Investigation into the effects of torrefaction on the quality of pyrolysis products

Nurhayati Abdullah, author

Abstrak

Interest in using biomass energy as an alternative to fossil fuels has advanced in recent years. This study aimed to assess the effects of torrefaction on the quality of pyrolysis products. Oil palm biomass, such as empty fruit bunches (EFB), mesocarp fiber (MF) and palm kernel shell (PKS) were either untreated (untorrefied) or torrefied (treated), and subsequently pyrolyzed. The experiment’s conditions for torrefaction were set to be a 220°C temperature, a 10°C/min heating rate, and 30 minutes holding time, and for pyrolysis they were set to a 650°C temperature, 20°C/min heating rate and 2 hours holding time. The nitrogen flow rate of 2L/min was maintained for both experiments. The results revealed that the torrefaction pretreatment improved the heating value of the torrefied biomass to 18–21 MJkg-1 from the previous value of 16–19 MJkg-1 for the untorrefied biomass. During torrefaction, the PKS showed a high solid yield of 95% due to high lignin content. The higher heating value (HHV) of the biochar and bio-oil derived from untorrefied and torrefied biomass were between 26–30 MJkg-1 and 16–17 MJkg-1 for the former, and 28–31 MJkg-1, and 17–20 MJkg-1 for the latter. The maximum HHV of 31.2 MJkg-1 was obtained from torrefied PKS biochar. The pyrolysis of torrefied biomass gave higher quality biochar and bio-oil compared to untorrefied biomass. The bio-oil acquired from the pyrolysis of the torrefied sample is less acidic and has a higher calorific value in comparison with the bio-oil obtained from the untorrefied sample. MF and PKS have demonstrated a superior outcome after torrefaction. In this way, the PKS and MF were identified as better biomass for torrefaction and pyrolysis compared to EFB.