

# TREATMENT OF LANDFILL LEACHATE BY NANOFILTRATION

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**Abstract** - The present study was done to treat the landfill leachate to meet the disposing requirements to the water bodies. Concentration of BOD, COD, TDS, TSS, pH, hardness and lack of nutrients in the methanogenic phase has restricted the biological treatment processes. Therefore membrane technology is adopted now-a-days. Nano membrane filtration is being used for the separation of immiscible particles from the landfill leachate. Nanofiltration removes upto 60-70% of COD and its combination of physiochemical methods at the beginning improves leachate treatment. Nanofiltration process has been reported to be a very efficient and promising method for removal of hardness, TSS, TDS, COD and BOD which results in the disposal requirements of the landfill leachate. It can able to remove both organic and inorganic dissolved particles in the leachate. Thus it is efficient in purifying the liquid which percolates from the solid waste i.e., leachate. Also permeate generated from the Nanofiltration unit is low in contaminants which meet the discharge standards.

**Key Words:** Leachate, Nanofiltration, membrane filtration, Landfill, solid waste.

## I. INTRODUCTION

India has a population of more than 121 crores, due to tremendous increasing population, the production of garbage also increases which is estimated to be 1 million ton per day. The available dump yards are not enough to accommodate such a large amount of waste. This leads to dumping of garbage on remote areas this related to become dump yard. Leachate is the liquid that drains or 'leaches' from a landfill. It varies widely in composition regarding the age of the landfill and the type of waste that it contains. It usually contains both dissolved and suspended material. Landfills leachate contains high concentration of organic matters, color, heavy metals and toxic substances. This kind of water can contaminate the ground water and other water bodies. Our aim in this work is to treat the landfill leachate to meet the disposing characteristics by the method of Nano filtration process.

## II. LITERATURE REVIEW

1. Arpita Anand and Shashank Shekhar Singh Department of Environmental Engineering, Delhi Technological University, Delhi

Membrane technology for leachate treatment

Rapid increase in population and industrialization leads to huge generation of solid waste throughout the country with landfilling as the most common practice for management of these solid wastes. It is estimated that out of 3267 MLD of sewage is generated in Delhi. Concentrations of COD, BOD<sub>5</sub>, heavy metals, NH<sub>4</sub>N, low BOD<sub>5</sub>/COD ratio and the lack of nutrients in the methanogenic phase have restricted the application of biological treatment processes like aerated lagoons, activated sludge, sequence batch reactors, trickling filter, rotational biological contactors, thereby membrane technology is now days being used. Membrane filtration can be defined as the separation of solid immiscible particles from a liquid or gaseous stream based primarily based on size difference. It includes processes such as reverse osmosis (RO), Nano filtration (NF), ultrafiltration (UF) and microfiltration (MF). MF cannot be used alone in leachate treatment, used as pre-treatment for other membrane processes e.g. UF, NF or RO. MF alone, the COD removal is between 25-35%. Using the UF step alone 50% of organic matter can be separated. Nano filtration removes up to 60-70% COD as well as about 50% ammonia from leachates while its combination with physic-chemical methods further improves leachate treatment bringing the COD removal (refractory COD inclusive) to a range of (70-80%). Reverse Osmosis process has been reported to be a very efficient and promising method for leachate treatment. Permeate generated from the reverse osmosis unit is low in inorganic and organic contaminants which meet the discharge standards.

2. R Mulyanti and H Susanto-(Master program of Environmental Science, School of postgraduate studies Universitas Siponegoro, Indonesia)

Wastewater treatment by nanofiltration membranes

Lower energy consumption compared to reverse osmosis (RO) and higher rejection compared to ultrafiltration make nanofiltration (NF) membrane get more and more attention for wastewater treatment. NF has become a promising technology not only for treating wastewater but also for reusing water from wastewater. This paper presents various applications of NF membranes including operating conditions, feed characteristics and membrane characteristics were discussed. In addition, fouling as a severe problem during NF application is also presented. Further, future prospects and challenges of NF for wastewater treatments are explained.

3. Mona A.Abdal-Fatah -(Chemical Engineering and Pilot Plant Department, National Research Centre, Cairo, Egypt)

Nanofiltration systems and applications in wastewater treatment:

Nanofiltration (NF) is one of the most important activities employed in wastewater treatment field. It is a relatively recent development in membrane technology and it can be aqueous or non-aqueous. Characteristics of NF fall between UF and RO, and functions by both pore-size flow (convective) and the solution-diffusion mechanisms. Membrane charges play an important role in membrane function and often NF membrane as have surface negative charges. NF technique is used in a variety of water and wastewater treatment (WWT) in different industrial applications. The main job of NF is the selective removal of ions and organic substances and it is used in some specified seawater desalination application. The main objective of this review is to illustrate the main applications of NF process in water reuse, WWT as tertiary treatment, water softening and desalination fields. Comparison of basic economic analyses with other alternative processes in profitability is also performed.

