

## **CASE STUDY**

*WORLDS FIRST LANDFILL LEACHATE MANAGEMENT AND WATER RECOVERY SYSTEM USING  
FPSTAR BOOMTUBE TECHNOLOGY*

*FPSTAR BOOMTUBE BASED LEACHATE TREATMENT PLANT AT BELLAHALLI LANDFILL,  
BENGALURU, IS WORLDS MOST ADVANCED ZERO LIQUID DISCHARGE TECHNOLOGY TO  
CONVERT LANDFILL LEACHATE INTO CLEAN WATER WITHOUT BIOLOGICAL OR CHEMICAL  
PROCESS*



***The State-of-the-art 120m<sup>3</sup> /day ZLD Landfill Leachate Treatment Plant at  
BBMP Landfill, Bellahalli, Bengaluru***

## Challenge

Bruhat Bengaluru Mahanagara Palike (BBMP) and Karnataka Rural Infrastructure Development Limited (KRIDL) was looking for an efficient and sustainable Leachate Treatment Plant for their Bellahalli Landfill in the outskirts of Bengaluru to treat Leachate percolating out of the garbage. Majority of Bengaluru's garbage is discarded at this scientific landfill in Bellahalli, Bengaluru North. The black, pungent liquid Oozing out of the garbage (called Leachate) was a major challenge as leachate is one of the main reasons for the stink and pungent odour.

Landfill **Leachate** means the liquid that has percolated through solid waste and contains dissolved and suspended materials from the solid waste that is disposed in a Municipal Solid Waste (MSW) Landfill. Landfill Leachate treatment and management is a huge problem for any Municipalities handling MSW across the world.

When water percolates through solid waste, both biological and chemical materials are leached into the effluent. Leachate from a Waste Management Facility can be hazardous to human health and the environment because of the potential chemicals and pollutants it can contain. Preventing contamination to groundwater, surface water and soil is the main goal when managing leachate. If leachate is not managed properly, it can also result in very bad odour, unsightly conditions, attract insects, and cause distress in vegetation.

There are many factors that can influence leachate generation. These include precipitation volumes, landfill cover, type of waste deposited, vegetation, climate, and landfill design.

### **Characteristics of Leachate:**

Leachate mainly consists of heavy metals, organic compounds and microbiological components carrying both dissolved and suspended materials. The typical composition of leachate from new and mature landfills varies based on weather, type of waste deposited, etc and includes:

- High COD [varies from 5000 – 80,000]
- High BOD [varies from 2000 – 45,000]
- High TDS [varies from 3000 – 60,000]
- Total Organic Carbon [TOC]
- Varying pH [varies from 5.2 – 10]
- High TSS [varies from 300 – 4000]

- Organic Nitrogen
- Ammonical Nitrogen
- High Alkalinity (as CaCo3)
- Calcium
- Magnesium
- Potassium
- Sodium
- Chloride

Leachate also carries and include elements like Lithium, Barium, Chromium, Iron, Nickel, Arsenic, Barium, traces of Cyanide and organic pollutants (eg: benzene, trichloroethylene, and PCBs). All these factors make leachate difficult to manage and extremely difficult to treat.

### **Current Leachate Treatment Technologies Challenges:**

The two main treatment technologies for leachate are biological and physical/chemical. Biological treatments were tried in newer landfills as the leachate may contain more biodegradable organics but was not successful due to presence of toxic substances and heavy metals. Other Leachate treatment methods include evaporation, treatment for disposal (dilution) and discharge to a municipal wastewater collection system. The conventional methods and technologies are not sustainable or dependable due to variations in the feed. Moreover, the capital cost and operations cost are extremely high.

BBMP & KRIDL after having understood the above challenges, was looking for a technology that could dependably treat leachate and recover clean water for reuse. The treated clean water from leachate was required to be fulfilling all norms of Pollution control Board for reuse with Zero Liquid Discharge. BBMP wanted to re-use the treated water for agriculture/gardening purpose around the Landfill and plan to release excess water to nearby lakes to recharge groundwater. The Capital and operating costs had to be kept to the minimum.

### **The Solution**

BBMP & KRIDL approached SEWCL and REWS INDIA with these challenges. After many months of trials and testing, a cost effective, advanced ZLD leachate management, treatment and Water Recovery system was proposed.

**AQUATRON – FPSTAR BOOMTUBE RESONATOR Based Waste Water Treatment and Water Recovery System**, World's most advanced technology to convert Landfill Leachate or any industrial waste water into clean water with ZERO Biological or Chemical process was studied and shortlisted due to its key benefits.

- Zero Liquid Discharge without evaporation/incineration thus reducing Capital and O & M cost
- Reduces COD and BOD by 98% after final process.
- Zero Chemical, Non-Biological process to convert TDS to TSS
- Extremely fast reaction time; processes Leachate online and clean water available for use immediately after fine filtration.
- Removes Arsenic, Nitrates, Heavy Metals, Soaps & Detergents, Fluoride, Oil and Grease.
- Very small space requirements when compared to conventional ZLD waste water treatment systems
- Can Stop and Start the Plant anytime depending on effluent availability without effecting the efficiency of the process.
- Extremely effective in removal of Colour, Turbidity, Odour, Total Organic Carbon (TOC), Natural Organic Matter (NOM)
- Works over wide pH range (6.5 pH to 9 pH)
- Treated water confirms to IS 10500 Standards, so safe to reuse.
- Minimal O & M cost when compared to conventional Wastewater treatment methods.
- Minimum Manpower to operate the plant depending on the plant size.
- Fully Automatic system. SCADA systems is highly advanced and powered by Artificial Intelligence, Back Propagation Neural Networks.

