SINTESIS KATALIS SILIKA MESOPORI DARI ABU DAUN SALAK TERIMPREGNASI MOLIBDENUM OKSIDA DAN APLIKASINYA UNTUK DESULFURISASI OKSIDATIF DIBENZOTIOFENA

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INTISARI

Emisi senyawa sulfur dari penggunaan bahan bakar fosil terus meningkat seiring tingginya mobilitas dan aktivitas industri. Masalah ini menjadi isu lingkungan serius yang mendorong pengembangan solusi desulfurisasi yang efisien dan ramah lingkungan. Menindaklanjuti urgensi tersebut, penelitian ini bertujuan untuk melakukan sintesis dan karakterisasi katalis molibdenum oksida terimpregnasi pada silika mesopori dari abu daun salak ($MoO_3/MSiO_2$), serta menguji performanya dalam reaksi desulfurisasi oksidatif dibenzotiofena (ODS–DBT) pada model bahan bakar. Silika mesopori disintesis menggunakan metode sol-gel kemudian diimpregnasikan dengan larutan prekursor amonium heptamolibdat tetrahidrat melalui metode *spray impregnation* dengan variasi konsentrasi logam Mo sebesar 5%, 10%, dan 15% (b/b). Karakterisasi katalis dilakukan dengan FTIR, XRD, NH_3–TPD, SAA, SEM–EDX *Mapping*, dan XPS.

Hasil karakterisasi menunjukkan bahwa katalis $Mo10\%/MSiO_2$ memiliki nilai keasaman tertinggi dan mampu menghasilkan performa katalitik terbaik dengan penurunan konsentrasi DBT tertinggi sebesar 92,15%. Kondisi optimum reaksi ODS–DBT ditentukan menggunakan *Response Surface Methodology–Central Composite Design* (RSM–CCD) dengan tiga variabel: waktu reaksi, rasio molar O/S, dan dosis katalis. Kondisi terbaik diperoleh pada waktu 45,20 menit, rasio molar O/S sebesar 10,16, dan dosis katalis 1,58% b/b, yang menghasilkan efisiensi penghilangan sulfur hingga 92,19%. Uji *reusability* menunjukkan bahwa katalis tetap aktif hingga penggunaan kelima. Temuan ini membuktikan bahwa abu daun salak dapat dimanfaatkan sebagai sumber silika untuk katalis heterogen yang mendukung prinsip kimia hijau dan ekonomi sirkular.

Kata kunci: abu daun salak, desulfurisasi oksidatif, molibdenum oksida, RSM CCD, silika mesopori.

SYNTHESIS OF MESOPOROUS SILICA FROM *Salacca zalacca* LEAVES ASH IMPREGNATED WITH MOLYBDENUM OXIDE CATALYST AND ITS APPLICATION FOR OXIDATIVE DESULFURIZATION OF DIBENZOTHIOPHENE

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ABSTRACT

Emissions of sulfur compounds from the use of fossil fuels continue to increase due to high mobility and industrial activity. This problem has become a serious environmental issue that encourages the development of efficient and environmentally friendly desulfurization solutions. Following up on this urgency, this study aims to synthesize and characterize molybdenum oxide catalyst impregnated on mesoporous silica from *Salacca zalacca* leaves ash ($MoO_3/MSiO_2$), and test its performance in the oxidative desulfurization reaction of dibenzothiophene (ODS–DBT) on model fuels. Mesoporous silica was synthesized using the sol-gel method and then impregnated with ammonium heptamolybdate tetrahydrate precursor solution through the spray impregnation method with variation of Mo metal concentration of 5%, 10%, and 15% (w/w). Catalyst characterization was carried out by FTIR, XRD, NH_3–TPD, SAA, SEM–EDX Mapping, and XPS.

The characterization results showed that Mo10%/$MSiO_2$ catalyst had the highest acidity value and was able to produce the best catalytic performance with the highest DBT concentration reduction of 92.15%. The optimum condition of ODS–DBT reaction was determined using Response Surface Methodology–Central Composite Design (RSM–CCD) with three variables: reaction time, O/S molar ratio, and catalyst dosage. The optimum condition was achieved at a reaction time of 45.20 minutes, an O/S molar ratio of 10.16, and a catalyst dosage of 1.58% w/w, which resulted in a sulfur removal efficiency of 92.19%. The reusability test showed that the catalyst remained active until the fifth use. These findings prove that *Salacca zalacca* leaves ash can be utilized as a silica source for heterogeneous catalysts that support the principles of green chemistry and circular economy.

Keywords: mesoporous silica, molybdenum oxide, oxidative desulfurization, RSM–CCD, *Salacca zalacca* leaves ash.