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Research Paper

Methods for waste water treatment in fabric industry

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ABSTRACT

The processes of textiles making or wet treatments and the finishing processes of textile materials are huge consumers of water with high quality. As a result of these different processes, significant amounts of polluted water are released. This study focuses on the problem of environmental protection against waste waters generated by textile industry. The methods of pre-treatment or purification of waste waters in the textile industry can be: Primary (screening, sedimentation, homogenization, neutralization, mechanical flocculation, chemical coagulation), Secondary (aerobic and anaerobic treatment, aerated lagoons, activated sludge process, trickling filtration, oxidation ditch and pond) and Tertiary (membrane technologies, adsorption, oxidation procedure, electrolytic precipitation and foam fractionation, electrochemical processes, ion exchange method, photo catalytic degradation, thermal evaporation). The assortment of the purification method depends on the composition and type of waste waters.

Key words: Textile industry, sedimentation, degradation, procedure.

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INTRODUCTION

The textile industry is one of the major and mainly complicated industrial manacles in manufacturing industry. The production of a textile requires numerous stages of mechanical processing, such as spinning, knitting, weaving, and garment production, which seem to be insulated from the wet treatment processes that include sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing operations. Thus there is a strong interrelation between dry processes and consecutive wet treatments. The textile industry emits a wide variety of from the entire stages in the processing of fibers, fabrics and garment production (Moustafa, 2015) (Table 1). These include wastewater, solid wastes, emissions to air and noise pollution.

The main environmental concern in the textile industry is the amount of water discharged and the chemical weight it carries. The textile industry is extremely water intensive. Water is used for cleaning the raw substance and for many flushing steps during the entire process of production. About 200 L of water are used to produce 1 kg of textile. Water is mainly used for: (a) the application of chemical onto textiles and (b) rinsing the manufactured textiles (Ntuli et al., 2016). The quantity of water consumed by different types of fabrics varies from industry to industry depending on the dyeing process and the type of fabrics produced. In detail, it has been found that 38% of water is used during process of bleaching, 16% in dyeing, 8% in printing, 14% in boiler and 24% for other uses. As a consequence of different processes, significant amounts of polluted water are released. The fact is that the water let out after the manufacture of textiles is fit beyond the standard and contains a large quantity of dyes and other chemicals which are destructive to the environment (Ntuli et al., 2016).
pollutants

PRECONDITIONS AND MEANS FOR RESOLVING THE PROBLEM

For some time, the toxicity of released wastewater was mostly determined by determining the biological effects of pollution, elevated bulks of foam, or intensively colored rivers near textile plants. At present, the recognition and

Table 1: Types of textile waste produced.

Process	**Wastewater**	**Solid wastes**	**Emission**
Fiber preparation	Little or none	Fiber waste and packaging waste	Little or none
Yarn spinning	Little or none	Packaging wastes, sized yarn, fiber waste, cleaning and processing waste	Little or none
Sizing	BOD, COD, metals, cleaning waste, size	Fiber lint, yarn waste, packaging waste, unused starch-based sizes	VOCs
Weaving	Little or none	Packaging waste, yarn and fabric scarps, used oil	Little or none
Knitting	Little or none	Packaging waste, yarn and fabric scarps	Little or none
Tufting	Little or none	Packaging waste, yarn and fabric scarps, off-spec fabric	Little or none
Desizing	BOD from sizes lubes, biocides, anti-static compounds	Packaging waste, fabric lint, yarn waste, cleaning and protection materials	VOCs from glycol esters
Scouring	Disinfectants, insecticide recisues, NaOH, detergents oils, knitting lubricants, spin finishes, spent solvents	Little or none	VOCs from glycol esters and scouring solvents
Bleaching	H_2O_2, stabilizers, high pH	Little or none	Little or none
Singeing	Little or none	Little or none	little amounts of exhaust gasses from the burners exhausted with components
Mercerizing	High pH, Sodium Hydroxide	Little or none	Little or none
Heat setting	Little or none	Little or none	Volatilization of spin finish agents-synthetic fiber production
Dyeing	Metals, salt, surfactants, organic processing, assistants, cationic materials, dye, BOD, COD, sulphide, acidity/alkalinity, exhausted solvents	Little or none	VOCs
Printing	Suspended solids, urea, solvents, color, metals, heat, BOD, spray	Little or none	Solvents, acetic acid – drying and curing oven emission combustion gasses
Finishing	COD, suspended solids, lethal materials, exhausted solvents	Fabric waste and trimmings, packaging waste	VOCs, contaminants in purchased chemicals, formaldehyde vapours, burning gasses

Table 2: Sources of water pollution at various stages of processing.

