WHY BIOLOGICAL FILTRATION SYSTEMS ARE THE BEST SOLUTIONS FOR WASTEWATER TREATMENT UNDER MOST CONDITIONS

R. Chhabra

Transchem Agritech Pvt. Ltd.
850/2 GIDC Estate, Makarpura, Vadodara, Gujarat, India 390010
Email: rahul@transchem.in

ABSTRACT

The 20th century has brought a lot of innovations and development but unfortunately not in the field of wastewater treatment, particularly in developing countries like India. There are various options for wastewater treatment, from conventional Effluent Treatment Plants (ETPs) / Sewage Treatment Plants (STPs) to Bio-Filtration wastewater treatment. In the 21st century, the solutions providers who win will inevitably be those that are efficient, decentralized and with minimal land use, all of which allows substantially reduced costs. The emerging trend is to treat wastewater at its source with a decentralized approach since transportation costs are 70-82% of the total spending of wastewater treatment in certain countries. Trans Bio-Filter is a patent pending, proprietary, green, sustainable and cost-effective wastewater treatment technology developed with 25 years of Research & Development keeping the need of the society in mind.

Keywords: *bio-filter technology; wastewater treatment; sustainability; decentralized treatment*

BACKGROUND

For developing regions of the world, including India and Africa, the focus is on building decentralized systems, wherein wastewater can be treated at the source. This is where innovation comes into play in India.

1. INTRODUCTION

Trans Bio-Filter is an innovative technology that harnesses the energy, carbon and other elements of wastewater and converts it to “Bio-nutritional" products, Bio-Fertilizer and nutrient rich water with the use of hybrid earthworms, organic and inorganic media.

1.1 Earthworms

1. Are versatile waste eaters and decomposers

2. Harbor wide range of microorganisms and enzymes; these half-digested substrates decompose rapidly and are transformed to vermi-compost

1.2 Organic Media

Supports hybrid earthworms and microbes

1.3 Inorganic Media

Sand, gravel and pebbles of various sizes in diameter

Vermi and Microbial-processes simultaneously work together. There is an increase in dissolved oxygen levels in treated water as a result. The filtration as a principle originates from

the fact that earthworms, in the process of feeding on the substrate, increase its surface area for further microbial colonization.

During this process, the important plant nutrients such as Nitrogen, Potassium and Phosphorus are converted through microbial action.

It also involves removal of organic matter by adsorption & filtration followed by biological degradation. There is also oxygen supply by natural aeration to the treatment system. It is a natural way of recycling nutrients and removing toxins.

1.4 The advantages of trans Bio-Filter technology:

1. The Life-Cycle is 100% green. The output is nutrient-rich water.

2. There is a range of applications from domestic sewage & municipal wastewater to industries e.g. Dairy, Dyes, Chemical and Food-related.

3. Everything is useful and reusable. There are no chemicals. There is no sludge. It is odor-free. There's no high-maintenance of skilled labor required.

4. Technology can be used for treatment of domestic as well as industrial effluent with high COD, BOD and TDS concentrations.

5. Trans Bio-Filter works at variable hydraulic loads. The outlet results are achieved even at 5% of the hydraulic load capacity.

6. Decentralized system to treat wastewater at its source saves high transportation costs. It also reduces power costs.

7. Substantial conservation of depleting freshwater resources as the treated water can be reused.

2. DESIGN

2.1 Overview

The trans Bio-Filter has four layers. It consists of a bed filled with organic and inorganic media along with hybrid earthworms. The wastewater passes through the filter beds where the organic matter is retained. The organic matter is then degraded. Trans Bio-Filter is designed for maximum removal of contaminants.

2.2 Details

Layer characteristics:

1. The top most active layer comprises of custom organic and inorganic media consisting of earthworms, microbial cultures & bedding material.

