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Synthesis and characterization of castor oil based semi-aromatic polyesters

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Poly(unsaturated castor oil terephthalate) (PUCOT) only were successfully synthesized in this study via poly-condensation reaction using p-TSA catalyst, castor oil (CO) and terephthaloyl chloride (TPLC) in a maintained 2:3 ratio (CO:TPLC) in order to balance the number of reaction sites of these monomers. Both solution and emulsion polymerization techniques using triethylene glycol dimethyl ether (TRIGLYME) and dimethyl formamide (DMF) solvents were applied. For solution polymerization, DMF was effective and produced high yield (28%) while TRIGLYME produced about 18%. However, in emulsion polymerization the high yield was about 17% and 16% when TRIGLYME and DMF solvents were used respectively. These yields reveal that solution polymerization is a suitable technique and DMF is the best solvent. The obtained polyesters were characterized using (ATRIR) spectrometer and simultaneous TGA and DTA thermal analyzer. Solubility and viscosity measurements were also determined. ATR-IR spectrometer indicated that all polyesters had characteristic functional groups namely =C-H for the unsaturated aliphatic chain, C=C for the benzene ring, C=O for the carbonyl group and O-C-O for an ester. TGA analysis indicated that these polyesters followed single-stage decomposition curves and were thermally stable from the ambient temperature up to around 241-252 °C where active degradation began up to 341-383 °C with weight loss ranging from 71.3 to 96.3%. DTA curves analysis showed their crystallization (T_c) and melting (T_m) temperatures ranged from 320 to 325 °C and 354 to 358 °C, respectively. These polyesters were soluble in high polar solvents like DMSO and DMF and have different intrinsic viscosities ranging from 2.683 to 5.851.