

Recycle and Reuse of Textile Waste Liquor from Scouring and Bleaching of Cotton

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Abstract

Environmental pollution is the global issue that results in adverse effects on living beings. It is one of the major concern areas for the whole world. During preparation of cotton woven fabric before dyeing mainly involves desizing, scouring and bleaching. Each process drains a plethora of chemicals along with water, in the effluent stream. The released chemicals by the global textile industry are continuously doing unimaginable harm to the environment. The focus of this research is to investigate the opportunities to prevent the pollution by recycling and reusing, the water and chemicals without addition of any treatment. this research is to investigate pollution prevention opportunities on recycling and reusing water and chemicals in the textile pre- treatment process without addition of any treatment and also protect the environment.

Index terms— scouring, recycled, pretreatment

1 I. Introduction

Industrialization has brought ease, comfort, luxury, and prosperity to our modern life. Wet processing industry uses vast amounts of water, energy, and chemicals. At the same time, it has also created problems for us. Two issues of concern today are environmental pollution by the industrial waste generated during manufacturing activities, and the other is the endangerment of the health and safety of the user of the industrial products. There are two approaches, to combat the menace of environmental pollution by liquid waste from the dye house/print works. One is the operation of Effluent Treatment Plant to control the pollution and the other is to prevent the pollution. The U.S. Environmental Protection Agency defines pollution prevention (also referred to as source reduction) as the use of materials, processes, or practices that reduce or eliminates the generation of pollutants or wastes at the source. Pollution prevention minimizes water pollution, land, and air. It is a source reduction and other practices that reduce or eliminate the creation of pollutants through increased efficiency in the use of raw material, energy, water or other natural sources or protecting resources through conservation. Reducing the volume of effluent released through the prevention of pollution can be accomplished by conservation and more efficient use of resources. Pollution prevention is accomplished through many ways such as:

? Good housekeeping and maintenance.

? Substitution of chemicals.

? Process modification and technology through the selection of clean/green technology.

? Recycle, Reuse and Recovery.

? Modification of machinery, equipment optimization of processes, dyes, chemicals, and water [8]. Moreover, Pollution prevention is more than just another way of reducing pollution. Pollution prevention is a philosophy. Such a philosophy does not accept "that is how we always did it" as a rationale for maintaining a policy or practice [3].

Pollution prevention may result in several benefits for the textile processor, these includes: Textile pre-treatment involves desizing, scouring and bleaching process. Desizing is a process of removal of starch from

the woven fabric. Scouring removes the natural (oil, wax, gum, fat etc) impurities. Bleaching destructs the natural color from the textile material. Each process drains a plethora of chemicals along with water, in the effluent stream. Pollutants released by the global textile industry are continuously doing unimaginable harm to the environment. It pollutes land and makes them useless and barren in the long run [2,3]. Table ??1 -Water usage and pollution loads in cotton pretreatment processes [7] Pre The main work of this research is to recycle and reuse the water and chemicals of the textile pretreatment process. Recycle means utilization of previously used process liquor one or more times/ purpose whereas reuse can be defined as the utilization of used process liquor for another purpose.

2 II.

3 Literature Review a) Cotton

Cotton is nature's most abundant polymer. It is an organic cellulosic compound which is a kind of polysaccharide. Cotton is the backbone of the world's textile trade. In the world cotton fiber has many qualities and countless end uses. Cotton mill consumption estimated around 24.3 million tones which are 45% of total world fiber production in 2015 [1]. It is a soft fiber of genus *Gossypium*. The cotton plant belongs to the natural order of the MALVACEAE. The cellulose polymers in cotton fiber have high degree of polymerization. The DP (Degree of polymerization) of cellulose molecule is high. It ranges as 10000 [1,2].

4 b) Fibre Morphology

Cotton is the important fiber in today's textile industry. The major use of cotton is to make the garments for over 5000 years before, so knowledge of the structural features of these cellulose substrates is essential for analyzing the effects of physical and chemical properties. Cotton fibers have a fibrillar structure. Their morphology, illustrated schematically in below figure, exhibits four main features: cuticle, primary wall, secondary wall, and lumen.