2. Next layer comprises of gravel, sized from 50 – 70 mm.

3. Below that is a layer of big gravel aggregates of 100 – 150 mm in size.

4. The bottom most layer comprises of big rubbles, sized from 200 - 230 mm.

3. METHODOLOGY

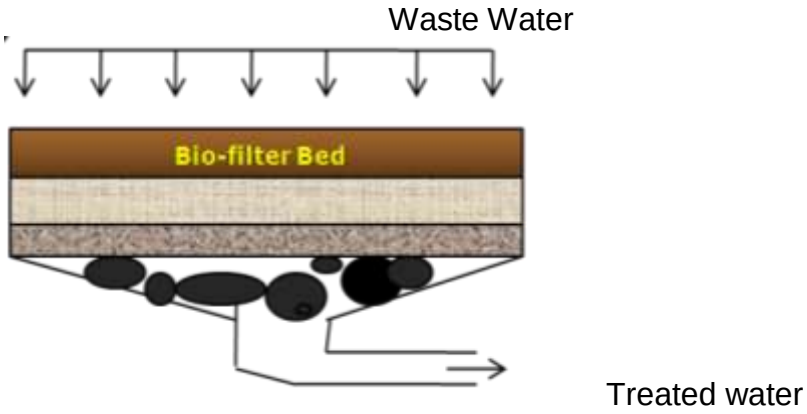

Figure 1. Flow Diagram of trans Bio-Filter wastewater treatment.

For domestic sewage, there are two flow rate options: 2000 liters per square meter or 6000 liters per square meter. For industrial effluent, the flow rate ranges from 150 to 750 liters per square meter.

When wastewater flows in, it is evenly sprayed on the surface. Through gravity, it trickles down. While it passes the system, it gets treated.

4. RESULTS OF SEWAGE TREATMENT

Sr. No.	Parameters	Units	Before treatment inlet	After trans Bio-Filter Treatment	Standard Irrigation Norms*
1	pH	--	7.0 – 7.8	**7.5 – 8.0**	5.5-9.0
2	Color	--	Dark Grey	**Pale yellow**	--
3	Odor	--	Strong	**Odorless**	--
4	T.D.S.	ppm	1500 – 2000	**1200-1800**	2100
6	Turbidity	NTU	100 – 150	**<10**	--
7	C.O.D.	ppm	500	**50-80**	100
8	B.O.D.	ppm	100 – 200	**10-20**	30
9	DO	ppm	Nil	**3-4**	--
10	Fecal Coliform	MPN / 100 mL	$> 10^6$	**$< 10^3$**	$< 10^3$

Table 1. Key parameters of sewage treatment.
***** Indian standard irrigation norms

There is a reduction of 90% in COD and BOD levels in case of sewage when treated with trans Bio filter. The outlet treated water is ideal for irrigation and with tertiary treatment, the treated water can be used for a variety of applications like flushing, irrigation, washing and can even be used for drinking purposes. We have already installed four plants in India on the concept of “Toilet to Tap” where we are treating sewage using our transBio filter technology and with tertiary treatment making it available for drinking purposes.

NUTRIENT RECOVERY THROUGH TRANS BIO-FILTER

Sr. No.	Parameters	Units	Before Treatment Inlet	After Treatment
1	NH_4-N	ppm	25-40	**< 1.0**
2	NO_3	ppm	10-20	**> 50**
3	Total P	ppm	4-8	**1-2**
4	Available P	ppm	1-2	**5-7**
5	Potassium	ppm	10-15	**20-25**

Table 2. Nutrient Conversion in Treated Water.

Table 2 summarizes how the treated water is rich in nutrients like Nitrogen, Phosphorus and Potassium.

Considering the nutrient content in treated water as:

- Available Nitrogen – 50 mg/l
- Available Phosphorous -- 7 mg/l
- Available Potassium – 25 mg / l

For 800 meter cube treated water, the nutrient availability is:

- Nitrogen – 40 kgs/day i.e. 14000 kgs/annum equivalent to 28 tons of Urea
- Phosphorous – 5.6 kgs/day i.e. 2000 kgs/annum equivalent to 4.0 tons of DAP
- Potassium – 20 kgs/day i.e. 7000 Kgs/annum equivalent to 12.0 tons of Potash

5. INDUSTRIAL EFFLUENT TREATMENT WITH TRANS BIO-FILTER: CASE STUDIES

Biological trickling filter through vermi filtration is age old technology and is being used for treatment of sewage across the world. Through our continuous research of 25 years and innovation using the principles of organic chemistry, inorganic chemistry and biotechnology we have been able to treat complex industrial effluents through our biological treatment system ie transBio filter.

