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A Review on the Drawbacks of Nano-Filtration of Textile Wastewater Treatment

Israt Zerin*
Department of Textile Engineering, Southeast University, Dhaka, Bangladesh.
Corresponding author: Email: israt@seu.edu.bd

Abstract
Wastewater is the output from dyeing, printing and finishing steps in the textile industries, consisting of extremely toxic materials including both organic and inorganic compounds. This is essential to treat wastewater before discharging into environment. The treatment method to be applied to wastewater depends on the its characterization of, costs of plant, maintenance and availability of infrastructure. Nano-filtration is a modern treatment method. This paper has been focused on the drawbacks of Nano-filtration techniques for wastewater treatment, its impact and some possible ways to overcome treatment difficulties.

Keywords: Nano-Filtration, Wastewater, Textile, Drawbacks.

1. Introduction
Industrial wastewater is the aqueous discharge that results from materials having been dissolved or suspended in water. Use of water in an industry depends on what kind of materials they process and what type of raw materials are used in the manufacturing plants. The water discharged form an industry must be treated before discharging to reduce any health effects on humans as well as for other organisms. There are mainly two types of treatment given to the industrial wastewater. Those are physicochemical and biological treatment. The treatment method to be applied to wastewater depends on its characterization, costs of plant, maintenance and availability of infrastructure. Physical treatment of wastewater is effective due to effective adsorbent, great capacity, high-quality treated effluent, absence of sludge production and little or no consumption of chemicals [1].

Dyeing, printing and finishing processes are the most polluting processes in the textile industries. Wastewater comes out from these steps containing highly toxic materials including both organic and inorganic compounds. So, environmental researchers have been giving priority to wastewater that is released by pre-treatment, dyeing, finishing and washing units of the textile industries.

Different filtration techniques like micro, ultra and Nano-filtration as well reverse osmosis are suggested, depending on the dimension of the pollutants [2]. Nano-filtration is widely accepted to reuse treated wastewater [3]. Using Nano-filtration technique in the final membrane process reported COD and TSS values were 142 mg/L and TSS 12 mg/L, respectively [4].

Color removal efficiency found as much as 98% by using Nano-filtration on simulated textile wastewater. Chemical oxygen demand is reduced up to 100% on use of reactive blue, disperse blue, direct and disperse red dyes [5].

2. Discussion
2.1 Rationale of the problem
Generally, Nano-filtration membranes are composite materials reinforced by polymer substrate and produce in a spiral configuration against a flat plane or tube geometry.

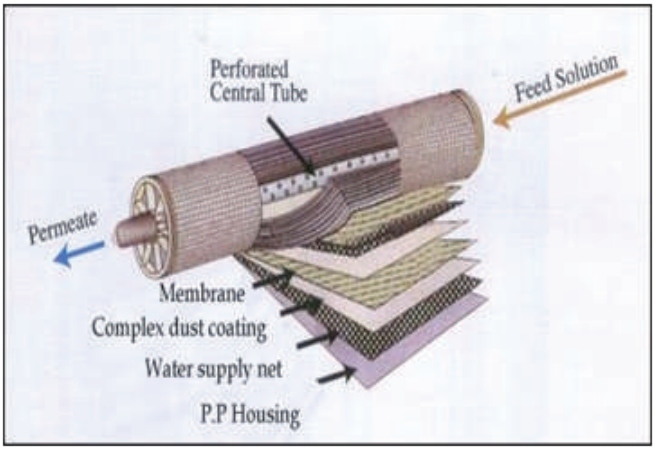

Figure 1. Nano-filter construction [6].

The preliminary of the technology of Nano-filtration is the use of pressure to split up soluble ions through a semi permeable layer from water. Nano-filtration does not have the capability of retention behavior like reverse osmosis.

Nano-filtration is a membrane filtration of pore size 0.001µ which is larger than reverse osmosis 0.0001µ. For this reason, COD, TSS and turbidity removal is not higher than reverse osmosis process. Generally, Nano-filtration membrane system is better for passing more salt than a reverse osmosis [4].

