

Optimization of superheated steam treatment to improve surface modification of oil palm biomass fiber

ABSTRACT

Superheated steam (SHS) pretreatment is an effective method for hemicellulose removal from oil palm biomass (OPB) fiber, which leads to the surface modification of the fiber. However, the current SHS pretreatment is conducted at a high temperature and has a long retention time, which causes the removal of cellulose, which is an important component for biocomposite production. This study was conducted to optimize the SHS treatment temperature and retention time so that hemicellulose but not cellulose was removed. Three types of OPB fibers were used: oil palm mesocarp fiber (OPMF), oil palm empty fruit bunch (OPEFB), and oil palm frond (OPF). The chemical composition data was analyzed using a type of response surface methodology (RSM), i.e., central composite design (CCD). The optimal SHS treatment temperature and retention time were 265 °C/5 min, 280 °C/5 min, and 300 °C/9 min for OPMF, OPEFB, and OPF, respectively. The removal of hemicellulose at these temperatures was in the range of 60% to 70%, while the cellulose degradation was maintained below 5%. Statistical analysis showed that the optimal SHS treatment time can be shortened to 5 min to 9 min, which is 18 to 20 times shorter than previously reported methods.

Keyword: Oil palm biomass fiber; Pretreatment; Superheated steam; Surface modification; Optimization