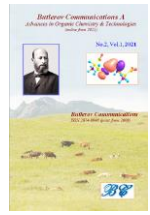
BUTLEROV HERITAGE

Butlerov Communications A
Advances in Organic Chemistry & Technologies
ISSN 2074-0948 (print)

2021. Vol.1, No.2, Id.22.
Journal Homepage: https://a-journal.butlerov.com/



Thematic section: Preparative Study.
Subsection: Chemistry of Organoelement Compounds.

Full Paper

The Reference Object Identifier – ROI-jbc-A/21-1-2-22
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-A/21-1-2-22
Received 10 May 2021; Accepted 12 May 2021

Influence of the method of obtaining silicon dioxide from rice husk on the composition and modifying effect in epoxy compositions

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Keywords: silicon dioxide, rice husk, ash, aerosil, phase composition, hardness, wear resistance, coefficient of friction.

Abstract

Rice husk is a promising source of silicon dioxide, the composition and properties of which depend on the processing technology of rice production waste. Rice husk silicates are completely amorphous or contain crystalline silicon dioxide. All investigated silicates are effective modifiers of epoxy coatings, improving their antifriction properties and increasing wear resistance. Rice husk ash increases the hardness of epoxies. The modifying effect of silicates obtained from rice hulls depends on their porosity, oil absorption and acid-base characteristics of the surface. Purely amorphous aerosil and vegetable silicon dioxide have a higher oil absorption than rice husk ash obtained at all temperatures under study. It was found that the total volume and area of micropores, specific surface area and average diameter significantly decrease with an increase in the combustion temperature of rice husks, as well as oil absorption. The higher oil absorption and porosity of rice husk ash obtained at lower temperatures is associated with a higher content of the organic phase in its composition, as indicated by a higher amount of carbon.

A greater increase in the performance of epoxy compositions is observed upon modification of rice husk ash obtained at 500 °C. This can be attributed to the presence in its composition of a relatively high amount of active amorphous silicon dioxide and a low carbon content. The presence of silanol groups in plant silicon dioxide obtained by alkaline cooking provides higher adhesive interactions at the interface and a greater modifying effect in epoxy compositions as compared to Aerosil.

Thus, silicates based on rice hulls are more effective fillers for epoxy materials than Aerosil. They are much cheaper than this synthetic silicon dioxide, since they are

obtained on the basis of waste of annually renewable plant raw materials, which at the same time contributes to solving environmental problems and fits into the mainstream of the circulation economy.

For citation: Elena M. Gotlib, Liubov A. Zenitova, Alina R. Valeeva, Rutthe S. Ntsoumou. Influence of the method of obtaining silicon dioxide from rice husk on the composition and modifying effect in epoxy compositions. *Butlerov Communications A*. **2021**. Vol.1. No.2. Id.22. DOI: 10.37952/ROI-jbc-A/21-1-2-22

References

[1] Nwosu-Obieogu Kenechi, Ch. Linus, Adekunle Kayode, Utilization of Rice Husk as Reinforcement in Plastic Composites Fabrication. *A Review, American Journal of Materials Synthesis and Processing*. **2016**. Vol.1. No.3. P.32-36.

[2] Duy Hung Nguyen, L.A. Zenitova, Quang Dien Le, and Do Tien Thinh Bui. Use of burn rice residues for production of nanosilica. *Butlerov Communications*. **2019**. Vol.57. No.3. P.155-161. DOI: 10.37952/ROI-jbc-01/19-57-3-155 (Russian)

[3] E.M. Gotlib, Thi Nha Phuong Ha, and N.V. Shilnikova. Ways to utilize by-products in the production of silica from rice husk. *Butlerov Communications.* **2020**. Vol.62. No.5. P.72-77. DOI: 10.37952/ROI-jbc-01/20-62-5-72 (Russian)

[4] M.S. Sarangi, R.C. Beher. Effect of temperature on morphology and phase transformations of nanocrystalline silica obtained from rice husk. *Phase Transitions: A Multinational Journal*. **2009**. Vol.82. No.5. P.377-386.

[5] A.B. Rohani. Production of High Purity Amorphous Silica from Rice Husk *Chemistry*. **2016**. Vol.19. P.189-195.

[6] M.I. Aujla, Ishtiaq-Ur-Rehman I-U-R, A. Javaid. Mechanism of silica precipitation by lowering pH in chemi- thermomechanical pulping black liquors. *Proceedings of the 1st WSEAS International Conference on Computational Chemistry*. Cairo, Egypt. **2007**. P.58-62.

[7] U. Kalapathy. An improved method for production of silica from rice hull ash. A. Proctor, J. Shultz. *Bioresource Technology*. **2002**. Vol.85. No.3. P.285-289.

[8] D.V. Sugonyako, and L.A. Zenitova. Polymer compounds and nanocompounds based on silica. *Butlerov Communications.* **2015**. Vol.43. No.9. P.78-83. DOI: 10.37952/ROI-jbc-01/15-43-9-78 (Russian)

[9] M.I. Aujla, Ishtiaq-Ur-Rehman I-U-R, A. Javaid. Mechanism of silica precipitation by lowering pH in chemi- thermomechanical pulping black liquors. *Proceedings of the 1st WSEAS International Conference on Computational Chemistry*. *Cairo. Egypt.* **2007**. P.58-62.

[10] R. Arjmandi, A. Hassan, K. Majeed, Z. Zakaria. Rice Husk Filled Polymer Composites. *International Journal of Polymer Science.* **2015**. P.32.

[11] H. Chen, F. Wang, C. Zhang, Y. Shi, G. Jin, S. Yuan. Preparation of nano-silica materials: The concept from wheat straw. *Journal of Non- Crystalline Solids*. **2010**. Vol.356. No.50-51. P.2781-2785.

[12] R. Ghosh. A review study on precipitated silica and activated carbon from rice husk. *Journal of Chemical Engineering and Process Technology*. **2013**. Vol.4. Iss.4. P.156-162.

[13] Elena M. Gotlib, Liubov A. Zenitova, Alina R. Valeeva, Rutthe S. Ntsoumou. Influence of the method of obtaining silicon dioxide from rice husk on the composition and modifying effect in epoxy compositions. *Butlerov Communications*. **2021**. Vol.66. No.6. P.43-47. DOI: 10.37952/ROI-jbc-1/21-66-6-43 (Russian)