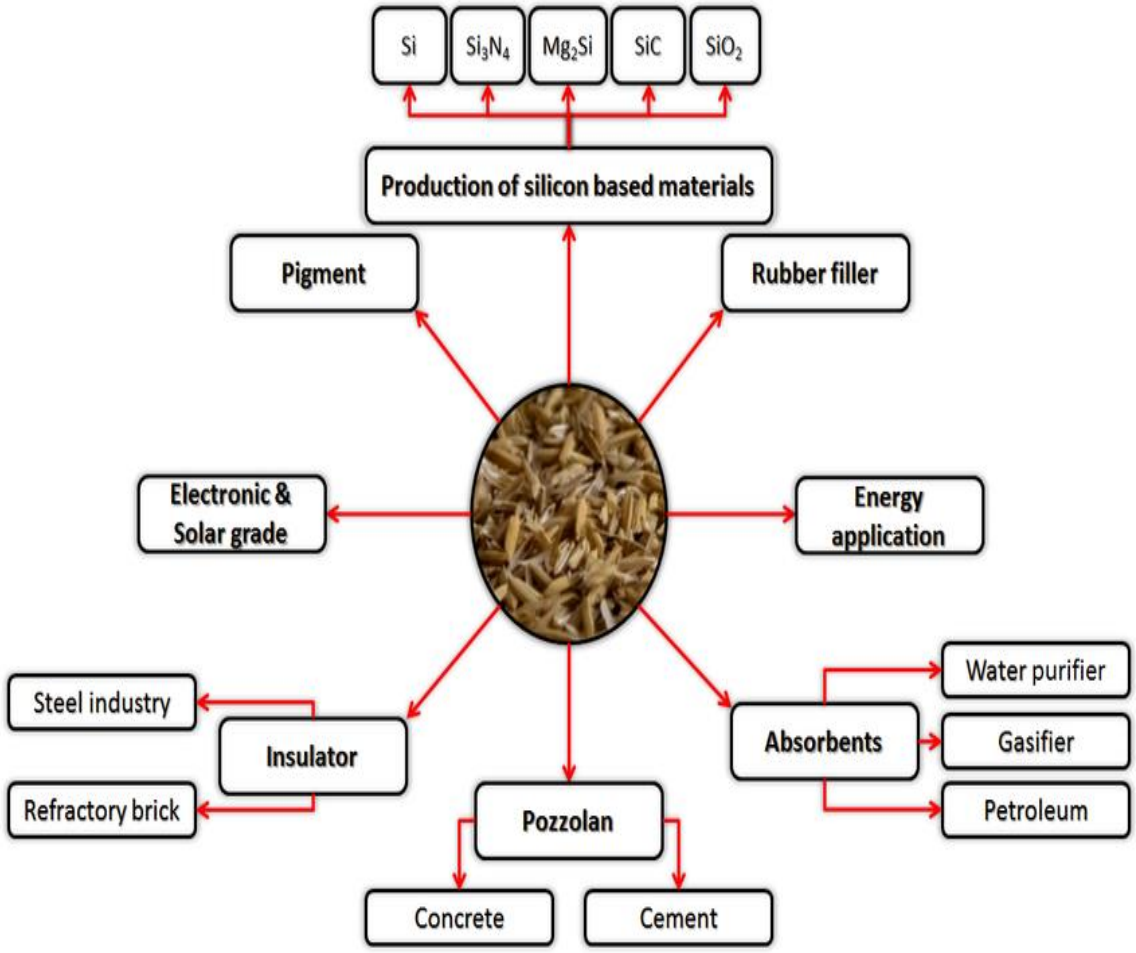


Fig. 3 Image of schematic diagram of applications of rice husk

(Ref. -https://www.researchgate.net/figure/Schematic-of-applications-of-derived-rice-husk_fig1_269334546)

Silica

Silica is found more frequently in nature in the form of quartz and in living organisms . High quality silica is typically found in unconsolidated deposits under thin layers of overburden. It is in the form of quartz veins within other rocks and these veins can be several meters thick. These rocks include fused quartz, crystals, fumed silica, silica gel and aerogels. The general name for

fibrous silica forms is chalcedony and includes versions of semiprecious stones such as agate, onyx and carnelian. Granular varieties include jasper and flint. There are also anhydrous forms, that is, diatomite and opal. Silica is widely found in many plants. Vegetation materials with a high content of silica photolith appear to be important for animal grazing, from chewing insects to ungulates. It has been shown to accelerate tooth wear and that high levels of silica in plants that herbivores consume often may have developed a defense mechanism against predation [30-31. It is also the main component of the biomass ash of the rice husk. It occurs in bacteria, unicellular organisms, plants and animals. In all the silicon compounds, silica plays a key role in many industrial applications throughout the world. Although silica is available in abundance from natural resources, the purity of silica is limited. To obtain pure silica in bulk, different methods of treatment are used. The purity of the silicaincreases during the realization of simple chemical processes without loss of its properties.

Nanoscale Silica

Although the large amount of silica and micro-silica particles are used for various industrial applications due to their exotic properties.Physicochemical. As a result, industries expect Nanoparticles with exotic properties. Nanosilica particles are of great scientific interest due to their large surface area and the size of their physical-dependent chemical properties. It is known that silica particles exist in both their crystalline and amorphous phases at the nanoscale. Between these two, amorphous nanosilicaparticles are needed in different industries due to their exotic properties. The interesting properties of the nanosilica particles depend mainly on the large surface area and the uniform distribution of the particle size. The high surface-to-volume ratio of the nanosilica particles provides a tremendous driving force for diffusion, particularly at elevated temperatures. The silica is composed of a silicon atom and two oxygen atoms. The

structure of silica is tetrahedral. A silicon atom is surrounded by four oxygen atoms. In the tetrahedral structure, all the silicon atoms are attached to four oxygen atoms.

Most oxygen atoms are bonded to two silicon atoms, so that the two tetrahedral atoms join at the corner to form bridging atoms. When all oxygen atoms are bridged, this leads to a regular matrix of atoms in a crystal lattice and, therefore, leads to a quality crystal structure. Some oxygen atoms are attached to a single silicon atom to form atoms that do not form a bridge. Therefore, the orientations are random and, therefore, lead to an amorphous structure. The relative amount of bridging ton on-bridging atoms determines the quality of the oxide. The structure of crystalline and amorphous silica is shown in following figure.