What is the origin of efficiency of partially burnt rice husk ash as wide-spectrum water filter?

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Rice husk ash burning at controlled temperature and compacted manually (without electrical supply) can be compacted and used as an extremely cheap but efficient water purifier, especially against salt or organic pollutants. Full technology from the field to repository that can be used has been described and openly free-access patented by PC Kumar [1]. At microscopic level rice husk ash fully burnt is a mesoporous silica-based material with local worm-like nanostructure and typical cylindrical pores of 2 nm has been shown to be an extremely efficient absorbers with a broad target range [2]. More recently, partial burning, i.e. using mesoporous material containing some graphitized carbon-rich material resulting from the combustion. In this case, the surface of the mesopores in this material is partly "hydrophilic" and partly "hydrophobic"., with afferent ion physisorbtion mechanisms. These partially burnt rice husk is produced in the form of a black powder have shown extremely improved performance for retaining salts as well as organic materials, and are used as commercially available advanced water filters. Long range interactions can decomposed in a general hydrophobic interaction[3], combined with electrostatic, depletion well as Hofmeister effects[4]. Hofmeister "inversions" have been known since nearly a century, but the first tentative predictive theory of inverted Hofmeister series are only recent [5].
In the present work, we characterize the nanostructure present by scattering of totally burnt and several batches of partially burnt rice husk prepared by Tata research for real applications. We measure salt and model organic retention, and will compare the results to the current cutting-edge theory of specific adsorption. Since the channels of this mesoporous material are of colloidal size[6], weak long range interactions are dominant [7]. We analyze in the case of rice husk ash in the case of salts and non-electrolytes the complex interplay between hydration force, dispersion forces and depletion effects in the light of most recent predictive theories available in the literature.

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