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Entitled

PREPARATION AND CHARACTERIZATION OF SAND/POLYMER COMPOSITE SHEETS FOR PRINTING APPLICATIONS

by

Sidra Siraj

Faculty Advisor

Prof. Ali H. Al-Marzouqi, Department of Chemical and Petroleum Engineering

College of Engineering

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Abstract

A stunning global demand of paper products is marked by >350 million tons of paper produced annually, leading to a rise in deforestation and consequently global warming. Therefore, an alternative to wood-based paper would be of high interests. The main aim of this thesis proposal was to develop a polymer composite sheet using a low-cost filler (natural sand) and polymer (high-density polyethylene, HDPE) as a replacement of the traditionally used wood fiber-based sheets. The polymer composite sheets were prepared by melting extrusion in a melt blender followed by compression molding. The effects of changing filler and polymer concentrations, and the use of a compatibilizer was investigated on the mechano-chemical performance properties of the composite sheets such as morphology, thermal and mechanical properties, and wettability characteristics used for printing applications. In terms of thermal stability, the addition of filler (sand) or compatibilizer (polyethylene-grafted maleic anhydride, PE-g-MA) did not change the melting, crystallization or degradation temperatures significantly, thereby promoting good thermal stability of the prepared sheets. The results obtained from the contact angle measurements, showed that the addition of compatibilizer improved water-wettability characteristics. For instance, a slight increase in the contact angle was observed for sheets prepared from 5 µm of sand particles at 35 wt% of the composition, from 92.08° to 99.4°, thereby supporting increased anti-wetting properties. Another example of improved wettability performance was in the case of printing ink. For the sheets prepared from 25 µm sand particles, at 35 wt% of the composition, the contact angle decreased from 44° to 38.30° with the addition of the compatibilizer, suggesting improved ink-wetting performance. A decrease in the elastic modulus was also observed with the addition of the compatibilizer. For compatibilized sheets prepared with 5 µm filler at 35 wt%, the elastic modulus decreased from 887.47 MPa before compatibilization to 687 MPa after compatibilization, which was quite comparable to regular A4 paper (175.18 MPa), as well as to the commercial stonepaper (596.32 MPa), implying that the prepared sheet had tensile property (10.98 MPa) in between the regular A4 paper (15.66 MPa) and stonepaper (6.17 MPa), which was obtained experimentally as well. The results from this study will be considered as a first step towards understanding compatibility of natural sand and polymers for paper manufacturing application. In addition, the current study will also contribute towards UAE's 2021 vision of sustainability.

Keywords: Sustainability, Sand, Polymer, Composite, Synthetic, Sheets.