On the Synthesis and Predictive Modeling of Thermostable Pigments Utilizing Silica Extracted from Rice Husk Biowastes

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Our project analyzes the utility of amorphous silica produced from rice husk biowastes in producing higher quality, thermostable pigments. Heating the husks produces rice husk ash (RHA) containing 99.96% pure silica. RHA's properties make it viable for zircon ($ZrSiO_4$)-producing pigment reactions, yielding thermostable RHA-based pigments. We show these pigments are of comparable or superior quality to those made from fumed or crystalline silica. Considering health risks associated with exposure to crystalline silica and the fumed silica's higher cost, there are many benefits to finding alternative materials. Via X-ray diffraction analysis of our final RHA-based pigments, we observe that temperatures of blue-green pigment reactions can be lowered to reduce cost for pigment synthesis. We synthesized novel pigments at 1,050 degrees Celsius as data points for our model to establish equations relating pigment chemical composition to coloration. The equations contain coefficients relating the effect of the compounds on resulting color; thus, users can predict a pigment's color given its composition. These results have numerous implications for the ceramics industry by reducing pigment synthesis cost, expediting production, and lowering workers' risk for developing diseases. Ultimately, because we have converted this biowaste into industrial products, our results promote sustainable development.

Awards Won:

Third Award of $1,000