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Electrochemical conversion of palmitic acid via Kolbe electrolysis for synthesis of n-triacontane

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Abstract

Fatty acids in vegetable oils and animal fats are a potential feedstock for the production of synthetic waxes, and this kind of waxes can be a substitute for petroleum waxes in the future because the feedstock is renewable. This paper described an optimization study on the production of n-triacontane (NTA) from palmitic acid via Kolbe electrolysis using a biphasic solvent system (H_2O/MeOH as aqueous phase, petroleum ether as organic phase). Response surface methodology (RSM) and Taguchi methodology (TM) were employed to research the production of NTA effected by amounts of KOH, reaction temperature, cell voltage and reaction time. On the basis of analysis of variance and range analysis of the two methods above, the maximum NTA yield was achieved at amounts of KOH of 1.3 equiv., reaction temperature of 57 ^{o}C, cell voltage of 20.0 V and reaction time of 20 h for RSM; while the amounts of KOH of 1.3 equiv., reaction temperature of 55 ^{o}C, cell voltage of 20.0 V and reaction time of 20 h for TM. Under these optimal conditions, the experimental yields of NTA were 69.5% and 64.7% for RSM for TM, respectively. The final product met the relevant standards of the needle penetration, lead, water soluble acids and alkalis, odor and polycyclic aromatic hydrocarbons by referring to Chinese waxes product standards. The results showed strong potential market applications of Kolbe electrolysis waxes.

Keywords: Kolbe electrolysis; Plamitic acid; Waxes; Response surface methodology; Taguchi