Sintesis Metal Organic Framework (MOF) Berbasis Logam Ca, Sr, dan Ba dengan Ligan Asam Glutamat sebagai Fotokatalis dalam Degradasi Zat Warna Metilen Biru = Synthesis of Metal Organic Framework (MOF) Based on Ca, Sr, and Ba Metals with Glutamic Acid Ligands as Photocatalysts in the Degradation of Methylene Blue Dyes

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Abstrak

Industri tekstil menghasilkan limbah cair yang mengandung zat warna sintetik seperti metilen biru (MB) yang sulit terurai. Kehadiran metilen biru di lingkungan perairan berdampak negatif karena toksisitasnya yang tinggi, mengganggu fotosintesis, dan mengurangi kadar oksigen terlarut. Penelitian ini bertujuan untuk mensintesis Metal Organic Framework (MOF) berbasis logam Ca, Sr, dan Ba dengan ligan asam glutamat (L-Glu) melalui metode solvotermal sebagai fotokatalis untuk degradasi zat warna metilen biru. Hasil sintesis MOF, yaitu Ca-Glu, Sr-Glu, dan Ba-Glu dikarakterisasi menggunakan Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), dan Ultraviolet-Visible Diffuse Reflectance Spectroscopy (UV-Vis DRS). Dalam uji aktivitas fotokatalitik MOF dilakukan dengan variasi jenis katalis, massa katalis, waktu iradiasi cahaya, dan kondisi yang dianalisis menggunakan Ultraviolet-Visible Spectroscopy (UV-Vis). Hasil uji aktivitas menunjukkan bahwa MOF Sr-Glu merupakan katalis paling optimum dalam mendegradasi metilen biru dengan persen degradasi sebesar 40,8783%. Pada pengujian variasi massa katalis menunjukkan bahwa Sr-Glu sebesar 30 mg merupakan massa optimum dengan persen degradasi sebesar 60,81%. Sintesis MOF yang ditujukan sebagai fotokatalis dibuktikan melalui variasi kondisi secara fotokatalisis, adsorpsi, dan fotolisis. Berdasarkan kinetika laju, reaksi degradasi mengikuti orde 1 dengan konstanta laju reaksi (k) sebesar 2,5 × 10-3 menit-1.

.....The textile industry produces wastewater containing synthetic dyes such as methylene blue (MB) that are difficult to degrade. The presence of MB in aquatic environments has significant negative impacts due to its high toxicity, which disrupts photosynthesis and reduces dissolved oxygen levels. This study aims to synthesize Metal-Organic Frameworks (MOFs) based on Ca, Sr, and Ba metals with glutamic acid ligand (L-Glu) through the solvothermal method as photocatalysts for the degradation of MB. The synthesized MOFs, namely Ca-Glu, Sr-Glu, and Ba-Glu, were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), and Ultraviolet-Visible Diffuse Reflectance Spectroscopy (UV-Vis DRS). Photocatalytic activity tests were conducted with variations in catalyst type, catalyst mass, light irradiation time, and conditions, analyzed using Ultraviolet-Visible Spectroscopy (UV-Vis). The results showed that Sr-Glu MOF was the most optimal catalyst in degrading MB with a degradation percentage of 40.88%. Variations in catalyst mass tests showed that 30 mg Sr-Glu was the optimum mass with a degradation percentage of 60.81%. The synthesis of MOFs as photocatalysts was demonstrated through variations in photocatalysis, adsorption, and photolysis conditions. Based on the reaction kinetics, the degradation reaction followed first-order kinetics