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Conservation of Water Resource in Textile and Apparel Industries

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Abstract: *Environmental aspects have been drawing extra space in all scholarly attempts of sustainable development as it's the only way forward to ensure sustainability in supply chain strategy at present global context. Conservation of natural resources, mainly water savings captured the prime attention of ecological concern for manufacturing entities; especially for industries like Textile and Readymade garment industry where plenty of water is used on daily basis. Textile processing is one of the largest and oldest industries worldwide and responsible for substantial resource consumption and pollution. This paper presents an approach towards environmental sustainability through adopting measures to conserve the water resource in the clothing industry.*

Key Words: *Conservation, Water resource, Sustainability, Textile and Apparel sector.*

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I. Introduction

Eco-friendly product manufacturing has received much fuel from industry stakeholders to gain competitive advantage through earning reputation at present business environment. Formulation of strategies is now on discussion table to go green by dealing with the top issues like environmental safety, scarcity of natural resources and energy. Being one of the industries with largest supply chain, textile operations require huge amount of water resource consumption and generate pollution that causes a significant ecological impact [1].

Efficient use of limited natural resources can hardly be overlooked by any industry which is trying to achieve a sustainable supply chain. Among all natural resources, water is the most vital and endangered resource at present. Except exceptions, any kind of manufacturing industries need water during manufacturing process. Textile sector is leading not only in terms of volume of water consumed but also in terms of volume of wastewater. It was known for many years that fresh water is not required for textile processes but consideration of product quality has drastically changed that perception. The textile and apparel industry consumes large amount of water in its varied processing operations. In the mechanical processes of spinning, knitting and weaving, water consumed is very small as compared to textile wet processing, where water is used extensively and millions of gallons of wastewater generated daily.

The terms water conservation and water saving are generally associated with the management of water resources under scarcity. However, these terms are often used with different meanings within specific scientific and technical disciplines or in the water user sector considered. Often, both terms are used synonymously [2]. Data presented in this paper is from the industries of Bangladesh and this paper reveals the importance of saving scarce water resource and shows some conservation measures for the sustainable development in the textile and RMG sector.

II. Discussion and Analysis

Global freshwater resources are getting scarcer due to an increase in water demand and deterioration of water quality. It's predicted that by 2030, we need around 50% more food and energy, and 30% more clean water. Fresh water has always been a scarce resource for our planet as 97.5% of all water is salt water; even 75% of that 2.5% fresh water is tied up in glaciers making only 0.625% of planet water available for use. Pollution from different sources in various forms is making water scarcity worsening day by day [3].

The quantity of water required for textile processing is huge and it varies from mill to mill depending on type of fabric, type of process, type of equipment and dyestuff, length of process. According to USEPA, a unit producing 20,000 Ib / day of fabric consume 36000 liters of water. Fibre like cotton production also requires large volume of water. Global water footprint related to the consumption of cotton products is estimated

at 256 Gm^3 / year, which is $43m^3$/year per capita in average; for Bangladesh, 764 Mm^3/year. Only cotton consumption is responsible for 2.6% of the global water use [4-8].
A typical relationship of cotton products with environment: [8]

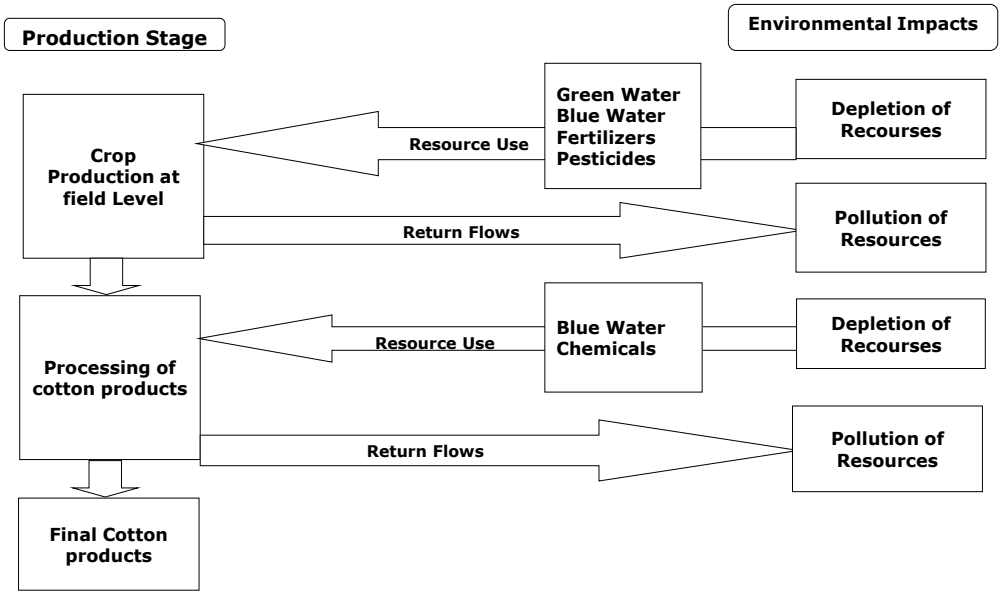

Fig: Impact of cotton production on the natural resources

The consumption of water in different stages in a typical cotton or synthetic mill is as follows [9]

Table 1: Usage of water in Textile industries

Table 2: Water consumed during wet processing

Purpose	Percent water use	
	Cotton textile	Synthetic textile
Steam Generation	5.3	8.2
Cooling water	6.4	--
Dematerialized water for specific purpose	7.8	30.6
Process water	72.3	28.3
Sanitary use	7.6	4.9
Miscellaneous and fire fighting	0.6	28.0