## The Technology

**AQUATRON BOOM TUBE FPSTAR** based Leachate Treatment technology is one of the finest Leachate treatment and water recovery technology using the most modern understanding of molecular physics.

Each atomic element in the periodic table has a Specific Frequency of Disassociation (SFoD). SFoD is a frequency in the shortwave band of the electromagnetic spectrum. When resonated for a specific time at a specific intensity, the targeted elements disassociate from its compounded form to elemental form. SFoD is unique to each element in the periodic table.

Any Wastewater contains many different elements, based on the effluent. Each element has its unique frequency. Depending on the elements present in the effluent, SFoD are delivered to the effluent that flows through a special reactor called **BoomTube Resonator (BTR)** which uses a patented

technology called "*Fine Particle Shortwave Thrombolytic Agglomeration Reactor*" or FPSTAR in short, which is a resonating column (antennas), tuned to different bands of frequencies starting from the lowest atomic weight to highest atomic weight.

As the leachate passes through the BoomTube Resonator, the elements in the leachate (except Hydrogen and Oxygen), will start disassociating from its compounded form to their equilibrium elemental state. The dissolved and suspended solids (dirt particles / pollutants) disassociate into its elemental forms and they agglomerate (come together) by inter-particle attraction (due to Van der Waals Forces) and electron reorganization under a weightless condition created by continuous free fall in the Boomtube Reactor takes place. It is a continuous process where fine particles even up to the size 1 nanometer disassociate & agglomerate.

The water from the Boomtube Reactor that comes out are then separated from the undesirable particles/pollutants using specialized TSS removal equipment and filtration systems. The agglomerated particles are separated from the water using specialized technology like Saturated Air Oxidation tank, Venturi, Plate Settlers, Filter Feed tank, Dual Media Filters, Activated Carbon Filters, Ultrafiltration and Nano Filtration / Polishing RO. The Nano/polishing RO used here is to filter fine nano particles which are in Suspended form. Hence, the membrane fouling and scaling is minimal when compared to conventional RO systems. The recovery is high and the processed reject (comprising of fine particles in Suspended form) is sent back to the input tank which is reprocessed ensuring zero wastage/reject. The treated water after the final fine filtration will have a TDS of less than 500 ppm and confirms to Pollution control norms for reuse of treated water.



The particles that settle in Oxidation tank and tube settler now form the sledge, mainly of oxides of specific atoms of elements originally present in the contaminated or polluted water. Depending on the nature of sludge (after Solid-Liquid Separation) and its potential to recover useful materials, suitable technology can be adopted to derive value from the sludge or convert to Energy or suitably disposed as per the Pollution control norms.

The FPSTAR leachate treatment & water recovery plant is an automatic computer controlled multi-stage system, that is fully plug and play. Very minimal manpower is required to start and stop the plant and occasionally check the quality of output water. One time setting of all process parameters ensures trouble free operation.

***The Process of Converting Raw Leachate to Clean water using FPSTAR technology comprises of 5 main stages:***

### **Stage 1:**

The Raw Leachate which is collected in the collection tank is pumped to Raw Leachate tank. The leachate goes into the Boomtube Resonator. The Boomtube Resonator [BTR] converts the compounds / pollutants into elemental state by using a patented technology called **Fine Particle Shortwave Thrombolytic Agglomeration Reactor[FPSTAR]**.



Each element has a specific frequency of disassociation. When resonated for a specific time at a specific frequency, the targeted elements are separated due to resonance principle. These undesirable particles / pollutants are removed in the subsequent stages.

In short, BTR converts Total Dissolved Solids [TDS] into Total Suspended Solids [TSS].

## **Stage 2:**

The water from the Boomtube that comes out have pollutants that are separated as Suspended Solids of very fine particles. This water is sent to a collection tank which feeds to a Venturi. Venturi is an equipment which creates turbulence so that the fine particles are made bigger using a thickener.



### **Stage 3:**

The water from the venturi is pumped to a plate settler, which settles the bigger particles. The bigger particles are removed as sludge into a sludge drying bed.





#### **Stage 4:**

From the plate settler, the water goes to a pre-filtration tank. Through a filter feed pump, the water is pumped to a multi-stage dual media filter and specialised activated carbon filtration system.



## Stage 5:

The water is then processed through a specialized industrial filtration system comprising of a 0.02 micron ultra filtration and a 0.001 micron membrane filter. The end result is clean fresh water after Stage 5.

The clean water is then pumped to a 5 Lakh litres RCC tank for re-use.



## **The Result:**

About 120,000 litres (120KLD) of leachate is treated at Bellahalli Landfill Leachate Treatment Plant every day. The clean water recovered is used for agriculture / gardening purposes currently and the excess water is planned to be released to a nearby lake soon.

The treated water parameters confirm to State & Central Pollution Control Board Standards and IS::10500 standards.

The entire plant is close loped and the footprint is only 3000 Sq. Ft.

The residue sludge from the collection tank is being treated using a proprietary technology called MIBR AD plant to convert them into Electricity.

The potential for Resource recovery of post Boomtube Resonator sludge (as elements) is under progress and is at testing stage enabling the birth of a new concept of *Zero Waste Discharge* Leachate Treatment and Management System.