

# Optimisation of process parameters for augmentation of silica purity using artificial neural network and Taguchi methodology coupled with membrane desalination - A compendious approach

*Uttarini Pathak<sup>1</sup>, Snehlata Kumari<sup>1</sup>, Tamal Mandal<sup>1\*</sup>*

*1) Department of Chemical Engineering, NIT Durgapur, India*

*1\*) Corresponding author, Department of Chemical Engineering, NIT Durgapur, India*

Corresponding author Email: [tamal.mandal@che.nitdgp.ac.in](mailto:tamal.mandal@che.nitdgp.ac.in) (M)-9434788078, Orcid ID: 0000-0002-0493-747X

## Abstract

Rice husk ash emerges as a major waste product from rice production practices. This study was attempted towards retrieval of silica from rice husk ash following an alkali treatment and acid precipitation with the objective of annihilating the local problems of disposal from the rice milling industries. Different parameters, like concentration of sodium hydroxide (NaOH), alkali impregnation volume per unit weight of the rice husk ash and reaction time were varied to determine the favourable process conditions following a single factor test. The maximum silica extraction was 98.96 % obtained with 4N of NaOH, 10 ml/g of alkali volume and treatment time of 1 hr. Experimental data was also validated using artificial neural network analysis (ANN) and Taguchi technique in determining the optimum levels. To ensure maximum purity of silica, the excess sodium chloride was recovered using a thin film composite reverse osmosis membrane with a maximum salt rejection of 94.6% accompanied by recycling of the wash water. Detailed characterisation of the synthesised silica powder and residual rice husk ash were executed using scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), Fourier transform infrared (FT-IR) spectroscopy, thermogravimetric analysis (TGA), BET surface area and particle size anatomization. Continuous recycling operations were performed to ensure the best possible reclamation of silica and reusability of rice husk ash.

**Keywords:** Rice Husk Ash; Dissolution-precipitation; Silica; TFC-RO Membrane desalination.