

ANALYSIS OF THE EFFECT OF TEMPERATURE AND TIME VARIATIONS ON FAST PYROLYSIS PERFORMANCE ON THE QUALITY OF BIO-OIL FROM OIL PALM EMPTY FRUIT BUNCHES

Nama Mahasiswa : Dicky Ramanda

Nim : 2204221390

Dosen Pembimbing : Alfansuri, S.T., M.Sc

ABSTRACT

Oil palm empty fruit bunches (EFB) are an abundant biomass waste with strong potential to be converted into renewable energy through the fast pyrolysis process, given the continued heavy reliance on fossil fuels and their environmental impacts. Prior literature indicates that temperature and heating time are the primary parameters governing the decomposition rate of cellulose, hemicellulose, and lignin, as well as secondary reactions such as cracking and repolymerization of pyrolysis vapor, which directly affect bio-oil quality. This study aims to analyze the effect of temperature and heating time variations on the performance of fast pyrolysis of EFB with respect to bio-oil yield, pH, and density, and to determine the optimum operating condition among the tested combinations. This study employed a laboratory experimental method with a quantitative approach and a 3×3 factorial design, testing temperature variations (500°C, 550°C, 600°C) and heating times (20, 30, and 40 minutes) using a batch-type pyrolysis reactor. Data were processed through yield calculation, density, and pH measurement, followed by descriptive quantitative analysis. The results showed a bio-oil yield ranging from 16.33% to 27.47%, pH values between 3.31 and 3.90, and density values between 1.056 and 1.233 g/mL. The optimum condition was obtained at 600°C for 40 minutes, yielding the highest bio-oil output (27.47%) and the lowest density (1.056 g/mL), although the pH value at this condition (3.64) was not the highest pH value observed among all treatments. It can be concluded that increasing temperature and heating time significantly increases bio-oil yield while decreasing its density, making this combination the best operating condition — based on yield and density — for producing bio-oil from EFB. These findings may support the development of renewable energy based on oil palm biomass waste in Indonesia.

Keywords: oil palm empty fruit bunches, fast pyrolysis, bio-oil, yield, density.