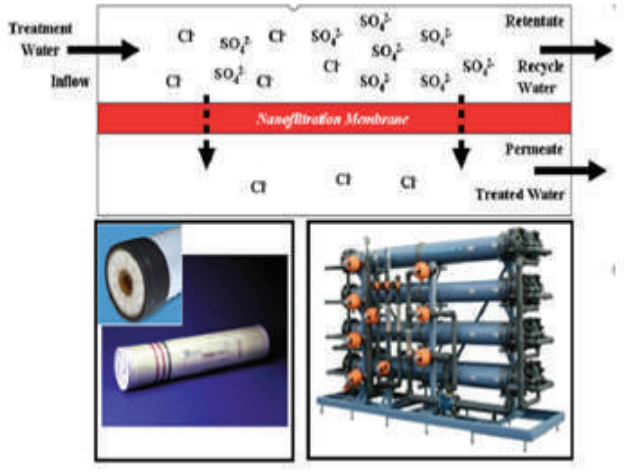

Figure 2. Principle of Nano-filtration, pictures of Nano-filtration membranes and array for treatment of water [7].

Comparison between three configurations of filter shows Nano fiber can improve the characteristics of effluent better than different yarns of different materials. But the combination of them reduces access turbidity which added extra cost to the plant [8].

Configuration I; The pricked cylinder (cross wound) with different yarns of different materials. Configuration II; The mixed multilayer channels composed of yarns and sheet of Nano-fibers.

Configuration III; A Combination of pricked cylinder (cross wound) with different yarns of different materials and mixed multilayer channels composed of yarns and sheet of Nano-fibers.

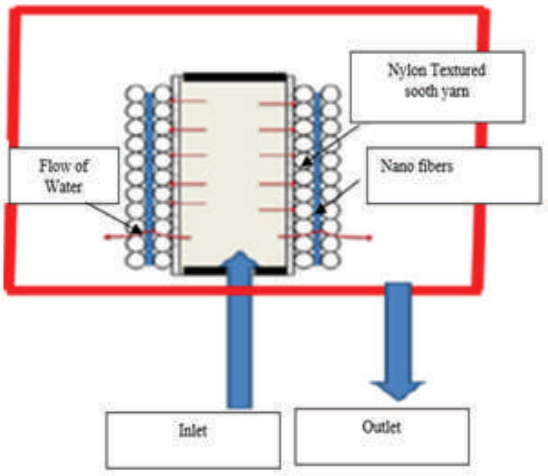

Figure 3. Configuration of filtration unit.

Turbidity has been reduced more in configuration II and III because of the sheet of Nano-fibers. It enhances capability of the filter to accumulate the micro size particles are also picked up by nano-filters.

Nano-filters can remove color up to 98% and 99.7% for acidic and reactive blue respectively at variable pressure. Use of the Nano-filters for biological and ultra filtration treatment is more effective for the removal of COD, color, salt and it provides the reuse option inside the textile factory [9].

Besides the advantages there are some draw backs in Nano-filtrations. There is a problem of reject stream generation on Nano-filtration technique in wastewater treatment plant. The rejection flux sometimes may be as high as 50%.

Another problem with Nano-filtration technique is that micro plastic might be escaped and retained after filtration. Membrane bioreactor is efficient for micro plastic removal [10].

For desalination purpose cost of Nano-filtration was high which can be reduced by controlling pore size without affecting rejection requirements [11].

2.1 Gap Analysis and Recommendations

2.1.1 Gaps

The main problem with Nanotechnology is associated with its price of the membranes used. The membranes are highly expensive.

Another problem is maintenance. The Nano-filter needs to be changed even before expiry due to the unavailability of replacement frequency.

Uses of Nano-filtration is less than other method of membrane filtration in textile and other industry like reverse osmosis and ultra-filtration.

2.1.2 Recommendations.

Researchers need to focus more on the Nanofiltration technology to make it cost effective.

Increase the durability of Nano-filtration membranes by further scientific research.

Government can take promotional measures to adopt new technology by the industries as a part of green solution of environment.

Availability of membrane may be increased by establishing industries for production of membrane or create facility of the textile industries to produce membrane by themselves.

3. Conclusion

Nano-filtration is a new technology that can be adopted by the textile industries to get more effective solution for treatment of wastewater. The drawbacks were discussed in this review should be addressed properly by concerned researchers and authorities. The costing of Nano-filtration can be reduced by further research works and efficiency may increase by combining with other technologies like bioreactor and ultra-filtration used for wastewater treatment. Further joint study with academics, researchers and regulatory authorities of the country on this area of research is necessary to mitigate the discussed drawbacks in this article.

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