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A Review on Cleaner Production in Textiles

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Abstract Textile industries are contributing in global cloth production in different countries of the Universe, such as China, India, Pakistan, Turkey, Egypt and Bangladesh. Textile industries could be benefited by implementing cleaner production (CP) Techniques. Micro and small enterprises (MSEs) can profit from CP through more efficient use of raw materials, machinery, higher quality and reduced waste treatment costs. Water is the principal medium for removing impurities, dyeing and finishing. So CP techniques are mandatory in wet processing units of textiles. In Bangladesh and neighboring countries many industries were benefitted by implementing CP techniques.

Keywords Cleaner production, Textile, Benefit

1. Introduction

Textile industries are contributing in global cloth production in different countries of the Universe, such as China, India, Pakistan, Turkey, Egypt and Bangladesh. Textile industries of above countries have been using most traditional techniques in processes. As a result, these industries decrease efficiency and increase risk to environment. But these industries could be benefited by implementing cleaner production (CP) Techniques in Textile sector. In 1990, UNEP defined cleaner production (CP) as "The continuous application of integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to human and environment" [1].

The CP concept is widely accepted and promoted globally currently. The policy used for implementation of CP can be simple. It complies Environmental Management Systems (e.g. ISO 14001 standard) utilized by medium and large enterprises.

The cleaner production (CP) could be defined as a preventive business strategy designed to conserve resources, mitigate risks to the environment, and promote greater overall efficiency through improved production techniques. Following factors are included in cleaner production method [2]

(a) substituting different materials,
(b) modifying processes,
(c) upgrading equipment,
(d) redesigning products &
(e) health and environmental safety benefits include chemical substitution, water saving and waste minimization.

Many cleaner production techniques provide opportunities to substantially reduce operating costs with improvement of the quality of products. Micro and small enterprises (MSEs) can profit from CP through more efficient use of inputs, machinery, and achievement of reduced waste disposal costs. On the other hand, modified and improved safety measures such as advance fire safety, can help industries to avoid dangerous accidents [2]. Micro and small industries can frequently get positive financial and environmental benefits indicating that cleaner production should be the first option considered in addressing environmental problems. Textile industries can be benefited by implementing CP widely. For example a polyester, cotton and lycra based women's wear textile industry implemented CP measures to decrease water consumption to 54% in the following processes [3]:

(i) adjustment of water consumption in fabric washing after dyeing units according to adequate amounts,
(ii) renovation of valves in the cooling line of dyeing machinery,
(iii) elimination of overflow washing practices,
(iv) reuse of tumbler dryer cooling water in the system,
(v) adjustment of water consumption in tumbler dryer cooling water in the system,
(vi) reuse of nap trimming cooling water in the system &
(vii) renovation of water softening device.

Now a days, the CP is updating with concept of resource efficiency noted as RECP. RECP includes chemical, thermal and electrical, load management, ETP management, fuel management, water saving and health and safety. Bangladesh is the readymade garment exporting country occupying the 2nd largest position in the World. A good number of international buyers are frequently doing business with garment industries in Bangladesh. As a result Bangladesh earned 28.1 billion US $ by exporting Ready

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Made Garment products in fiscal year 2016-17. Textile industries of Bangladesh are major consumers of energy resources of the country. Main energy resource of Bangladesh is natural gas. But the storage of natural gas is going out within the next decades. So the authorities of Textile industries must optimize energy resources. This concludes that Bangladesh Textile industries can earn benefits by implementing CP techniques in short and long terms. The objective of this paper is to introduce necessary information and latest updates regarding CP techniques in textiles. This paper includes a review on CP production techniques in textiles based on literature survey on Bangladesh and global perspectives.

2. Discussion

Sustainable cleaner production in wet processing units of textiles is very important because huge water and chemicals are consumed in these units. Water is the principal medium for removing impurities after dyeing and finishing [4]. So CP techniques are mandatory in wet processing units of textiles. CP could be applied to wet processing units of textiles by updating and improving current operation methods, changing in product design and reformulation. Improvement of current operation methods can be divided into six types [4]. Those are,

(i) material or other feedstock substitution,
(ii) equipment or process modifications,
(iii) good operating practices and training,
(iv) inventory management and purchasing,
(v) spill and leak prevention &
(vi) on-site reuse, recycling or recovery.

Desizing is important in pretreatment of cotton fabric wet processing which is done before dyeing and printing. Sizing materials coated on fabric are removed by desizing. Cleaner production technologies are applied for desizing of cotton fabric. Enzymatic desizing is eco-friendly. Winch technology is applicable for the highest quality of desizing [5].

By applying CP techniques benefits obtained in both of financial and environmental sides. For example, in a textile process house located at Narol, Ahmedabad, Gujarat, India, the unit was able to benefit annually by about INR 85,67,712 with an investment of INR 20,57,500 [6]. In another unit located at Vatva, Ahmedabad in the state of Gujarat of India they were able to benefit annually by about INR 9,28,290 (yearly saving), with an investment of INR 17, 10,000 (one time investment) [6].

In Bangladesh, Partnership Cleaner Textile (PaCT) supports textile wet processing factories in adopting cleaner production [7]. PaCT helps factories to identify and implement cleaner production measures in different segments like water, energy and chemical usage in the dye houses, factory utilities and effluent treatment plants (ETPs). These measures give several benefits such as low-cost, easy to implement, factory-specific, quick-return, and highly profitable.

In Lebanon, Cleaner Production techniques are significantly used [8]. As per the report, Cleaner Production is most commonly applied to production processes by bringing about the conservation of resources, the elimination of toxic raw materials, and the reduction of wastes and emissions. However it can also be applied throughout the life cycle of a product, from the initial design phase through to the consumption and disposal phase. Techniques for implementing Cleaner Production include improved housekeeping practices, process optimization, raw material substitution, new technology and new product design.

