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Pollution and Management of Water in The Textile Wet Processing

Abstract

Textile processing is an important sub-sector in the textile industry which uses a large quantity of water for various processes such as sizing, desizing, scouring, bleaching, dyeing, printing etc. Water is the most abundant as well as important compound exists on this planet. It has been estimated that with the rising population, consumption of water is increasing about two to three percent annually. Thus it is easy to anticipate that water for the textile industry will keep on becoming more and more expensive. Good quality water had been abundantly available at a negligible price till recently and so had been taken for granted. This situation has now changed radically and water is being given status of a raw material and due consideration is given to its availability and quality as well as to its disposal arrangement after use.

Keywords: Suspended impurities, Industrial effluents, Hardness of Water, Total Dissolved Solids, dyestuff, re-dyeing, Reverse Osmosis.

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Introduction

Water is the most abundant as well as the most important compound that exists on our planet. No life whether vegetable or animal can exist without water. Out of various textile activities, the textile processing contributes about 70% of pollution. Due to the nature of various chemical processing of textiles, large volumes of waste water with numerous pollutants are discharged which directly or indirectly affect our environment and ecosystem. There is no simple solution for the industry to overcome the problem of water shortage and it requires a multi-dimensional approach to ensure production of the quality products at an acceptable cost.

Objective of the study

The textile wet processing industries consumes a large amount of water in its manufacturing processes. The waste water from these processing plants is classified as the most polluting of the all industrial sectors. The objective of this study is to find out the ways to reduce the demand of fresh water in the textile processing units, maximize reuse of the water, establishing water purifier units in the textile plants itself and to find out other supplements to the existing water resource.

The only source of fresh water on earth is evaporation from the seas and lakes and it has been estimated to be about 230 cubic miles every day. Unfortunately, out of this total evaporation, 210 cubic miles rain back on the seas and only 20 cubic miles are blown over to land to support life on earth. The main sources of water for drinking, irrigation and industry such as rivers, lakes, subsoil water, canals etc are all fed by the rainwater. Water is a very simple compound but has very unique physical and chemical properties. Its density for example, increases with lowering of temperature but unlike other substances, it starts decreasing after reaching a temperature of 4°C. This unusual property is perhaps responsible for existence of any Living being on our planet today. The fall in density below 4°C creates an insulating layer of ice on the surface of oceans and lakes. In the absence of this layer, all the water sources would have frozen from bottom to top during the ice ages and the entire marine life would have perished. Water has a highly surface tension and a high dielectric constant. The latter property is responsible for the great capacity of water to dissolve ionic and polar compounds thus making water an excellent solvent. Interestingly, water is corrosive to metals and minerals and yet it is essential for the living organisms.

Dew and rain, as condensed from water vapours, are in a very pure state but on contact with air, water dissolves gases like carbon dioxide and oxides of nitrogen and sulphur that are usually present in the atmosphere of the urban areas. Dust as well as bacteria are also washed down with rain and add to the impurities. The river water, therefore, contains both the suspended and dissolved mineral and organic matter in addition to dissolved gases and bacteria.

Effect of Water-Impurities on wet processing

Impurities in water can seriously affect quality of wet processing and even damage the fibres depending on their nature and concentration. The major impurities and their effects are briefly discussed below:

Organic Matter, Turbidity and Colour

Turbidity and colour are usually due to presence of organic matter in water and this detracts the brightness of the bleached goods and purity of shade of the dyed goods. The organic matter whether dissolved or suspended also breeds micro organisms that may develop mildew, fungi etc. which in turn produce coloured spots, foul smell and even holes in the fibrous material. The micro-organism also grows inside the water pipes and chokes these and sometimes even dissolves the pipe-metal.

Hardness

The immediate difficulty associated with hardness that comes to one’s mind is wastage of soap used in scouring of wool and silk fibres and soaping of Reactive, Vat and Azoic dyed and printed goods. However, this wasteful problem has been more or less overcome by replacement of soap with synthetic detergents. The synthetic detergents can withstand hardness because their calcium and magnesium derivatives are fairly soluble in water. Hardness creates many other undesirable effects in wet processing. The textile dyes for each fibre are designed to have low solubility in water and this become difficult to dissolve in very hard water.

Total Dissolved Solids (TDS)

In addition to hardness causing calcium and magnesium salts, water contains other dissolved salts that are mainly sodium cations and chloride, sulphate and bicarbonate anions. These sodium salts increase TDS of water and also create many difficulties in processing of textiles. Dyes of low solubility are likely to be precipitated even in softened water of high TDS on dissolving and the same can happen in preparing printing pastes. Presence of excessive amount of sodium ions also gives a moist handle to the finished fabric due to their tendency to hold water.

Dissolved Gases

Water normally has small quantities of oxygen and carbon dioxide dissolved in it. The later reacts with steel pipes carrying water and steam, to form soluble ferrous bicarbonates and damage cotton goods by lowering their strength and even making holes. The dissolved oxygen can cause serious damage to the boilerplates by converting the ferrous bicarbonate, formed initially, into ferric oxide and releasing carbon dioxide to react again with more iron. Oxygen in water also wastes the reducing agents like dithionite that is used in application of vat dyes.

