MANTECH Publications

Journal of Research in Environmental Sciences and Engineering
Volume 3 Issue 2

"Overview of Anaerobic Filter Media in Compacted Sewage Treatment Process"

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Abstract

Compact Sewage Treatment Process (CSTP) is essentially adopted for the collection, treatment and disposal or reuse of treated wastewater from individual household, isolated communities, Industries and other parts of communities. Centralized wastewater treatment system involves large quantities of wastewater. However, centralized collection and treatment of wastewater requires pumps, piping materials and energy, ultimately increasing the cost of the treatment system. Hence, constructing a centralized treatment system for small communities or urban areas will result in burden for low income countries. To overcome this problems or lacunae, the Decentralized Wastewater Treatment Systems (DEWATS) are the good alternatives which are more cost effective and efficient way of wastewater treatment to improve environmental health conditions as well as providing opportunities for re-use and resource recovery.

Keywords*: Bioballs, Graded Stone, Anaerobic Reactor*

INTRODUCTION

With rapid expansion of cities and domestic water supply, quantity of gray/wastewater is increasing in the same proportion. As per CPHEEO estimates about 70-80% of total water supplied for domestic use gets generated as wastewater. 60% of industrial waste water, mostly large scale industries, is treated. Performance of state owned sewage treatment plants, for treating municipal waste water, and common effluent

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treatment plants, for treating effluent from small scale industries, is also not complying with prescribed standards. Thus, effluent from the treatment plants, often, not suitable for household purpose and reuse of the waste water is mostly restricted to agricultural and industrial purposes. There are higher risk associated to human health and the environment on use of wastewater especially in developing countries, where rarely the wastewater is treated and large volumes of untreated wastewater are being used in agriculture.

In class-I cities, oxidation pond or Up-flow Anaerobic Sludge Blanket technology is the most commonly employed. The conventional wastewater treatment processes are expensive and require complex operations and maintenance. The sludge removal, treatment and handling have been observed to be the most neglected areas in the operation of the sewage treatment plants (STPs) in India.

The anaerobic treatment technology has rapidly developed in recent decades. The anaerobic treatment process has also recognized as one of the most effective methods for treating organic waste stream, including industrial and domestic wastewater. There are various factors affecting design and performance of anaerobic filters. In general these factors can be divided into three categories; physical factors, performance factors and hydraulic factors.

In general the treatment unit thus adopted can be named as Compact Sewage Treatment Process (CSTP). Different Compact treatment plants are available such as Conventional Septic Tank (CST), Constructed wetland, upflow Anaerobic Sludge Digester (UASB), Moving Bed Bioreactor (MBBR). To maintain the CSTP with better condition for longer time requires monitoring of performance. The performance evaluation of the unit will help to find out system response in treatment aspect for given site condition. The generated data will be helpful to carryout modification or possible advancement in CSTP.

ANAEROBIC TREATMENT PROCESS

The fermentation process in which organic material is degraded and biogas (composed of mainly methane and carbon dioxide) is produced, is referred to as anaerobic digestion. Anaerobic digestion processes occur in many places where organic material is available and redox potential is low (zero oxygen). This is typically the casein stomachs of ruminants, in marshes,

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sediments of lakes and ditches, municipal landfills, or even municipal sewers.

