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# Rekayasa Silika Mesopori Berbasis Limbah Biomassa Sekam Padi dengan Surfaktan Non-Ionik Sebagai Material Adsorben Bisfenol A = Engineering of Mesoporous Silica Based on Rice Husk Biomass Waste Using Non-Ionic Surfactant as Adsorbent Material for Bisphenol A

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Abstrak

Bisfenol A (BPA) merupakan senyawa kimia berbahaya yang tergolong Endocrine Disrupting Chemical (EDC), umum digunakan dalam industri plastik dan resin epoksi. Salah satu metode paling efektif untuk mengurangi risiko BPA adalah adsorpsi. Silika mesopori, yang biasanya disintesis dari prekursor sintetik seperti tetraethoxysilane (TEOS), memiliki kelemahan berupa biaya tinggi dan potensi dampak negatif terhadap kesehatan. Oleh karena itu, digunakan alternatif bahan baku berupa limbah biomassa sekam padi. Penelitian ini merekayasa silika mesopori dari sekam padi untuk mengevaluasi kapasitas dan efisiensi adsorpsinya terhadap BPA serta menentukan model kinetika adsorpsi yang sesuai. Sintesis dilakukan menggunakan NaOH 2,25 M dan HCl 2,25 M, dengan variasi penambahan surfaktan P123 (5, 10, dan 15 gram). Proses kalsinasi dilakukan pada suhu 500°C selama 6 jam. Analisis FTIR mengonfirmasi keberadaan gugus Si-O-Si, sementara analisis BET menunjukkan diameter pori 3,06 nm dan luas permukaan 373,963 $m^2/g$ pada penambahan 15 gram P123. Analisis SEM memperlihatkan morfologi yang semakin homogen pada penambahan 15 gram P123, didukung dengan hasil UV-Vis yang menunjukkan kapasitas adsorpsi dan %removal tertinggi sebesar 61,39 mg/g dan 61,39% jika dibandingkan dengan penambahan 5 dan 10 gram P123. Penelitian ini menunjukan bahwa model kinetika adsorpsi yang sesuai dengan proses adsorpsi Bisfenol A menggunakan silika mesopori ialah model Pseudo-First Order.

.....Bisphenol A (BPA) is a hazardous chemical compound classified as an Endocrine Disrupting Chemical (EDC), commonly used in plastic and epoxy resin industries. One of the most effective methods to mitigate BPA exposure is adsorption. Mesoporous silica, typically synthesized from synthetic precursors such as tetraethoxysilane (TEOS), has drawbacks, including high costs and potential adverse health effects. Therefore, an alternative raw material derived from rice husk biomass waste was utilized. This study engineered mesoporous silica from rice husks to evaluate its adsorption capacity and efficiency for BPA and determine the appropriate adsorption kinetics model. The synthesis was conducted using 2.25 M NaOH and 2.25 M HCl, with the addition of P123 surfactant at varying amounts (5, 10, and 15 grams). Calcination was performed at 500°C for 6 hours. FTIR analysis confirmed the presence of Si-O-Si functional groups, while BET analysis revealed a pore diameter of 3.06 nm and a surface area of 373.963 $m^2/g$ with the addition of 15 grams of P123. SEM analysis demonstrated increasingly homogeneous morphology at 15 grams of P123, supported by UV-Vis results indicating the highest adsorption capacity (61.39 mg/g) and removal efficiency (61.39%) compared to 5 and 10 grams of P123. This study concludes that the adsorption kinetics of Bisphenol A using mesoporous silica follows the Pseudo-First Order model.