

**SINTESIS SILIKA MESOPORI BERBASIS ABU BOILER PABRIK
KELAPA SAWIT (MS-OPBA) MENGGUNAKAN *TEMPLATE* METIL
ESTER SULFONAT (MES) UNTUK ADSORPSI BIRU METILEN**

Shinta Ayu Kusumaningtyas

21/476312/PPA/06163

INTISARI

Penelitian adsorpsi zat warna biru metilen pada silika mesopori berbasis abu *boiler* pabrik kelapa sawit (MS-OPBA) termodifikasi sebagai adsorben telah dilakukan. Modifikasi silika mesopori menggunakan metil ester sulfonat (MES) sebagai *template* bertujuan untuk meningkatkan ukuran pori silika abu *boiler*. Silika termodifikasi ini diaplikasikan sebagai adsorben biru metilen dengan menentukan nilai kapasitas adsorpsi dari silika abu *boiler* tanpa *template* maupun dengan *template*. Silika termodifikasi tersebut dikarakterisasi dengan FTIR, XRD, BET, SEM-EDX, sedangkan nilai kapasitas adsorpsi biru metilen diukur menggunakan spektrofotometer UV-Vis.

Hasil dari modifikasi silika dengan *template* ditunjukkan oleh adanya pergeseran puncak pada bilangan gelombang 1219–1128 cm^{-1} yang merupakan gugus sulfonate. Kondisi optimum adsorpsi biru metilen oleh adsorben MS-OPBA tanpa *template* diperoleh pada pH 7, massa adsorben 0,04 g, waktu kontak selama 60 menit dan konsentrasi biru metilen 25 mg/L dengan kapasitas adsorpsi sebesar 15,396. Adsorpsi biru metilen oleh MS-OPBA tanpa *template* mengikuti model kinetika orde kedua-semu dengan nilai $R^2 = 0,998$ dan nilai konstanta laju adsorpsi sebesar 0,111 g/mg menit. Proses adsorpsi mengikuti model Isoterm Langmuir. Kondisi optimum adsorpsi biru metilen oleh MS-OPBA dengan *template* diperoleh pada pH 7, massa adsorben 0,03 g, dan waktu kontak selama 45 menit dan konsentrasi biru metilen 20 mg/L. Adsorpsi biru metilen oleh MS-OPBA dengan *template* mengikuti model kinetika orde kedua-semu dengan nilai $R^2 = 0,999$ dan nilai konstanta laju adsorpsi sebesar 1,706 g/mg menit. Proses adsorpsi mengikuti model Isoterm Langmuir.

Kata kunci: Abu *boiler*, silika, metil ester sulfonat, adsorpsi, biru metilen

SYNTHESIS OF MESOPOROUS SILICA BASED ON BOILER ASH PALM OIL FACTORY (MS-OPBA) USING METHYL ESTER SULFONATE (MES) TEMPLATE FOR METHYLENE BLUE ADSORPTION

Shinta Ayu Kusumaningtyas

21/476312/PPA/06163

ABSTRACT

Research on the adsorption of methylene blue dye on mesoporous silica based on modified *boiler* ash palm oil factory (MS-OPBA) as an adsorbent has been carried out. Modification of *boiler* ash silica using methyl ester sulfonate (MES) as a template aims to increase the pore size of *boiler* ash silica. Modified silica was applied as methylene blue adsorbent and determined the adsorption capacity of *boiler* ash silica with and without template. The results of the research were proven through the FTIR, XRD, BET, SEM-EDX, and the adsorption capacity was measured using a UV-Vis spectrophotometer.

The results of the modification of the silica with the template were indicated by a peak shift at wave numbers 1219–1128 cm^{-1} , which was a sulfonate group. The synthesis results show that *boiler* ash silica is amorphous. Optimum conditions for methylene blue adsorption by *boiler* ash silica adsorbent MS-OPBA without template were obtained at pH 7, with an adsorbent mass of 0.04 g, a contact time of 60 minutes, and a methylene blue concentration of 25 mg/L with an adsorption capacity of 15.396. The adsorption of methylene blue by MS-OPBA without followed a pseudo-second-order kinetic model with a value of $R^2 = 0.998$ and an adsorption rate constant value of 0.111 g/mg min. The adsorption process follows the Langmuir Isotherm model. Optimum conditions for methylene blue adsorption by MS-OPBA with template were obtained at pH 7, an adsorbent mass of 0.03 g, a contact time of 45 minutes, and a methylene blue concentration of 20 mg/L. Adsorption of methylene blue by MS-OPBA with template followed a pseudo-second-order kinetic model with a value of $R^2 = 0.999$ and an adsorption rate constant value of 1.706 g/mg min. The adsorption process follows the Langmuir Isotherm model.

Keywords: Boiler ash, silica, methyl ester sulfonate, adsorption, methylene blue