Title of the Thesis

INVESTIGATIONS ON OIL SORPTION CHARACTERISTICS OF KAPOK, MILKWEED, NETTLE AND COTTON NONWOVENS

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Abstract

Oil spill is a very common issue polluting the water body leading to damages to flora and fauna. Commercially, polypropylene sorbent is widely used for oil spill clean-up. But this is not a bio-degradable material. Hence natural fibers having oleophilic characters such as Cotton, Nettle, Kapok and three types of milkweed (*Asclepiassyriaca, Calotropisprocera*and *Calotropisgigantea*) were used in this work. The fibers were selected because of their voluminous resulting in required characterization for oil sorption.

The physical and chemical characterizations of fibres were done using various methods. The selected fibres had easy wetting property with oils and poor wetting property with water. Oil sorption characteristics of fibers in the form of loose fibrous assembly revealed that upto 0.94 porosity values, the fineness of fibers did not show significant influence on sorption but there was higher influence beyond 0.95 porosity. Beyond 0.95 to 0.99 porosity values, the effect of fiber fineness was significant in sorption.

The cotton fibers treated with alkali have not shown any improvement in oil sorption. The Acetylation of nettle fiber has shown slightly lower sorption value than raw nettle fiber. From this study, it can be articulated that when compared to surface modified natural fibers, raw natural fibers have shown high oil sorption. Further, using raw fiber may also be economical and environmental friendly.

Needle-punched structures developed from 100 % nettle, 75/25 nettle/kapok and 50/50 nettle/kapok with different areal density were tested for sorption with 100 % HD, 100 % diesel oil and with oil-water mixture in the form of floating film. Maximum oil sorption capacity of 28.5 g/g and 22.5 g/g for HD oil and diesel oil respectively was observed for 50/50 nettle/kapok blended nonwoven.

Considering the high oil sorption of kapok, attempts have been made to produce kapok / polypropylene (80/20) needle punched nonwoven for oil spill clean-up process. The maximum oil sorption of this was found to be 40.80 g/g and 29.0 g/g for High Density oil (HD) and diesel oil respectively which is higher than the commercial polypropylene based oil sorbent pad. High retention value of 0.88 to 1.00 was observed.

In order to analyze the effect of fiber fineness and other process parameters, three variables such as micronaire, punching density and areal density in three levels were analysed for cotton needle-punched nonwoven. Maximum oil sorption capacity was found to be 29.91 g/g and 18.09 g/g for high density (HD) oil and diesel oil respectively. The finer cotton fibers exhibited maximum oil sorption capacity.

It has been found that the fibers having high surface area with voluminous lumen and low density had huge potential in oil sorption. But they also have a limitations in structuring. So, a series of thermally - bonded hybrid oil-sorbent nonwovens were developed using kapok, milkweed, Calotropisprocera, Calotropisgigantea, cotton and polypropylene. Among the different blend proportions, the maximum oil sorption capacity of the developed thermal bonded nonwoven was 40.16 g/g for HD oil and 23.00 g/g for diesel oil. Further, a high porosity combined with high surface area played a major role in deciding the oil sorption and retention characteristics. The oil was selectively and completely sorbed by the nonwoven samples of CP and CG fibers and no oil slick was found in the water. This indicated that the CP and CG fibers could be used as effective biodegradable oil sorbent for oil spill cleanup.