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BAMBOO AS A TEXTILE FIBRE

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Abstract: *In recent years a great zeal for natural textile fibres has increased throughout the world. Bamboo fibre being natural has recently attracted environment concerned researchers. The chemical composition of bamboo is similar to other bast materials. The Bamboo Culm is aligned with cellulose fibers along its length, carrying nutrients between the leaves and roots. Its chemical constituents are primary cellulose, hemicellulose and lignin, accounting to more than 85% of the total mass. The lignin content in bamboo is much higher than that in bast fibres. In general, an increase in lignin leads to a reduction in cellulose content. Since cellulose is a primary component of bamboo textiles, younger culms may be better suited to textile applications as lignification continues beyond the first growth season. Bamboo textiles are usually source from bamboo aged from three to five years. Textile fibre extraction generally consumes massive amounts of energy, water and chemicals, producing lethal wastewater, which contains miscellaneous range of contaminants, and results in serious environmental problems. Therefore, it is necessary to develop sustainable technologies for textile fibre extraction leading to minimization of the adverse effect of discharge on the environment. This review addresses the potential application of different technologies of bamboo fibre extraction and delignification methods to enhance its acceptability as textile fibre.*
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Keywords: Bamboo fibres; Fibre extraction; Lignin content

1. Introduction

Ecological or environmental [1] problems have become global in character and there is an urgent need worldwide to tackle these problems. Environmental protection and production of quality textiles of international standards are two serious challenges before textile processors. Along with the ecofriendly approach of choosing natural dyes, the consideration to other natural materials has also been enhanced. In textiles, market of bamboo clothing [2&3] has suddenly raised due to the facts that it is ecofriendly, 100% biodegradable and can be completely decomposed in soil by micro organisms. Some studies convey that bamboo, jute, ramie etc. fibres/fabrics can be manufactured or produced with use of ecofriendly chemical or additive. The present study is therefore aimed at pretreating the bamboo fibre/fabric in environmentally friendly ways and investigating the effect of pretreatments on the properties and dyeing behaviour of the fibre particularly with natural dyes like turmeric, tea [4].

2. Experimental

2.1 Materials

Raw culm of *Bambosa vulgasis* was harvested from Botanical Garden of Guru Nanak Dev University, Amritsar. All the chemicals used in this investigation were of AR grade and were purchased from Merck Ltd., Hi-media Labs, Bombay (India).

2.2 Methods

The retted fibre bundles were treated with different concentrations of sodium hydroxide. After removal from the sodium hydroxide solution, the fibres were washed, neutralized and semidrying for 1 hour; the fibres were further subjected to bleaching processes for maximum separation of the fibres.

2.3 Optimization of NaOH concentration

The retted bamboo fibres were soaked into NaOH solution with different concentration (0.05 N, 0.1 N, 0.2 N & 0.3 N) with a fibre to liquor 1:40 at 35 ^{o}C for 72 hour followed by washing at 40 ^{o}C for 15 minutes, neutralization and drying.

2.4 Bleaching with Peracetic Acid (PAA)

The in-house prepared peracetic acid was used to bleach the pretreated bamboo fibres using 10 g/L of stock solution at 70 ^oC for 90 minute using pH 7 in the presence of 5//L sodium meta silicate as stabilizer. After bleaching samples were thoroughly washed and dried.

2.5 Bleaching with hydrogen peroxide (H_2O_2)

The pretreated bamboo fibres were bleached using 10 g/L of hydrogen peroxide solution (30%/) at 90 ^oC for 60 minute using 2 g/L Ultavon EL and 3 g/L caustic soda in the presence of 1g/L Clarite G as stabilizer. After that the bleaching samples were thoroughly washed and dried.

3. Graphic Material

3.1 Effect of NaOH concentration on lignin content of CAN retted, sequential sodium hydroxide & peracetic treated and sequential sodium hydroxide & hydrogen peroxide treated bamboo fiber

Figure 3.1 show the changes in lignin content with the increase in concentrations of sodium hydroxide (with & without subsequent bleaching process). The maximum loss in lignin was caused by NaOH→H_2O_2 process with no acceptable weight loss in pretreated fibres with higher concentration of sodium hydroxide i.e., 0.3 N. NaOH→PAA process produced reasonable reduction in lignin content and weight loss.