Table 2: Water Consumed during wet processing

Process	Percent water consumed
Bleaching	38
Dyeing	16
Printing	8
Boiler	14
Other uses	24

Table 3: Requirements of water for cotton products wet processing operations

Process	Requirements in liters/ 1000kg of product
Sizing	500-8200
Desizing	2500-21000
Scouring	20000-45000
Bleaching	2500-25000
Mercerizing	17000-32000
Dyeing	10000-30000
Printing	8000-16000

Table 4: Requirements of water for synthetic products wet processing operations

Process	Requirements in litres / 1000kg of product				
	Rayon	Acetate	Nylon	Acrylic / Modacrylic	Polyester
Scouring	17000-34000	25000-84000	50000-67000	50000-67000	25000-42000
Salt bath	4000-12000	--	--	--	--
Bleaching	--	33000-50000	--	--	--
Dyeing	17000-34000	34000-50000	17000-34000	17000-34000	17000-34000
Special Finishing	4000-12000	24000-40000	32000-48000	40000-56000	8000-12000

Wastewater management has already been incorporated in operational strategy in many top RMG industries worldwide and it's high time for others to realize it as a core strategy of environmental CSR and sustainability as well. It has captured its own demand to be evaluated as a core element of efficiency, gaining comparative and competitive advantage through reduced consumption, resulting in reduced cost and branding of not only being eco-friendly but also for being sustainable.

Table 5: Water Saving Best Practices [10]

Practice	Resource saved (%)	Financial savings per ton of fabric produced (BDT / ton)	Water savings per ton of fabric produced (ton water / ton fabric)
Eliminate water leaks and reduce hose pipe use	0.3% to 0.7%	7 to 31	1.0 to 1.5
Reuse cooling water from dyeing machines	8% to 15%	392 to 714	19.8 to 35.3
Reuse process water from rinsing operation	9% to 12%	91 to 426	21.6 to 23.5

III. Recommendations

To develop a water conservation program, first step for a industry is to conduct a site survey in order to determine where and how water is being used, then adopting 7Re's-

The 7 Re's	Content of the element	Environmental management Tool
Reduce	Optimization: Possibilities for savings in water, energy and chemicals within existing equipment.	Process intensification
Rebuild and renew	Modernization: Possibilities for improvements by rebuilding or renewing old equipment.	Process intensification
Replace	Chemical substitution: Substitution of hazardous chemicals by less hazardous chemicals.	Chemical substitution
Reuse	Direct water reuse: Collection and reuse of water and waterborne energy and chemicals	Process integration
Reclaim and reuse	Water reclamation and reuse: Collection and upgrading of water prior to reuse of water and waterborne energy and chemicals	Process Integration
Recover	Energy recovery: Recovery energy in water streams by heat exchange	Process Integration
Remove	Water treatment and discharge: Collection and treatment of water prior to discharge	Effluent treatment

Water conservation measures results in- reduction of processing cost; reduction in wastewater treatment cost; reduction in thermal energy consumption; reduction in electrical energy consumption and reduction in pollutants load. Water conservation and reuse program is likely to generate tremendous benefit through decreased cost of purchased water and reduced cost for treating wastewater, eventually making fund available for further expansion of the mill or up gradation of process and equipments to facilitate better quality. Water consumption in a textile factory can be reduced by implementing various changes ranging from simple procedures such as fixing leaks, to more complex options such as optimizing water use and reducing the number of process steps. Some recommendations are as follows:

Good Housekeeping

A reduction in water use of 10 to 30 percent can be accomplished by taking strict housekeeping measures includes repairing leaks, faulty valves, spills; turning off water when machine is not running; making sure that taps and hoses are turned off when not required; sweeping floors instead of washing; identifying unnecessary washing of both fabrics and equipments.

Water reuse and recycle

Water reuse measures reduce hydraulic loadings to treatment systems by using the same water in more than one process. Reuse can be done with the process water and water from auxiliary processes like water of bleach bath, final rinse water from dyeing for dye bath make up, soaped wastewater, dye liquors, wash water etc; recycling should be conducted with cooling water.

Automation

Some automatic equipment can be installed to rectify faults and to reduce water consumption. Using automatic shut valves, flow control valves, installing water meters or level controllers on major water carrying lines, using comparatively water saver dyeing machines can add significant contribution.

Proper planning and research for process improvements: Advanced research should be undertaken to improve the efficiency level of water consumption and planning should be formulate on the basis of that. Using water efficient machine and equipments, reducing the number of process steps, optimizing process water use can surely add substantial positive contribution. Employee training to raise awareness on water and energy conservation is always fruitful.

IV. Conclusion

For millennia, civilizations developed in water scarce environments, however where scarcity was less stringent than that we know today. Water, being one of the most common raw material for manufacturing entities and the main cost centre for textile wet processing, proper concentration on its conservation is unavoidable. Water savings, reclamation and reuse in industry are topics of increasing economic interest due to increasing water scarcity and costs. Increased competition for clean water due to declining water tablets, reduced sources of clean waters and increased demands from both industrial and residential growth are primary concern as they directly influencing higher cost and scarcer natural resource. This paper presented experience based results of water savings and reuse in industry exemplified by the textile industry based on available literatures. Further studies will be interesting to explore technical solutions for each unit in the long supply chain of textile manufacturing.

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