Our biological system ie transBio filter reduces COD and BOD loads and other impurities like Ammonia-NH_3, H_2S etc even in presence of high TDS and at varied hydraulic load giving cost effective sustainable results. The reductions in contaminants sector-wise and effluent-wise are summarized as follows:

In one case where we have replaced a conventional Industrial effluent treatment plant(chemical industry effluent containing Sulphur and chloride) with trans Bio-filter system, with a plant capacity of 180 KLD, the results were as follows:

1. The power load was reduced by 82%
2. The retention time was reduced by 99% from 10 days to 45 minutes
3. The Capital Expenditure was reduced by 75%
4. The Operations Expenditure was reduced by 65%

Distillery Effluent- Slop Multi Effect Evaporator Condensate

For Distillery Effluent – Slop MEE condensate, the results show that trans Bio-Filter system can be one of the best technologies which works and giving consistent reduction in contaminants. Even when there is shock load of 700% in the effluent concentration our system works, whereas conventional systems might get disturbed and do not give desired outlet parameters. The studies at lab level were done with effluent having COD concentration of 4900 ppm and the same was reduced to 250 ppm. During onsite pilot plant live trials for a period of

30 days the effluent COD concentration went upto 38000 ppm and the same was reduced to 2790 ppm. The plant is giving consistent reduction of 93% even at 700% shock load. The results can be seen in Table 3.

Distillery Effluent	**MEE Condensate Treatability studies results**		**MEE Condensate onsite pilot studies results**	
	COD (ppm)	Turbidity (NTU)	COD (ppm)	Turbidity (NTU)
Before treatment inlet	4900	25	38000	212
After trans Bio-Filter treatment	**250**	**35**	**2790**	**89**

Table 3. Distillery Effluent results.

Phenolic Effluent treatment

Trans Bio-Filter system shows outstanding results for complex compounds like Phenol as well. The Phenol concentration of 1325 ppm was reduced to less than 1 ppm without the addition of any chemicals or tertiary treatment in case of Phenolic effluent. Table 4 shows the results.

Phenol Effluent	**COD (ppm)**	**Phenol (ppm)**
Before treatment inlet	4605	1325
After trans Bio-Filter treatment	**Less than 250**	**Less than 1**

Table 4. Phenol Effluent results.

Natural Dye

In one of the installation of transBio filter in Dye industry, the effluent is generated from Natural Dyeing/Block printing. The treated water is re-used in-house for washing purposes. The COD concentration of 1500 ppm was reduced to less than 150 ppm after treatment.

Natural Dye Effluent	**COD (ppm)**	**BOD (ppm)**
Before treatment inlet	1500	500
After trans Bio-Filter treatment	**<150**	**<30**

Table 5. Natural Dyeing results.

Caprolactam Effluent treatment

Trans Bio-Filter system can handle complex effluent with COD concentrations up to 52000 ppm. There is a reduction of COD to 350 ppm or 98% after treatment with tertiary systems. It can also handle concentration loading of Sulfates, Sulfides and SO_3. After tertiary treatment, the level is Nil.

Caprolactam effluent	**COD (ppm)**	**Sulfates (ppm)**	**Sulfide (ppm)**	**SO_3 (ppm)**
Before treatment inlet	52416	2044	105	39
After trans Bio-Filter treatment	**350**	**Nil**	**Nil**	**Nil**

Table 6. Caprolactam Effluent treatment results.

Dairy Effluent

Trans Bio-Filter system also works well for the treatment of Dairy effluent with high organic load. Detailed studies were conducted on effluent generated from ice cream manufacturing and Cheese Whey. With COD concentration of more than 60000 ppm, it was reduced to 600 ppm.

Dairy – Cheese and Ice cream Manufacturing	**Cheese Whey effluent**			**Ice cream effluent**		
	COD (ppm)	**Turbidity (NTU)**	**BOD (ppm)**	**COD (ppm)**	**Turbidity (NTU)**	**BOD (ppm)**
Before treatment inlet	60000	1000	48000	14000	1000	8000
After trans Bio-Filter treatment	**600**	**50**	**120**	**250**	**50-80**	**120**

Table 7. Dairy effluent treatment results.

6. CONCLUSION

The results of the data clearly show that treatment through trans Bio-Filter system is very effective for the reduction of BOD, COD and solids found in the wastewater. The technology works even in the presence of high TDS and gives consistent cost effective reduction even at variation in hydraulic loads. Trans Bio-Filter has been successful in treatment of complex effluent and proves that biological filtration systems are the best solutions for waste water treatment under most conditions.

For the innovative 21st century, trans Bio-Filter is a wastewater treatment technology that fits right in because it solves issues related to wastewater treatment that the 20th century could not adequately address. A decentralized approach can help address a number of issues including transportation, reusability and costs. When treated at source, the water can be used for non-potable applications like agriculture and potable application using simple tertiary treatment systems. Trans Bio-Filter can efficiently treat industrial effluent and domestic sewage and is economically & ecologically viable with a low footprint.

7. REFERENCES

None