Abstract

Lignocellulosic biomass is currently being studied worldwide as a source of cellulose for various value-added applications. In this study, the straw of Indian Pearl millet (PMS) (Pennisetum glaucum) was systematically studied and characterised for the first time. The feedstock was separated into peripheral leaves, sheath, and core, and their chemical composition was determined. Raw feedstock contains about 46% cellulose, with 52%, 40%, and 44% in the core, sheath, and leaves, respectively. The other components include ~ 24% hemi cellulose, ~17% lignin, and 11% ash. Morphologically, the straw comprises a honeycomb structure made from thin-walled vascular cells. A simple alkali treatment was used to extract pure cellulose from PMS. Extracted cellulose was processed to produce long fibres and short fluff fibres. The crystallinity of long fibers and fluff was 65% and 57%, respectively, and the moisture content for both was 8-9%. The tenacity of long fibres ranged from 180.4-292.86 MPa, and elongation was 2.6-3.8%. The fluff fibres were tested and evaluated as a possible absorbent for use in feminine hygiene products. They show absorption of 10g of water and 11.2g of blood per gram of its own weight.

Twenty commercial sanitary napkins (SN) were compared for physical properties as well as absorbancy of three test fluids. A simple burette-based method was developed to test the absorbancy of samples. SN samples were produced from PM fluff, commercial fluff and a 50:50 mixture of the two. These were tested for absorbancy of DI water, saline and artificial blood. Rewetting and strike-through tests for SN were also carried out. Commercial fluff performed better than PMSF, but the mixture showed much better performance than the commercial fluff on all tests.

The long fibres obtained from PMS were used as a bio sorbent for a cationic dye Methylene Blue (MB) and two anionic dyes Reactive Blue 171 (RB) and Acid Red 57 (AR). Kinetic and thermodynamic studies were conducted to determine the adsorption mechanism of these dyes on PMS fibres. The saturation adsorption of MB was 50 mg/g, while that for anionic dyes was 35 mg/g-38 mg/g. The adsorption process was endothermic in nature. Results indicate that a combination of physical and chemical sorption mechanisms are responsible for the adsorption of dyes on PMS. The study shows that PMS can serve as an indigenous and sustainable source of cellulose for selected industrial applications. By changing the processing sequence, the form and properties of cellulose can be tuned to meet the expected

performance requirements.