Anaerobic treatment itself is very effective in removing biodegradable organic compounds, leaving mineralised compounds like NH4+, PO43-, S2- in the solution. Anaerobic treatment can be conducted in technically plain systems, and the process can be applied at any scale and at almost any place. More over the amount of excess sludge produced is very small and well stabilized, even having a market value when the so called granular anaerobic sludge is produced in the bioreactor. Moreover, useful energy in the form of biogas is produced instead of high-grade energy consumed. Accepting that anaerobic digestion in fact merely removes organic pollutants, there are virtually few if any serious drawbacks left, even not with respect to the rate of start-up of the system. Figure 16.1 shows the fate of carbon and energy in both aerobic and anaerobic wastewater treatment (AnWT) assuming that the oxidation of 1 kg COD requires 1 kWh of aeration energy. In contrast to anaerobic treatment, aerobic treatment is generally characterized by high operational costs (energy), while a very large fraction of the waste is converted to another type of waste (sludge). Aerobic treatment in a conventional activated sludge process yields about 50% (or more) new sludge from the COD converted, which requires further treatment, e.g. anaerobic digestion, before it is reused, disposed off or incinerated. The carbon/energy flow principles of aerobic and anaerobic bio-conversion largely affect the set up of the corresponding wastewater treatment system. Not surprisingly, to date, An WT has evolved into a competitive wastewater treatment technology. Many different types of organically polluted wastewaters, even those that were previously believed not to be suitable for An WT, are now treated by anaerobic high-rate conversion processes.

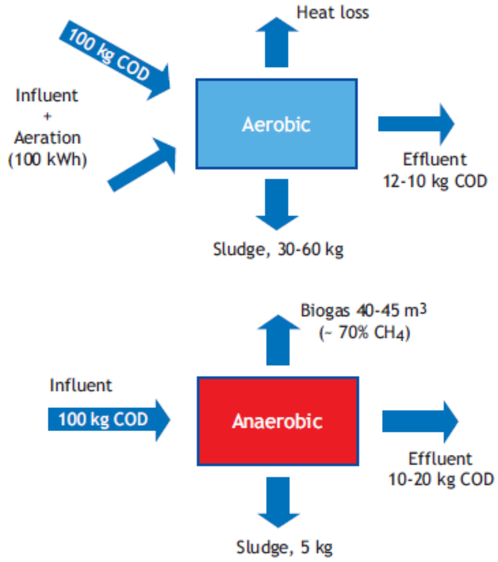

Figure 1: Fate of carbon and energy in aerobic (above) and anaerobic (below) wastewater treatment

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FILTRATION

Filtration is commonly the mechanical or physical operation which is used for the separation of solids from fluids by interposing a medium through which only the fluid can pass. Oversize solids in the fluid are retained, but the separation is not complete; solids will be contaminated with some fluid and filtrate will contain fine particles (depending on the pore size and filter thickness). Filtration is also used to describe some biological processes, especially in water treatment and sewage treatment in which undesirable constituents are removed by adsorption into a biological film grown on or in the filter medium.

ACHIEVING FLOW THROUGH THE FILTER

Fluids flow through a filter due to a difference in pressure — fluid flows from the high pressure side to the low pressure side of the filter, leaving some material behind. The simplest method to achieve this is by gravity. In the laboratory, pressure in the form of compressed air on the feed side (or vacuum on the filtrate side) may be applied to make the filtration process faster, though this may lead to clogging or the passage off in e particles. Alternatively, the liquid may flow through the filter by the force exerted by a pump, a method commonly used in industry when a reduced filtration time is important. In this case, the filter need not be mounted vertically.

SLOW SAND FILTER

Slow sand filters are used in water purification for treating raw water to produce a potable product. They are typically 1to 2meters deep, can be rectangular or cylindrical in cross section and are used primarily to treat surface water. The length and breadth of the tanks are determined by the flow rate desired by the filters, which typically have a loading rate of 0._ to 0.1to 0.2meters per hour (or cubic meters per square meter per hour). Although they are often the preferred technology in many developing countries, they are also used to treat water in some of the most developed countries such as the UK where they are used to treat water supplied to London. Slow sand filters now are also being tested for pathogen control of nutrient solutions in hydroponic systems.

FEATURES

Slow sand filters have a number of unique qualities:

1. Unlike other filtration methods, slow sand filters use biological processes to clean the water, and

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are non-pressurized systems. Slow sand filters do not require chemicals or electricity to operate.