Process	Possible pollutants	Nature of effluent
Desizing	Starch, glucose, polyvinyl acetate, resins, fats and waxes do not exert a high BOD	Very small volume, high BOD (30-50% of total), polyvinyl acetate
Kiering	Caustic soda, waxes, sodium carbonate, sodium silicate and fragments of cloth	Very little, strongly alkaline, dark color, high BOD values (30% of total)
Bleaching	Hypochlorite, chlorine, sodium hydroxide, hydrogen peroxide, acids	Minute volume, strongly alkaline, low BOD (5% of total)
Mercerizing	Sodium hydroxide (Caustic soda)	Small volume, strongly alkaline, low BOD (Less than 1% of total)
Dyeing	Dye stuff, acerbic and reducing agents like sulphides, Soap and acetic acids	Large volume, strongly colored, quite high BOD (6% of total)
Printing	Dye, starch, gum oil, china clay, caustic, acids and metallic salts	Very little volume, oily appearances, quite high BOD
Finishing	Traces of starch, tallow, salts, particular finishes	Very minute volume, less alkaline, low BOD

classification of waste water are in accordance with accessible municipal regulations. Broad regulations define the mainly significant substances that are vitally controlled by consumers and suggest a set of activities that should be practical in order to minimize the amount of released hazardous substances. The characteristics of textile effluents differ and depend on the type of textile manufactured and the chemicals used. The textile wastewater effluent contains elevated amounts of agents causing damage to the environment and human health including suspended and dissolved solids, biological oxygen demand (BOD), chemical oxygen demand (COD), chemicals, contain trace metals, such as As, Cr, Zn and Cu and color (Table 2).

The activities to treat harmful wastes can range from permissible prohibition to cost saving recycling of chemicals. Depending on the type of manufactured goods and treatment, these steps can demonstrate intense variability. Effluents treatment plants are the most broadly accepted approaches towards achieving environmental security. Except, unluckily, no single treatment methodology is appropriate or commonly adoptable for some kind of effluent treatment. Therefore, the treatment of waste stream is completed using different methods, which comprise physical, chemical and biological treatment depending on the pollution load. Our plan is to adopt technologies giving smallest amount or zero environmental pollution. Throughout the last 50-75 years, there have been ever-increasing efforts to somehow assemble manufacturing processes in such a method that they cause smallest damage to the environment.

At the same time, these efforts are aimed at developing appropriate technologies for wastewater treatment and set up enough relationship between regulators and industry. To decrease the amount of generated waste waters, it is compulsory to apply a systematic approach to reducing the generation of waste at basis. Thus, this approach prevents the production of waste waters in the first place, somewhat than treating it once it has been produced using end-of-pipe treatment methods. Figure 1 shows a general action path recommended to minimize the present problems associated with the wastewater released from textile plant (Schonberger et al., 2013).

This is a method that should be applied to all inputs and outputs of a manufacture process. Once waste minimization has been carried out in the factory, waste matter will still be produced which will require some form of treatment prior

