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Methods for waste water treatment in Fabric Industry

Ghulam Murtaza[1], Rehman Habib[2], Kamran Sardar[3], Rose Mary[4], Iqra Nasim[5]
[1-5] Department of Environmental Sciences University of Lahore-Lahore, Pakistan

Abstract
The processes of manufacture of textiles or wet treatments and finishing processes of textile supplies are huge consumers of water with elevated quality. As a result of these different processes, significant amounts of polluted water are released. This paper puts importance 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.

Keywords: textile industry, sedimentation, degradation, procedure

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 like sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing operations, other than there is a strong interrelation between dry processes and consecutive wet treatments. The textile industry emits a wide variety of pollutants from the entire stages in the processing of fibers, fabrics and garment production (Moustafa 2015) [2]. [Table1].

These comprise wastewater, solid wastes, emissions to air and noise pollution. The chief environmental concern in the textile industry is about 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 chiefly used for: (a) the application of chemical onto textiles and (b) rinsing the manufactured textiles (Ntuli *et al.*, 2016) [3]. 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 detail 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) [3].

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	Little or none	VOCs from glycol esters and scouring solvents

	lubricants, spin finishes, spent 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

Preconditions and means for resolving the problem

For a long time the toxicity of released wastewater was mostly determined by the finding of biological effects from pollution, elevated bulks of foam, or intensively colored rivers near textile plants. Today, the recognition and 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 like As, Cr, Zn and Cu and color (Table 2).

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

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 by different methods, which comprise physical, chemical and biological treatment depending on 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 an enough relationship between regulators and industry. To decrease the amount of generated waste waters it is compulsory applying of a systematic approach to reducing the generation of waste at basis. In additional words, this approach prevents the production of waste waters in the first place, somewhat than treating it once it has been produced by 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) [5].

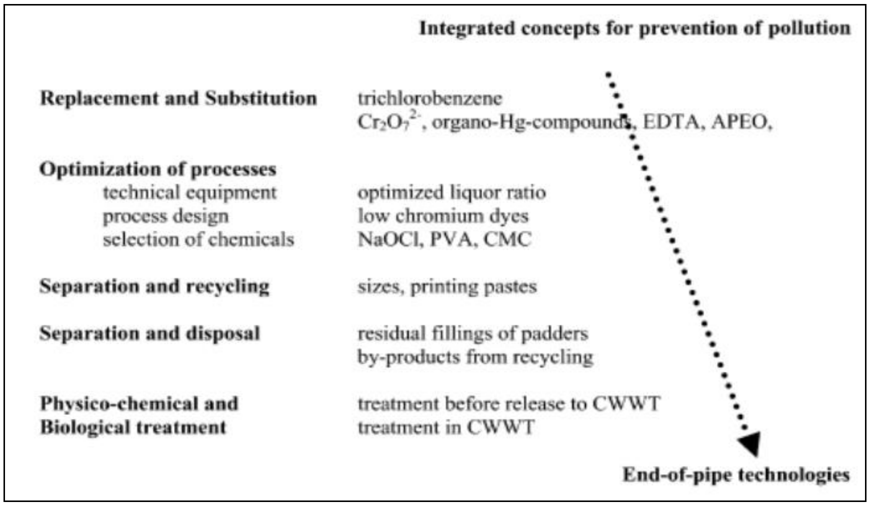

Fig 1: Action plan to minimize the present problems associated with the wastewater released from textile plant

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 that will require some form of treatment prior to disposal to sewage, sea river or. 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:

1. Concentrated liquids: fillings of padders (dyeing, finishing), printing pastes, used dye baths
2. Medium polluted wastes (washing, rinsing baths)
3. 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.

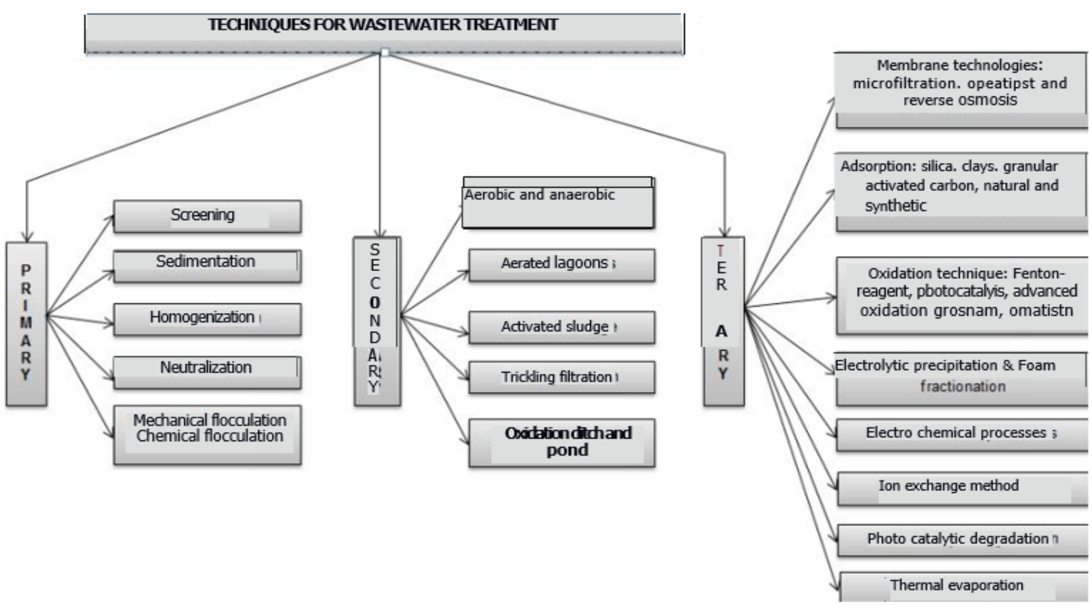

Fig 2: Various methods for the treatment of wastewater from textile plants

The treatment processes may be categorized into primary, secondary and tertiary treatment process (figure 2). The chief principle of secondary treatment is to provide BOD removal beyond what is attainable by simple sedimentation. It as well 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 to 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).

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 treatment of all wastewater and water recycling (Park and Shore 2010) [4]. The application of a certain technology for wastewater treatment is dependent on the type of waste and too on the quantity of used water. Also 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 large-scale, because of the lot of cleaning and removing steps concerned. 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 has 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 consequence not only in enhanced environmental performance, but also in considerable savings on individual textile companies.

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