Cleaner production assessment studies were carried out according to the Integrated Pollution Prevention and Control and Industrial Emission Directive in a cotton/polyester fabric finishing–dyeing textile mill, located in Denizli, Turkey [9]. They evaluated environmental performance of the mill. The mill authority collected data of the material flow and the energy consumption in all processes to understand benefits of cleaner production studies. During these studies, they calculated mass-energy balances and specific input and output values based on the production processes. Inventory management is mandatory of any production oriented industry. So they prepared a chemical inventory list and collected all material safety data sheets to understand the chemical effect as well as safety status.

During this study statistical Multi-criteria Decision-Making methods were used in the decision-making process. Besides, technical and environmental performances, potential benefits and savings were determined with the implementation of identified 22 Best Available Techniques such as good management practices, water and energy consumption optimization-minimization techniques, chemical consumption optimization and substitution. After implementation of suggested 22 Best Available Techniques, following reductions could be achieved if those techniques were implemented in the future: 43–51% water consumption, 11–26% energy consumption, 16–39% chemical consumption, 42–52% wastewater flow rate, 26–48% chemical oxygen demand load, 12–32% waste flue gas emissions, and 8–18% solid waste generation. 1–26 months payback periods were estimated.

The above results indicate that cleaner production practice in a textile mill of Turkey introduced significant benefits in water consumption, energy consumption, chemical consumption, chemical consumption, wastewater flow rate, chemical oxygen demand load, waste flue gas emission and solid waste generation. Because of reduction of energy and chemical consumptions industry achieved financial benefits. On the other hand due to reduction of water consumption industry produced less effluent. Due to reduction in chemical oxygen demand industry could control water pollution which was beneficiary for aquatic lives.

In Austria, cleaner production was practiced in interlining fabric manufacturing industry [10].

Fresner [10] reported the course and the results of a waste and emissions minimization. It was conducted within the Austrian PREPARE-project, which was designed to produce case studies in Austria to demonstrate the potential of the cleaner production approach to solve existing environmental problems of companies. As per the report, the concept was proved by results. The authority proved that after implementation of cleaner production techniques water use could be reduced by 30%, the chemical oxygen demand of waste water by 30%, and 15% of the gas consumption of the dryers could be saved.

Dumitrescu et al. [11] reported about benefits of cleaner production techniques in Romania.

According to the report changes resulting from adopting environmentally sensitive criteria in Novatextile Pitesti, Romania have improved the operation of the production plant and reduced costs at the same time.

The Lithuanian textile industry accounts for some 30% of national industrial production [12]. It consists of over 50 major companies and employs over 35.000 workers. The industry thus provides important opportunities to improve the environmental impact of Lithuanian industry. After implementation of cleaner production practices in the textile industry by good housekeeping, the use of environmentally benign auxiliaries and environmentally improved processes the industry achieved benefits. It reduces discharges to water and will encourage water and energy savings by textile companies. In addition, success among the 8 pilot companies chosen for the project will create the conditions for the continuation and wider dissemination of clean production methods throughout the industry. Results will be elaborated into a textile industry specific audit method, with checklists and standards for CP practices set out for the industry. This is behaved as an important step in environmental protection in Lithuania. As per the report, a heavy environmental burden has been created on the country through its use of toxic dyestuffs and auxiliaries. Implementation of cleaner production methods environmental pollution was protected in the country.

In Tanzania, some achievements reported by cleaner production techniques [13]. Status of industrial heavy metals, pH, color, dissolved oxygen concentration, total dissolved solids concentration, chlorides concentration, total solid concentration, chemical oxygen demand, and biochemical oxygen demand established in textiles industries in Tanzania. Status of heavy metals and chemicals in textile industries established and shared among different stakeholders. Increased awareness of the hand textile manufacturers on improvement of batik production, natural chemicals, chemical handling and waste disposal.

In South Africa [14], 36 manufacturers and 18 related organizations participated in a range of synergistic activities in Textile sector. Authorities changed their organizations' attitude and produced improvements beyond their initial imaginations. For example, following waste minimization training with 16 manufacturers the companies showed savings of over R19-million in a year, from reductions in the usage of water, effluent, energy, chemical and waste.

A cleaner production approach was done in South African Textile industry by Danish Cooperation for Environment and Development [15]. The paper described the cleaner production approach taken by the textile pipeline in Denmark. The paper stated that summary of views of 17 participants about cleaner production wet processing options considered as relevant for the South African industry.

A different type of cleaner production study was done in composite textile industries in Kenya [16]. In this study, effect of manager supports and employees' skills on adoption of cleaner production in composite Kenyan textile industry was studied. The study concluded that Adoption of cleaner production technologies is enhanced manager support.

In Indonesia cleaner production brought positive impact in Boutique industry [17]. The aim of this research was to conduct cleaner production options for improving the environmental performance during the production of batik industry. The use of natural dyes instead of synthetic dyes reduced environmental pollution.

In another report, cleaner production methods implemented in Chinese printing industry [18].

The textile-printing industry in China makes an important contribution to the national economy. The pollution problems have caused gradual deterioration to the environment and adverse impacts on the local community. Authors stated that, cleaner production gave a powerful tool to measure the level of cleaner production of textile-printing enterprises. As an effective way to save water resource and reduce waste emission, the cleaner production technique integration is provided for the enterprises to solve environmental pollution problem and save water.

3. Conclusion

Conventional textile production causes serious harm to environment. It is not cost effective also. At present water and energy saving is a great concern in Textile industries. To get benefits regarding water and energy cleaner production (CP) is mandatory. Bangladesh and other countries can get benefits by implementation of CP techniques.

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