2. Cleaning is traditionally by use of a mechanical scraper, which is usually driven into the filter bed once it has been dried out. However, some slow sand filter operators use a method called "wet harrowing", where the sand is scraped while still under water, and the water used for cleaning is drained to waste;

3. For municipal systems there usually is a certain degree of redundancy, it is desirable for the maximum required throughput of water to be achievable with one or more beds out of service;

4. Slow sand filters require relatively low turbidity levels to operate efficiently. In summer conditions and in conditions when the raw water is turbid, blinding of the filters occurs more quickly and pre-treatment is recommended.

5. Unlike other water filtration technologies that produce water on demand, slow sand filters produce water at a slow, constant flow rate and are usually used in conjunction with a storage tank for peak usage. This slow rate is necessary for healthy development of the biological processes in the filter.

While many municipal water treatment works will have 12 or more beds in use at any one time, smaller communities or households may only have one or two filter beds.

In the base of each bed is a series of herringbone drains that are covered with a layer of pebbles which in turn is covered with coarse gravel. Further layers of sand are placed on top followed by a thick layer of fine sand. The whole depth of filter material may be more than _ meter in depth, the majority of which will be fine sand material. On top of the sand bed sits a supernatant layer of raw, unfiltered water.

Advantages

- As they require little or no mechanical power, chemicals or replaceable parts, and they require minimal operator training and only periodic maintenance, they are often an appropriate technology for poor and isolated areas.

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- Slow sand filters, due to their simple design, may be created DIY (Do it yourself). DIY slows and filters have been used in Afghanistan and other countries to aid the poor.

- Slow sand filters are recognized by the World Health Organization, Oxfam, United Nations and the United States Environmental Protection Agency as being superior technology for the treatment of surface water sources. According to the World Health Organization, "Under suitable circumstances, slow sand filtration may be not only the cheapest and simplest but also the most efficient method of water treatment."

Disadvantages

- Due to the low filtration rate, slow sand filters require extensive land area for a large municipal system. Many municipal in the world initially used slow sand filters, but as cities have grown, they subsequently installed rapid sand filters, due to increased demand for drinking water.

- Continuous Up flow Sand Filter

- Configuration and Principle

FILTER MEDIA

Most major water treatment plants in the world use filter media in the process of producing drinking water. This research describes and provides data on the main types of media commonly used, anthracite, Sand, garnet and support gravel. For each type of media the standard grades are listed and the hydraulic curves given. A page is provided where the specification of filter media is explained. The advantages of multimedia filtration are discussed as is the correct way of media installation.

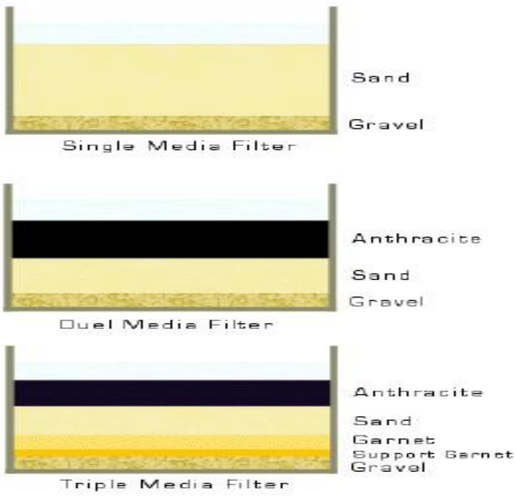

Figure 2: Examples of Filter Media

CONCLUSION

According to the results and the data obtained from literature studies, filter material ratio affected BOD removal efficiencies at the treatment performance

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of anaerobic filters. Especially, the removal efficiencies of anaerobic filter filled fully are more than the anaerobic filter having different filter material ratio. On the other hands, the operation mode of the anaerobic filters as well is significant from the point of COD removal efficiencies. The removal performance of filters operated as continuous mode is higher than anaerobic filter operated as semi-continuous mode. Moreover, it is incontestable that the temperature is effective on treatment performance. It follows from data obtained that temperature positively increases COD removal efficiencies.

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