Delignifikasi tandan kosong kelapa sawit dengan metode amonium hidroksida berbantuan gelombang mikro = Delignification of oil palm empty fruit bunches using microwave-assisted ammonium hydroxide method

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Abstrak

Produksi komoditas sawit terbesar di dunia. Proses pengolahan sawit menghasilkan limbah tandan kosong sawit (TKS) dengan kisaran 20-23 % dari berat tandan buah segar. TKS merupakan biomassa lignoselulosa, sehingga mengandung selulosa, hemiselulosa, dan lignin. Pemanfaatan selulosa dan hemiselulosa membutuhkan praperlakuan untuk membuka ikatan lignin yang menyelubungi keduanya. Pada penelitian ini, akan dilakukan praperlakuan tandan kosong sawit dengan metode amonium hidroksida berbantuan gelombang mikro. TKS diberi praperlakuan fisika dengan pencucian dan penggilingan hingga mencapai ukuran 30 mesh. Selanjutnya TKS dimasukkan ke dalam gelas kimia dan diberikan larutan amonium hidroksida dengan rasio padat-cair 1:10 dan konsentrasi yang divariasikan (7,5; 10; 12,5%). Campuran dimasukkan ke dalam microwave dengan variasi daya 280, 560, dan 840 W, serta variasi waktu 3, 6, dan 9 menit. Sampel dikarakterisasi dengan uji lignin Klason, SEM, dan XRD.
Hasil yang diperoleh kemudian dioptimasi dengan metode Response Suface Methodology dengan pengaplikasian model Box-Behnken. Hasil mikrograf SEM menunjukkan perekahan dan pembentukan pori-pori pada mikrostruktur TKS. Hasil difraktogram XRD menunjukkan penurunan kristalinitas selulosa TKS sebesar 36,38%. Delignifikasi tertinggi diperoleh pada daya 840 Watt, konsentrasi 10%, dan waktu radiasi 9 menit, yaitu sebesar 63,32%. Hasil uji statistik dan model yang diperoleh menunjukkan efek linear pada faktor daya dan konsentrasi, sedangkan faktor waktu radiasi menunjukkan efek kuadratik. Titik optimum yang diperhitungkan terdapat pada daya 839,190 Watt, konsentrasi 12,427%, dan waktu radiasi 8,762 menit, dengan prediksi delignifikasi sebesar 79,514%.
.....Indonesia is an agricultural country with the largest production of palm oil commodities in the world. The palm oil processing will produce oil palm empty fruit bunches (OPEFB) waste with a range of 20-23% of the weight of fresh fruit bunches. OPEFB is a lignocellulosic biomass, which contain cellulose, hemicellulose, and lignin. The use of cellulose and hemicellulose requires pretreatment to open the lignin bond that covers those materials. In this study, pretreatment of oil palm empty bunches using microwave-assisted ammonium hydroxide method will be carried out. The OPEFB was given a physical pretreatment by washing and grinding to reach a size of 30 mesh. After that, the OPEFB was put into a beaker and mixed with ammonium hydroxide solution with a solid-liquid ratio of 1: 10 under varied concentration (7.5; 10; 12.5%). The mixture was put into a microwave under power variation of 280, 560, and 840 W, with time variation of 3, 6, and 9 minutes. The samples were then characterized by Klason lignin, SEM, and XRD tests.
The results obtained were then optimized using Response Suface Methodology with the application of the Box-Behnken Model. The SEM micrograph showed openings and formation of pores in the OPEFB microstructure. The XRD diffractogram showed a 36.38% decrease in cellulose crystallinity. The highest delignification was obtained at power of 840 Watts, concentration of 10%, and time of 9 minutes, which was

63.32%. The statistical test and the model that was obtained showed a linear effect on power and concentration factors, while the radiation time factor showed a quadratic effect. The calculated optimum point was obtained at power of 837.190 Watts, concentration of 12.427%, and time of 8.762 minutes, with the predicted delignification of 79.514%.