Water Management

Good quality water had been abundantly available at a negligible price till recently and so had been taken for granted. To process one kilogram of the fabric in a textile processing unit, required quantity of water varies between 90 to 150 liters depending upon nature of fibres, class of dyes, method of dye-application and the processing machines used. To meet their needs, the textile unit extract of the sub-soil water but its quality and even quantity is not dependable and further deteriorates on prolonged extraction.

There is no simple solution for the industry to overcome the problem of water shortage and it requires a multi-dimensional approach to ensure production of the quality products at an acceptable cost. Following can be some suggestions and conclusions:

Suggestions and conclusion

Conservation of water is the single most effective method to meet water shortage in textile industry and may be practiced in a number of ways. It has been established that the continuous bleaching and dyeing machines are more efficient in water consumption than the batch processing. The modern continuous processing machines are very economical in use of water. However their installation is not always possible because of considerations of high capital cost, small running lengths in one shade and also for unsuitability for fabrics that need special handling. Consumption of water depends upon the class of dyes used but most of the water is required for post-dyeing washing and soaping treatments. The pigments that requires no washing also consume water in the ratio of one is to one. On the other hand, vat, azoic and reactive dyes need extensive washing and soaping and so need large quantities of water. Consumption of water by different classes of dyes in the ascending order is Pigment, Disperse, Direct, Acid, Sulphur, Reactive, Vat and Azoic.

In places where sub-soil water has TDS not above 2,000 ppm, it is possible to use it selectively for rinsing off the unfixed Reactive and Direct dyes. This rinsing should be followed by a treatment with dilute acetic or formic acid to remove calcium and magnesium salts and washing with low TDS water before soaping or any other treatment. Large quantity of good quality water is used for lowering temperature of dyeing machines and power generators that is often allowed to go to waste. This water can be best used for boiler feed water to take advantage of its heat content. A careful inspection of machines and processes will indicate where improvements could be made for saving water; the leaking joints and faulty valves on the waterlines not only waste water but also make the dye house untidy. The dyeing machines are rarely calibrated to relate volume of liquors to its height in the machine which is responsible for lack of control over liquor-ratios when dyeing fabric of varying weights and densities.

As discussed above, the quality water is going to be in short supply for the textile industry permanently and this shortage will be progressive. It is, therefore, necessary to consider alternative processes to supplement the existing water sources and the most obvious choice is demineralization or desalination of the brackish sub-soil water and even sea water. Following are the three major methods that can be successfully used for de-salination of water:

Vaporization and Condensation

In this system, saline water is heated preferably under reduced pressure to boiling point in flash evaporators and the water vapours are cooled to condense into pure water. This process is comparatively expensive one.

Reverse Osmosis Process

According to the principle of osmosis when a salt solution is separated from water with semi-permeable membrane, water molecules tend to move across the membrane towards the salt solution under the concentration gradient. This principle is used in the reverse osmosis process for reducing salt concentration in brackish waters. The process was known for quite some time but could become commercially feasible only after robust and long lasting synthetic semi-permeable membranes were developed and became available at competitive prices. With reduction in cost of the membrane, the reverse osmosis method of demineralization of water has now acquired a great commercial significance and its use is rapidly increasing in the textile wet processing.

Ion-Exchange Demineralization Process

This system works on the principle of the water softening plant but have two columns of resins. Cations and anions of the dissolved salts are replaced with hydrogen and hydroxyl ions respectively mild water of a very high purity or zero conductivity is obtained. After exhaustion, the cationic resins are regenerated with a mineral acid and the anionic resins are regenerated with caustic soda. The capital cost of the equipment is lower than the earlier two systems but the high cost of chemicals required to regenerate the resins is high and so makes the process un-economical for the textile industry.

References

1. *Rott, U., and R. Minke, 1999. Overview of wastewater treatment and recycling in the textile processing industry.Water Sci. Technol. 40:37-144.*
2. *Slokar, Y.M., and M.A. Majcen. 1997 . Methods of decolorization of textile wastewater. Dyes and Pigmants 37:335-356.*
3. *Chavan. R.B. 2001. Environment-friendly dyeing processes for cotton. Ind. J. Fibre Textile Res. 4:239-242.*
4. *Lin,S.H. and M.L.Chen. 1997. Treatment of textile wastewater by chemical methods for reuse. Water Res.31:868-876.*
5. *Marrot.B. and N. Roche. 2002. Wastewater treatment and reuse in textile industries. a review. Res. Adv. Water. Res.3:41-53.*
6. *Robinson, T., G. McMullan, R. Marchant, and P. Nigam. 1997. Remediation of dyes in textile effluent: a critical review on current treatment technologies with a proposed alternative. Colorage 44:247-255.*
7. *Chakraborty, S.S., S. De, J.KBasy, and S. DasGupta. 2005. Treatment of a textile effluent:application of a combination method involving adsorption and nanofiltration. -Desalination 174:73-85.*