

Application of response surface methodology (RSM) for optimizing the palm-based pentaerythritol ester synthesis

ABSTRACT

The present study was performed to optimize reaction parameters for the transesterification reaction of palm oil methyl ester and pentaerythritol by using response surface methodology (RSM). The affecting parameters were selected as temperature (140–190°C), amount of catalyst (0.5–1.5 wt%), palm oil methyl ester-to-pentaerythritol molar ratio (4:1–5:1) and reaction time (1–5 h), in order to produce pentaerythritol ester (tetraester). The optimum operating conditions; temperature at 158°C; amount of catalyst, 1.19 wt%; molar ratio, 4.5 and 1 h of reaction time were obtained with the result of the pentaerythritol ester's yield of 40.13%. The interaction parameter of the catalyst amount with the palm oil methyl ester-to-pentaerythritol molar ratio was found to be the most significant amongst all of the interaction parameters. The pentaerythritol ester properties were analyzed and compared with the commercial oven chain lubricant. The results indicated that the pentaerythritol ester is able to withstand a high temperature environment with a flash point of 302°C and viscosity of 12.7 cSt at 100°C.

Keyword: Biolubricant; Response surface methodology; Pentaerythritol ester; Characterization