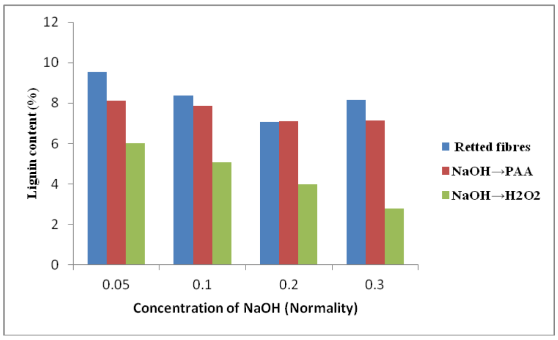
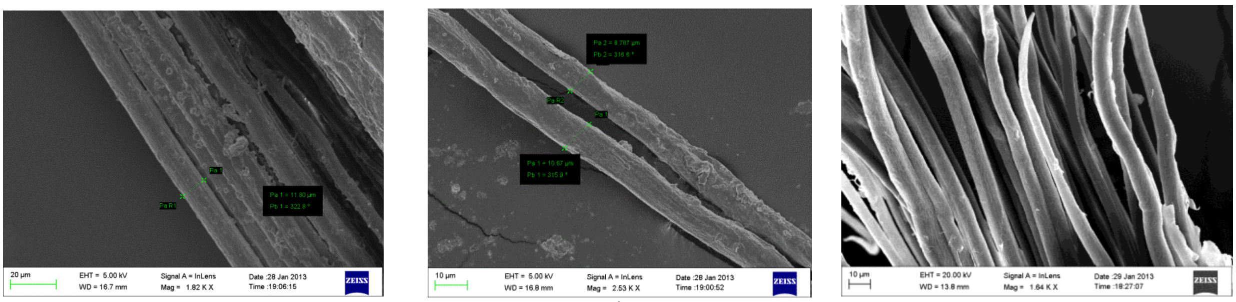


Figure 3.1: Effect of NaOH concentration on lignin content of retted, NaOH→ PAA treated & NaOH→H_2O_2 treated bamboo fiber

3.2 Surface morphology of bamboo fibres

Surface pictures of treated bamboo fibre with different concentrations of sodium hydroxide and further differently (individually) treated with PAA & H_2O_2 bleaching agents are shown in Figure 3.2 (b & c). A huge amount of gum in the alkali treated bamboo fibres can be seen in Figures 3.2 (a). After treatment with PAA & H_2O_2, the bamboo fibres were fiberized, but it can be seen that the bamboo fibre were joined with large amount of gum on surface in case of PAA bleaching (Figures 3.2 (b)). With the bleaching with H_2O_2, the bamboo fibres were receiving smoother and finer surfaces (Figures 3.2 (c)). These pictures show that the fibres treated with PAA & H_2O_2 have a more uniform geometry of fibrils arrangement than the fibres treated with different concentrations of alkali (without subsequent bleaching).



a. b. c.

Figure 3.2: a. 0.3 N NaOH, b. 0.3 N NaOH →PAA, and c.0.3 N NaOH →H_2O_2

This two-stage delignification of bamboo fibres with alkali and different bleaching agents could obtain fibres with good physical appearance & properties. Alkali pretreatment prior to bleaching could significantly reduce

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H_2O_2 & PAA loading in subsequent stage by partially removing the lignin and swelling the fibres. The maximum loss in lignin was found in case of NaOH→H_2O_2 process along with no acceptable weight loss. On the other hand, the pretreated fibres with higher concentration of sodium hydroxide i.e., 0.3 N followed by PAA bleaching step (NaOH→PAA) produced reasonable reduction in lignin content and weight loss with acceptable whiteness and tensile strength.

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