ABSTRACT

The free hydroxyl groups of the cellulose chains within lignocellulosic fibers (LCFs) tend to attract water molecules in moist environment causing the fibers to swell and causing the cellulose chains lose integrity because of hydrolysis and oxidation because of the actions of biogenic enzymes or because of chemical factors such as acidity, alkalinity, and salinity or UV irradiation.

In this research a non-hazardous and inexpensive chemical process has been developed for treating LCFs, e.g., jute and sisal using an alkaline water-based emulsion of vegetable oil (neem oil, rice bran oil) and plant based phenolic resin to enhance their short-term tensile strength and degradation resistance without potential toxic leachate generation. The treatment involves part transesterification of cellulose hydroxyl groups of fibers with vegetable oil or blocking of hydroxyl groups with phenolic resin via hydrogen bond formation. Treatment with alkaline neem oil-phenolic resin emulsion was found to be most effective for enhancing tensile strength as well as degradation resistance of LCFs. Yarns were spun manually or mechanically from treated jute fibers. Geotextiles were also fabricated in a commercial jute mill from the treated fibers to establish the industrial adaptability of the process. Additionally, treatment was applied on commercial grade geotextiles manufactured from untreated jute fibers. The treatment did not adversely affect flexibility and filtration properties of the geotextiles.

The treatment caused the short-term fiber tensile strength to increase by 75 % for jute and 62 % for sisal, the water absorption to decrease from 255 % to 79 % (in terms of dry fiber weight) for jute, and from 185 % to 62 % for sisal. Treated jute and sisal fibers retained, on an average, 80 % and 75 % of their initial tensile strengths, respectively, after 120-d biodegradation. The corresponding tensile strength retention for untreated jute and sisal fibers were only 10 % and 15 %, respectively. After 120-day immersion into a 3 % saline environment, treated jute and sisal fibers retained 72 % and 68 % of their initial tensile strengths, while untreated jute and sisal fibers retained only 6 % and 7 %. Further the treated fibers and geotextiles were found to be stable upon being exposed to pH ranging between 4 and 9. The biodegradation and UV-degradation related half-lives for geotextiles after treatment found to exceed 3 to 4 times compared to untreated samples.

Keywords: *Lignocellulosic fibers, Tensile strength, Degradation resistance, Goetextiles, Half-life*