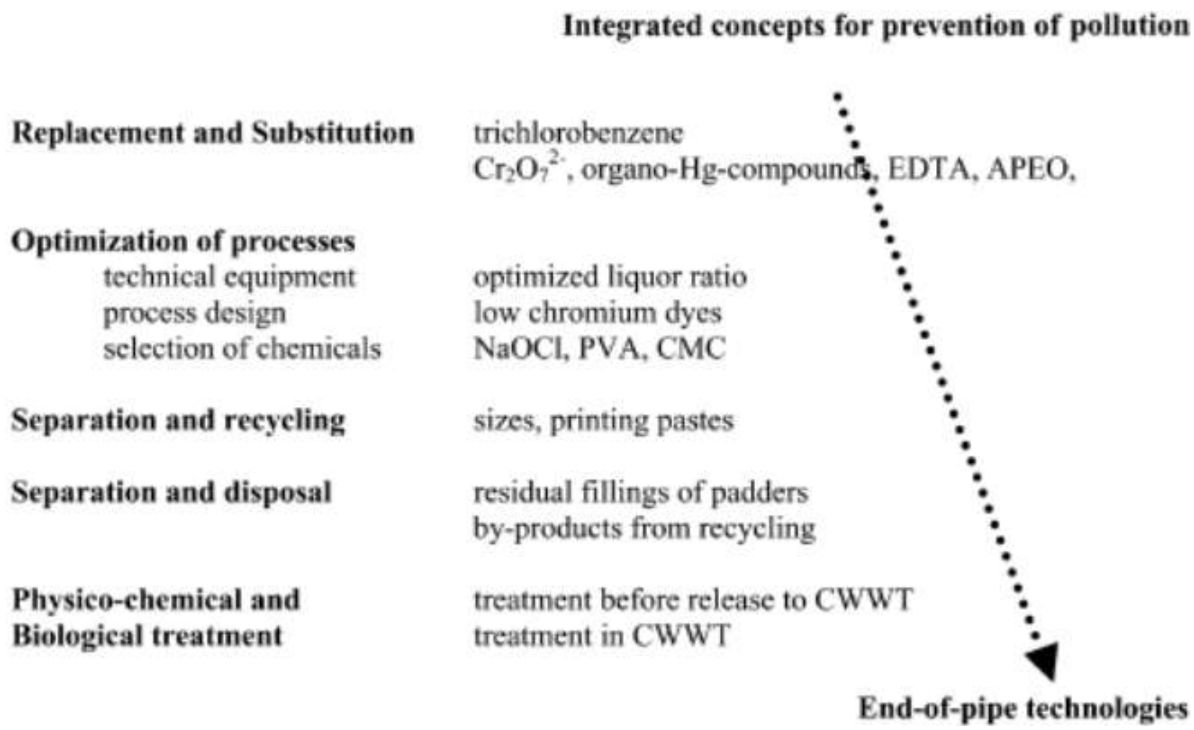

Figure 1: Action plan to minimize the present problems associated with the wastewater released from textile plant.

to disposal to sewage, sea river. Reducing the amounts of generated waste water is vital because it contributes to reducing operating costs, the risk of liability and the need to treat the effluents with end-of-pipe methods. It also helps to increase the effectiveness of production processes, environmental protection and health, increasing awareness and raising the morale of employees.

END-OF-PIPE TREATMENT METHODS

Several techniques and types of apparatus have been developed and tested in laboratory tests, on a pilot scale, or in complete technical application. The introduction of a technique is always coupled to a common wastewater treatment concept and has to consider the entity situation of a textile producer (Laxman, 2009). As a initial step, a separation of different types of wastewater into the following groups is recommended:

i. Concentrated liquids: fillings of padders (dyeing, finishing), printing pastes, used dye baths
ii. Medium polluted wastes (washing, rinsing baths)
iii. Low to zero polluted wastes (cooling water).

This result in a further effective treatment system as a minor volume of waste water is treated and it allows for the use of definite treatment methods rather than trying to find one method to treat a mixture of waste with diverse characteristics. The segregated clean streams can then be reused with little, or no, treatment elsewhere in the factory. There are two possible locations for treating the effluents, at the textile factory or at the sewage works. The advantage of treating wastewater in the textile factory is that it provides incomplete or full re-use of water. Produced waste water has to be cleaned from, fat, oil, color and other chemicals, which are used during the numerous production steps.

The treatment processes may be categorized into primary, secondary and tertiary treatment process (Figure 2). The main principle of secondary treatment is to provide BOD removal beyond what is attainable by simple sedimentation. It also removes substantial amounts of oil and phenol. In secondary treatment, the dissolved and colloidal organic compounds and color present in waste water is removed or reduced and stabilize the organic matter. Textile processing effluents are acquiescent for biological treatments. The textile waste also contains important quantities of non-biodegradable chemical polymers. Since the conventional treatment methods are insufficient, there is the need for well-organized tertiary treatment process. The generally used technologies are: coagulation and / or flocculation, membranes (microfiltration, nanofiltration and reverse osmosis), adsorbents (silica, clays, granular activated carbon, natural and synthetic bio adsorbents), oxidation (Fenton-reagent, photocatalyis, advanced oxidation processes, ozonation) and biological treatments (aerobic and anaerobic).