Cotton consists of cellulosic and non-cellulosic material; the primary wall has a network of cellulose fibrils covered with the outer most layer cuticle, covered waxes, and proteins. It serves as a smooth, water-resistant coating, which protects the fiber. The outer cell wall is relatively hydrophobic.

The wax renders the fiber impermeable to water and aqueous solutions unless a wetting agent is present. Cuticle layer surrounded by a primary wall, built of cellulose, pectin, waxes and protein material. The inner part of the cotton fiber comprises of the secondary part, subdivided into several layers of parallel cellulose fibrils and the lumen. The secondary wall consists of several layers and the spiral angle of the fibrils varies from one layer to the next, from about 20° to 35°. The lumen, the cavity that may remain after the protoplasm in the cell interior has proteins, coloring matter and minerals deposited on its walls. The smallest unit of the fibrils consists of densely packed bundles of cellulose chains [6,9].

The hydroxyl groups OH protruding from the sides of the molecule chain link neighboring chains together by the hydrogen bond and form ribbon-like micro-fibrils which arrange into larger building blocks of the fiber [2].

It is very laborious to give a precise value for the degree of polymerization (n) of cotton. The DP of cellulose varies with its origin and is expressed as an average value, since a distribution is found in most samples. The degree of polymerization of cellulose molecule may be as high as 10000 [4]. Iodine drop test (Tegewa test) employed to check the desizing efficiency. The principle of this test is the violet coloration of starch with iodine. Hence, the presence of starch remaining on fabric is deciphered. The desized fabric immersed in a beaker consists of a solution of potassium iodide and iodine for 1 min. After one minute the sample is rinsed thoroughly under water, dabbed with filter paper and compared with the Tegewa scale or violet scale, having rating 1 to 9. The scale denotes 1 is no removal of size material and rating of 9 indicates complete removal of size material from the fabric. The acceptable rating is 6-7.

5 III. Methodology

6 b) Drop Test

The absorbency test followed by using AATCC Test Method 79-2000, where a drop of water is acquiesced to fall from a settled height onto the firm surface of a sample specimen. The time required for the reflection of the water drop to disappear, measured and recorded as wetting time. It took five seconds or less to represent the adequate absorbency.

7 c) Column Height

For column height, 18X5 cm 2 sample was prepared. This sample hung from support by immersing the 1 cm portion of the fabric.

The sample was dried and observed the wicking height performance. The wicking length is 30-50 mm and the above range indicates excellent scouring. 30 mm denotes acceptable and 40-45 mm is good to very good scouring.

8 d) Presence of Alkali in the Scouring Bath

In this test, the accurately measured volume of the sample titrated against a standard sulphuric acid solution with a phenolphthalein indicator. The alkalinity measured is regarding of CaCO_3 (mg/l) Where, Alkalinity, mg $\text{CaCO}_3 / \text{l} = (\text{A})(\text{N})(50,000)/\text{ml sample}$: A:

Milliliter of the standard acid used, N:

Normality of the standard acid. In case of bleaching also similar trend was observed in respect of weight loss.

9 VI.

10 Conclusion

The proposed sustainable pre-treatment process was highly efficient in conserving water, energy and process chemicals. When the scouring and bleaching baths recycled, excess utilization of alkali and hydrogen peroxide in both process seen. The fabric properties after recycling was found good up to 2 times. Samples treated in the mixed bath, also showed good scouring and bleaching effect among them, the bath ratio was S:B 30:70 provided a better result. By understanding the potential of the waste stream, it can generate a new way to reduce discharged wastage water and chemicals. This work will reduce the effluent and minimize the load on the effluent treatment plant.

