

INTISARI

Tanaman buah merah merupakan tanaman khas Papua dengan hasil minyak yang sangat bermanfaat bagi kesehatan manusia. Pada proses pembuatan minyak buah merah menghasilkan sekitar 60% ampas buah merah yang dibuang sebagai limbah. Penanganan limbah ampas buah merah sebagai *biochar* dapat dijadikan adsorben limbah cair. Adsorben *biochar* ampas buah merah digunakan untuk mengadsorpsi limbah zat warna *methylene blue*. Penelitian ini dilakukan dengan tahapan pirolisis, aktivasi KOH dan studi adsorpsi. Preparasi ampas buah merah diawali dengan proses pirolisis selama 120 menit dengan suhu 450°C hingga *biochar* yang dihasilkan dilakukan pengayakan dengan ukuran 50 mesh. *Biochar* ampas buah merah selanjutnya di aktivasi menggunakan KOH 1,5 N selama 120 menit untuk mengetahui kinerja *biochar* dalam mengadsorpsi *methylene blue*. Kinerja *biochar* ampas buah merah ditinjau berdasarkan studi kinetika, termodinamika dan studi isoterm adsorpsi pada berbagai variasi waktu, konsentrasi dan suhu adsorpsi. Berdasarkan parameter lain untuk mengetahui karakterisasi *biochar* ampas buah merah dilakukan analisis hasil FTIR yang menunjukkan beberapa gugus fungsi yang mendominasi *biochar* seperti ikatan C=O, C-H dan C=C yang menunjukkan adanya penurunan intensitas gugus fungsi pada *biochar* hasil aktivasi. Uji adsorpsi dilakukan pada konsentrasi 50, 100 dan 150 mg/L selama 120 menit dengan interval 20 menit untuk studi kinetika yang menunjukkan bahwa proses adsorpsi dikategorikan jenis adsorpsi kimia dengan pemodelan yang sesuai adalah *pseudo second order* dimana menghasilkan nilai koefisien korelasi (R^2) mendekati 1 dengan nilai konstanta kecepatan (k_2) masing-masing konsentrasi sebesar 0,6183; 0,6176 dan 0,182 g/mg.min⁻¹. Pada uji studi isoterm dilakukan variasi konsentrasi 50, 60, 80, 100, 120 dan 150 mg/L selama 120 menit. Berdasarkan perhitungan menggunakan pemodelan isoterm Langmuir dan Freundlich penelitian ini lebih cenderung ke isoterm Langmuir yang menunjukkan lapisan permukaan pada proses adsorpsi adalah monolayer dengan nilai konstanta kecepatan Langmuir (K_L) sebesar 1,2979 mg/L. Studi kinetika dan isoterm adsorpsi dijalankan pada suhu 30°C sehingga diperlukan tinjauan termodinamika adsorpsi pada berbagai suhu 30, 35, 40, 45 dan 50°C. Hasil studi termodinamika menunjukkan nilai ΔH° sebesar 31,608 kJ/mol, ΔS° sebesar 0,128 kJ/mol dan nilai ΔG° masing-masing suhu -7,176; -7,816; -8,456; -9,096 dan -9,736 kJ/mol sehingga dapat disimpulkan proses adsorpsi tergolong endotermis dan terjadi secara spontan.

Kata kunci : Ampas buah merah, *Biochar*, Adsorpsi, *Methylen blue*

ABSTRACT

The red fruit plant is a typical Papuan plant with oil yields that are very beneficial for human health. The process of making red fruit oil produces about 60% red fruit waste which is disposed of as waste. Handling red fruit waste as biochar can be used as an adsorbent for liquid waste. The red fruit waste biochar adsorbent was used to adsorb methylene blue dye waste. This research was carried out with the stages of pyrolysis, KOH activation, and adsorption studies. Preparation of red fruit waste begins with a pyrolysis process for 120 minutes at a temperature of 450°C until the resulting biochar is sieved with a size of 50 mesh. The red fruit waste biochar was then activated using 1.5 N KOH for 120 minutes to determine the performance of biochar in the adsorption of methylene blue. The performance of red fruit waste biochar was reviewed based on kinetics, thermodynamics, and adsorption isotherm studies at various adsorption times, concentrations, and temperature variations. Based on other parameters to determine the characterization of red fruit waste biochar, FTIR results were analyzed which showed several functional groups that dominated biochar such as C=O, C-H, and C=C bonds which indicated a decrease in the intensity of functional groups in activated biochar. The adsorption test was carried out at concentrations of 50, 100, and 150 mg/L for 120 minutes with an interval of 20 minutes for a kinetic study which showed that the adsorption process was categorized as a chemical adsorption type with the appropriate modeling being pseudo-second-order which resulted in a correlation coefficient value (R^2) approaching 1 with the value of the velocity constant (k_2) for each concentration of 0.6183; 0.6176 and 0.182 g/mg.min⁻¹. In the isotherm study, various concentrations of 50, 60, 80, 100, 120, and 150 mg/L were carried out for 120 minutes. Based on calculations using the Langmuir and Freundlich isotherm modeling, this study is more inclined to the Langmuir isotherm which shows that the surface layer in the adsorption process is a monolayer with a Langmuir velocity constant value (K_L) of 1.2979 mg/L. The study of adsorption kinetics and isotherms was carried out at a temperature of 30°C so that a thermodynamic review of adsorption at various temperatures of 30, 35, 40, 45, and 50°C was required. The results of the thermodynamic study show that the value of ΔH° is 31.608 kJ/mol, ΔS° is 0.128 kJ/mol and the value of ΔG° is -7.176; -7,816; -8,456; -9.096 and -9.736 kJ/mol so it can be concluded that the adsorption process is classified as endothermic and occurs spontaneously.

Keywords: Red fruit waste, *Biochar*, Adsorption, *Methylene blue*