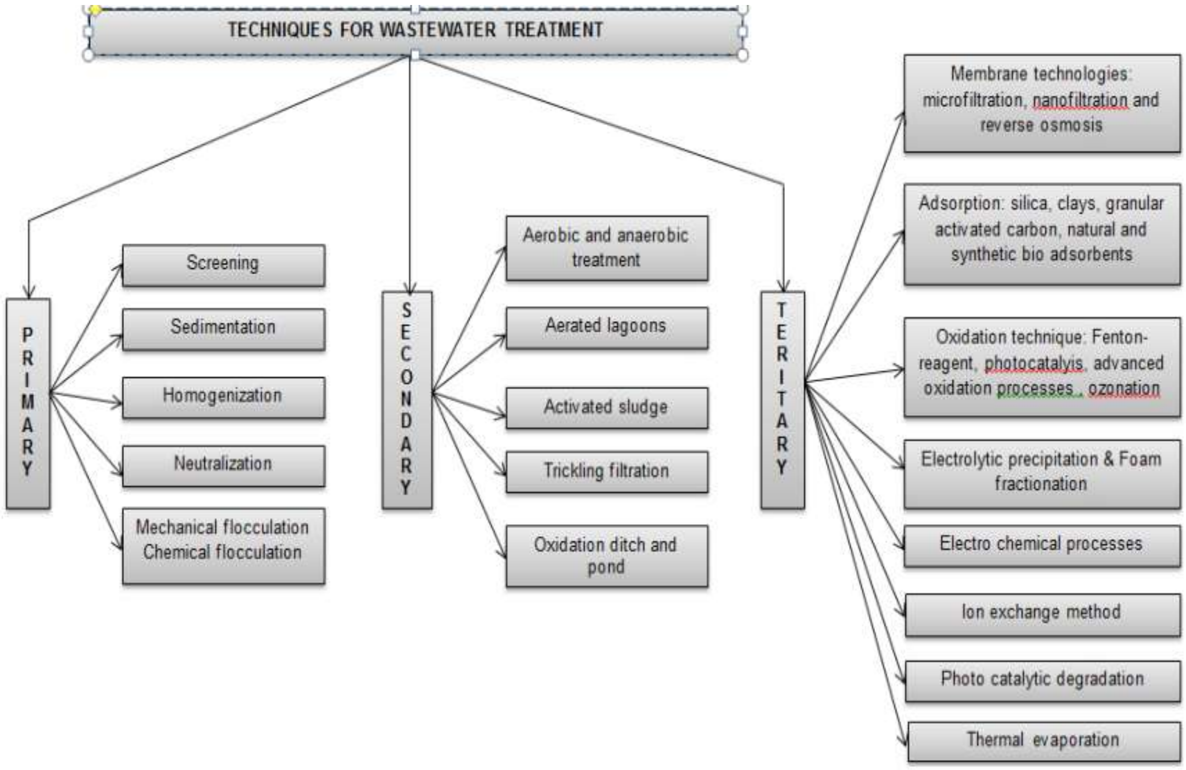

Figure 2: Various methods for the treatment of wastewater from textile plants.

Given the fact that the wastewater from the textile industry is complex and variable, it is unlikely that one treatment technology will be appropriate for the treatment of all wastewater and water recycling (Park and Shore, 2010). The application of a certain technology for wastewater treatment is dependent on the type of waste and also on the quantity of used water. In addition, not all plants uses the identical chemicals, particularly companies with a special standard try to maintain water cleaned in all steps of production. Water treatment with diverse types of pollutants is of large-scale because it involves lot of cleaning and removing steps. So the concepts, to treat the water can vary from each other. Usually, a combination of procedures and tools are applied and a large variety of concepts have been realized.

CONCLUSION

The value of water resources is universally recognized and the superiority of life depends on the capability to manage accessible water in the great attention of the people. The processes of production of textiles particularly wet treatments and finishing processes of textile resources (finishing, dyeing, printing, etc.) are enormous consumers of water with high value. As a consequence of these different processes, significant amounts of polluted water are released. Joints efforts are needed by water technologists and textile industry experts to reduce water utilization in the industry. While the user industries must attempt to optimize water consumption, water technologists should take on an integrated approach to treat and recycle water in the industry.

End-of-pipe technologies are used for wastewater treatment and comprise sequential application of a set of methods: coagulation / flocculation, flotation, adsorption, evaporation, oxidation, combustion, use of membranes, etc that have been adapted to the particular circumstances of a textile plant. As a consequence of the tremendous diversity of textile processes and products, it is impossible to develop a practical concept for an effective treatment of wastewater without a comprehensive analysis of the real condition in the textile plant. Description of textile process waste matter streams is especially significant to develop strategies for water treatment and use again. To optimize treatment and reprocess possibilities, textile industry waste streams ought to be in principle measured separately. When the characteristics of the separate streams are known, it can be determined which streams may be collective to improve treatability and increase reprocess options. It is significant to explore all aspects of reducing emissions and waste yield from the textile industry because it will result not only in enhanced environmental performance, but also in considerable savings on individual textile companies.

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