

Development of low-cost silica gel from rice husk ash for thin layer chromatography (TLC)

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This study investigates the synthesis of sustainable, rice husk ash-derived silica gel for use as the stationary phase in the thin-layer chromatography (TLC) technique. Commercially available silica used for TLC is considerably costly, as it is derived from non-renewable sources and also involves complex manufacturing processes. Therefore, the objective of this research was to produce fluorescent material-incorporated TLC material at a low cost for use in teaching laboratories. We have developed a new methodology by modifying the conventional sol-gel process for extracting silica from rice husk. Rice husk ash was acid-treated using 1 M HCl under controlled conditions, and silica (SiO_2) was prepared by reacting the acid-treated ash with 3 M NaOH under microwave heating, followed by precipitation using 1 M HCl to adjust the pH to 2.5, and then again neutralizing the solution using 1 M NaOH. The resulting silica gel was aged, filtered, and dried. The dried mass was ground into fine powder, resulting in an average silica yield of 87.14 %. For TLC applications, a fluorescent material synthesized from manganese-doped zinc

silicate was incorporated to enable the visualization of colorless solutes under UV illumination, and CaSO_4 was added to serve as the binder. The incorporation process was optimized using sonication to ensure uniform distribution of the fluorescent material. The silica mixture was evenly applied to the glass plate and dried in an oven at 110 °C. Characterization of the synthesized material was performed using Fourier Transform Infrared (FTIR) spectroscopy to confirm the chemical composition and bonding. The modified TLC silica provided accurate R_f values and facilitated effective visualization of compounds like anthracene, 2-naphthol, and benzaldehyde. These findings confirm that rice husk ash-derived TLC silica offers an eco-friendly and cost-effective alternative to commercial TLC silica.

Keywords:

Manganese-doped zinc silicate, Rice husk ash, Sol-gel method, Thin-layer chromatography.