

Kinetics of thermal hydrolysis of crude palm oil with mass and heat transfer in a closed system

ABSTRACT

Crude palm oil (CPO) is the main product of oil palm processing and is obtained through a series of unit operations. In a palm oil mill, the main unit operations involve applying saturated steam in the steriliser and digester. The high temperature and water content used will induce thermal hydrolysis, leading to accumulation of free fatty acids (FFAs), the levels of which are considered a major quality index of CPO. A detailed study of the thermal hydrolysis of CPO at different temperatures and water contents in a closed-vessel system was carried out. The results show that there was an increase in FFA accumulation as temperature and initial water content increased. A kinetic model of the hydrolysis was constructed taking into account heat and mass transfer phenomena. The important parameters of the model were the reaction frequency factor (k_{OT}) and the power factor of water fraction (n), which were successfully estimated by gPROMS ModelBuilder at $2.55 \times 10^{-6} (\text{m}^3/\text{kmol})^{0.85} \text{min}^{-1}$ and 0.62, respectively. A sensitivity analysis revealed that the simulated profiles (*i.e.* FFA content and vapour mass flux, W·WV) were highly sensitive to these parameters. The model can be a useful tool in the further redesign and quality improvement of the industrial of CPO extraction processes.

Keyword: Crude palm oil; Palm fruit; Thermal hydrolysis; Triglycerides; Free fatty acid