

Modeling of two-phase flow in porous media: transport behavior of lubricant oil in rubberwood

Chutima Kongvarhodom¹ Phakkhananan Pakawanit² Pothiwan Lakonpon³ Napat Suteerapornchai⁴
Sutatch Ratanaphan⁵

Nowadays, eco-friendly technologies for separation of oil/water mixtures have been developed. Wood becomes a promising material for a conduit for fluid flow due to its natural hierarchical structure and high porosity. However, due to the structural complexity of the wood, the oil transport in wood is difficult to be monitored. Synchrotron X-ray Tomographic Microscopy (SR-XTM) is a reliable and robust technique to observe the oil transport in real geometries of wood. This work presents monitoring of the lubricant oil transport behavior in rubberwood using the SR-XTM. Additionally, a numerical model solved using a finite element analysis (FEA) with phase field method and creeping flow model is conducted on the lubricant oil transport in rubberwood to predict the time-dependent fraction of lubricant oil within rubberwood. The model results are compared with experimental data. The lubricant oil transport in rubberwood demonstrates that the lubricant oil advances along the efficient transport pathways which are vessel cells. However, the closed vessel cells act as a barrier of oil transport that would affect a reduction of oil flux. It is also found that the surface tension has a great effect on the liquid flowing through the microstructure of rubberwood. The SR-XTM technique combined with the simulation obtained from this work opens new horizons for exploring a wide range of permeable materials for oil separation and also extends the wide applications of wood.

¹King Mongkut's University of Technology Thonburi
chutima.kon@kmutt.ac.th

²Synchrotron Light Research Institute
phakkhananan@slri.or.th

³King Mongkut's University of Technology Thonburi
pothiwan.l@mail.kmutt.ac.th

⁴King Mongkut's University of Technology Thonburi
aumnapat2402@gmail.com

⁵King Mongkut's University of Technology Thonburi
sutatch.ratanaphan@mail.kmutt.ac.th