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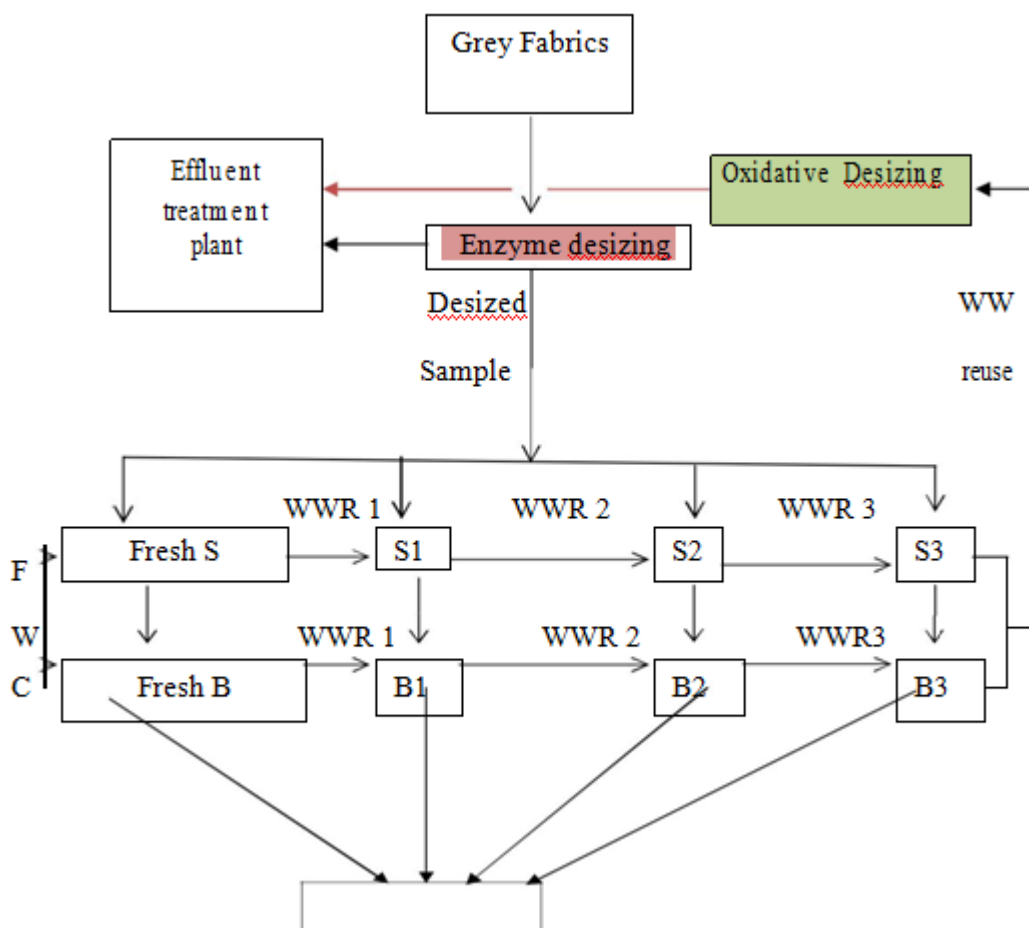


Figure 1: Fig. 3 . 1 :

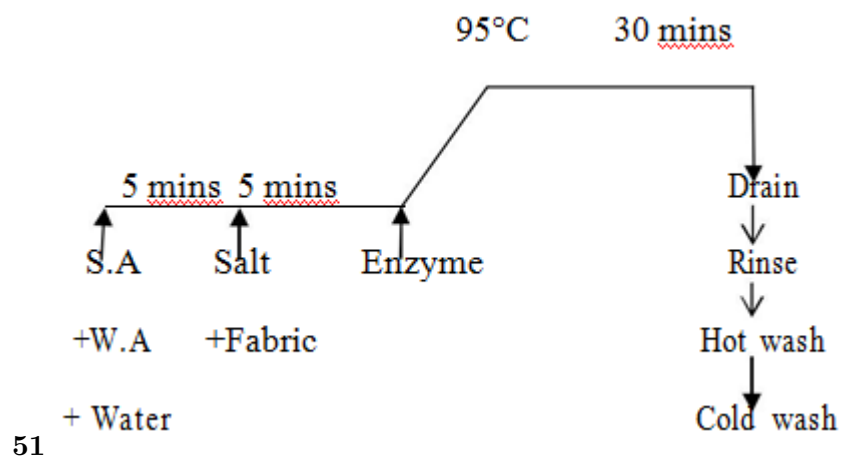


Figure 2: Fig. 5 . 1 :