### III. NEED FOR STUDY

- Since Nano filtration has some unique physiochemical properties that lend themselves for the treatment of landfill leachate.
- For instance, carbon nanotube membranes can remove almost all kinds of water contaminants including turbidity, oil, bacteria, viruses and organic contaminants in the landfill leachate while treating.
- Also nanotechnology can able to tackle the removal of impurities, sediments, chemical effluents, charged particles, bacteria and other pathogens at faster rate which causes contamination in the landfill leachate

### IV. OBJECTIVES

- To treat the raw leachate using Nano membrane filter which helps in softening of waste water for instance it removes polyvalent cation and involves in disinfection.
- To remove the infecting by-product precursors such as natural organic matter and synthetic organic matter.
- To satisfy regulatory norms for leachate discharge in to the environment.

## V. MATERIALS AND METHODOLOGY

### 1. SITE SELECTION AND COLLECTION OF SAMPLE

Chennai is one of the dense populated (11 million) city in India. Nearly 6700 tons of solids wastes are generated and dumped in solid waste dump yard on daily basis. It contains two open solid waste dump yards in Perungudi and Kodungaiyur where we have selected Perungudi solid waste dump yard as our sample (Leachate) collection zone. Perungudi dump yard lies at 12.057°13.5" N and 80.014°05.8" E. The moisture and liquid coming out of the solid wastes gets accumulated in the low land areas and generated as leachate. Therefore the leachate was collected from the moisture logged areas near the dumping site.



Fig -1: Perungudi dump yard map



Fig -2: Dump yard

## 2. ANALYSING THE CHARACTERISTICS OF LEACHATE

The major organic and inorganic components are BOD, COD, TS, TSS, TDS,  $Ca^{2+}$ ,  $Na^{+}$  where analyzed in the laboratory using recognized methods. The total hardness ( $Ca^{2+}$ ) was determined by titration with 0.02N EDTA with eriochrome black-T as indicator. The  $Na^{+}$  concentration and presence was determined using flame photometer. The Biological oxygen demand of the sample (Leachate) was determined by the titration with sodium thiosulphate where alkali iodide and concentrated sulphuric acid are the reagents used before titration in addition with that starch was used as indicator. The chemical oxygen demand was determined by titration against 0.1Nferrous ammonium sulphate where sulphuric acid with reagent (conc.  $AgSO_4 + H_2SO_4$ ), standard potassium dichromate, one pinch mercurous sulphate and silver sulphate were added to the sample before titration. Ferroin was used as indicator for titration.

## 3. TREATMENT PROCESS

Required amount of leachate is taken and poured into the experimental setup using measuring jar. The leachate was fed into the alumina bed thickness of 2cm and kept it for about 48 hours to absorb the contaminants present in leachate. After 48 hours it is clearly absorbed that the color leachate changes from black to brown color. It shows that activated alumina absorbed the oxide particles present in the leachate. After that, the leachates pass through the carbon filter. The activated carbon at the top with the thickness of 2cm. below the carbon layer filter consist of the sand layer of thickness of 8cm which consist of sand particles, which passes through 4.75 mm and retains in 2.36mm sieve. Next to the sand layer the filter consist of layer of small pebbles of thickness 6cm. At the bottom of the filter it has large pebble layer of about 5cm thickness. This carbon filter removes contaminants and impurities present in the leachate fed from the alumina bed using chemical absorption. The leachate is then allowed to pass through the Nanofiltration system. This system consists of sponge filter, a discharge pump and Nano filter membrane. The filtered water from the carbon filter is passed through the sponge filter. The sponge filter has the pore size of 5 microns. It removes the particles having the size more than 5 microns. After it is filled it is fed to the Nano filter housing with the help of the suction pump which has the discharge capacity of 1.2 liters per minutes. After passed through the Nanofiltration it is collected and tested for analyzing the results.



Fig -3: Nano membrane



Fig -4: Experimental setup

## VI. RESULTS AND ANALYSIS

The treated effluent is again tested for determining its characteristics and the results were tabulated and compared with the characteristics of raw sample.

Table -1: COMPARISION OF CHARACTERISTICS OF RAW SAMPLE AND TREATED SAMPLE

Parameters	Raw sample	Treated sample	Efficiency (%)
pH	7.86	7.33	6.74
Hardness (mg/l)	673.31	360.7	46.42
BOD (mg/l)	294	24	91.8
COD (mg/l)	80	16	80
TDS (mg/l)	10000	4000	60
TSS (mg/l)	4000	0	100
Sodium (mg/l)	2.54	1.56	38.58

### 3. CONCLUSION

Nanofiltration can be effective in treating sanitary landfill leachate, although characteristics of the leachate must be considered. The treatment with Nano membrane was brought out in the tests as follows. Approximately 12 minutes were sufficient time to finish the entire treatment of leachate. In the Nanofiltration system successfully from the activated alumina bed. NF membrane mainly involves in the removal of COD, BOD, and polyvalent ions in leachate results in the efficient removal of hardness and inorganic contaminants in the leachate. It can be considered that, the treated water can be used for toilet flushing, watering of lawns and other purpose etc. Therefore the process is an ecofriendly without use of undesirable chemicals, highly durable, low electricity with zero operational assistance and less maintenance cost.

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