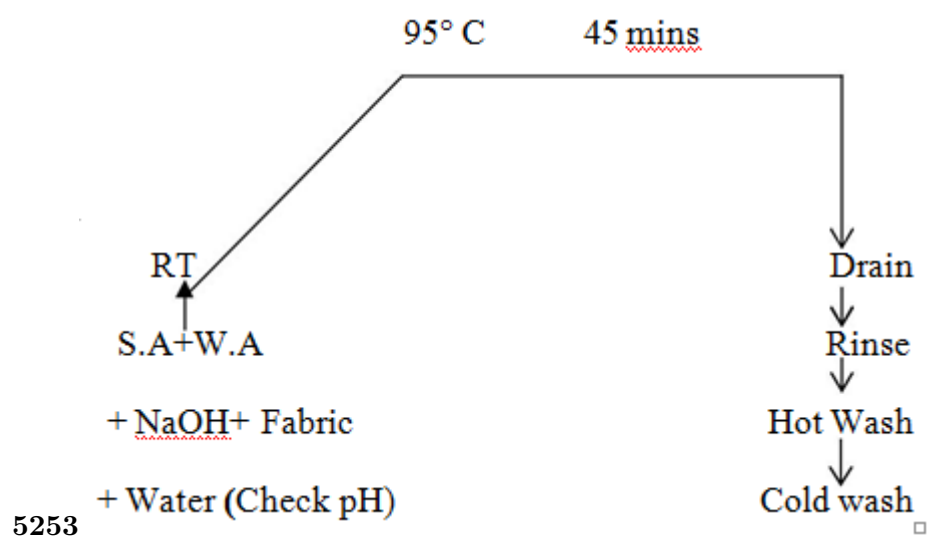


Figure 3: Fig. 5 . 2 :Fig. 5 . 3 :

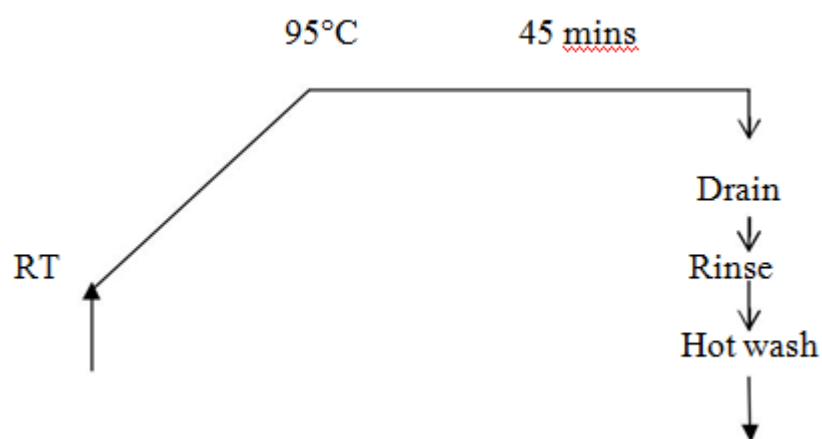


Figure 4:

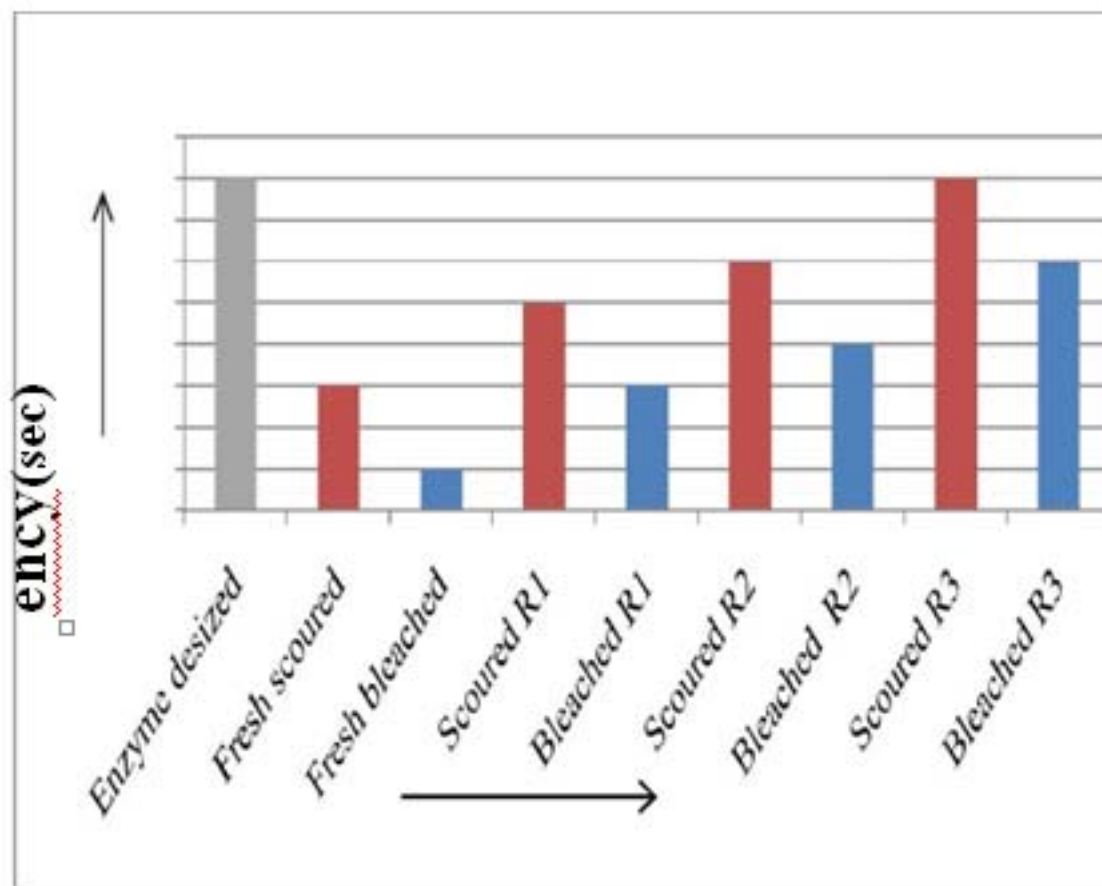


Figure 5:

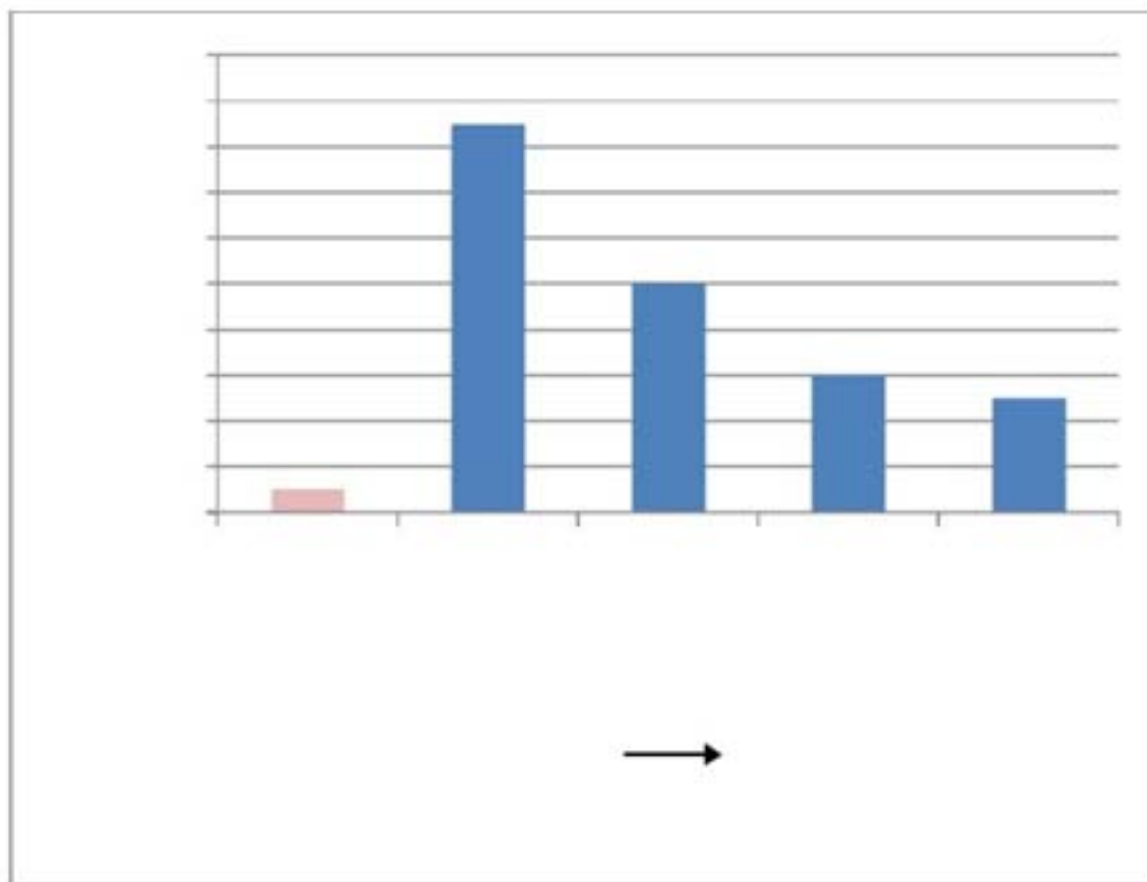


Figure 6:

[Yelin and Villiers ()] , R E Yelin , Villiers . *Textile Chem. Color* 1972. 4 p. 50.

[Marmer et al. ()] , W N Marmer , J M Cardamone , B G Ping , F Casado . *Text. Chem. Colorist* 1993.

[International Journal of Engineering Research and Development (2013)] , ISSN: 2278-800X. *International Journal of Engineering Research and Development* 2278-067X. January 2013. 5 (8) p. .

[Broadbent and So ()] *Basic Principles of Textile Coloration: Society of Dyers and Colourists*, A D Broadbent , Dyers So , Colourists . 2001.

[Mock ()] 'Bleaching'. G N Mock . *Encyclopedia of Polymer Science and Engg* 1985. John Wiley. 2 p. .

[Mock ()] 'Bleaching'. G N Mock . *Encyclopedia of Polymer Science and Engg* 1985. ATIRA. 2 p. .

[Shore (ed.) ()] *Cellulosics Dyeing*, J Shore (ed.) (Bradford, UK) 1995. SDC.

[Karmakar ()] *Chemical Technology in the Pre-Treatment Processes of Textiles*, S R Karmakar . 1999. Elsevier Science.

[Shaid et al. ()] 'Direct reusing of textile wastewater in scouringbleaching of cotton goods devoid of any treatment'. A Shaid , S Osman , A Hannan , M A R & bhuiyan . *International Journal of Engineering Research and Development* 2011. 5 p. .

[Renfrew and Hunter ()] *Dyers So, Colourists. Reactive Dyes for Textile Fibres: The Chemistry of Activated [pi]-bonds as Reactive Groups and Miscellaneous Topics: Society of Dyers and Colourists*, Ahm Renfrew , A Hunter . 1999.

[Chakraborty and Chakraborty ()] *Fundamentals and Practices in Colouration of Textiles*, J N Chakraborty , J N Chakraborty . 2014. WPI India. (Second Edition)

[Eichhorn ()] *Handbook of Textile Fibre Structure: Natural, regenerated, inorganic and specialist fibres*, S Eichhorn . 2009. 2.

[Cook ()] *Handbook of Textile Fibres: Natural Fibres*, J G Cook . 1968. Merrow Publishing Company.

[Jhala et al. ()] P B Jhala , M M Vyas , K Subrahmanyam . *Water and Effluents in Textile*, 1981.

[Morton et al. ()] *Physical Properties of Textile Fibres*, W E Morton , Jws Hearle , T Institute . 2008. Woodhead Publishing.

[Rahman Bhuiyan et al. ()] 'Scope of reusing and recycling the textile wastewater after treatment with gamma radiation'. M A Rahman Bhuiyan , M Mizanur Rahman , A Shaid , M M Bashar , M A Khan . *Journal of Cleaner Production* 2016. 112 (4) p. .

[Needles ()] *Textile Fibers, Dyes, Finishes, and Processes: A Concise Guide*, H L Needles . 1986. Noyes Publications.

[Choudhury ()] *Textile Preparation and Dyeing: Science Publishers*, Akr Choudhury . 2006.

[Bergenthal ()] *Wastewater Recycle and Reuse Potential for Indirect Discharge Textile Finishing Mills*, J F Bergenthal . 1984. US Environmental Protection Agency, Industrial Environmental Research Laboratory

[Park and Shore ()] 'Water for the dyehouse: supply, consumption, recovery and disposal'. J Park , J Shore . *Dyers Col* 1984. (J. Soc.)