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Case Report

MLVSS / MLSS ratio's standard value obtained from different aeration tank samples of different capacity sewage treatment plant - A case study

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ABSTRACT

Waste water treatment system plays a vital role in controlling pollution of natural water bodies like lake, pond, river etc., by Municipal and Industrial effluents. Different industrial effluents play its own role in contaminating the water bodies which in turn creates huge impact for aquatic and terrestrial life. From past studies we understood that, all the sewage treatment systems have a secondary treatment step which are mainly driven by Bacterial oxidation or in other terms can be pronounced as Biological augmentation, Biological calcification etc., In environmental engineering term this bacterial growth will be pronounced as MLSS (Mixed Liquor Suspended Solids) and MLVSS (Mixed Liquor Volatile Suspended Solids). MLVSS will be an inclusive part of the MLSS and also can be sorted as live bacterial cells which can really does the oxidation process in the secondary treatment step of Sewage treatment plant. Hence, this study was performed to evaluate the percentage or concentration of MLVSS available in the total value of MLSS. For this study aeration tank water samples were collected from 6 different STP capacities from 6 different areas. All the samples were tested for MLSS and MLVSS concentration with the available standard method of drying. Drying with 105° C in oven gives the value of MLSS and drying with 550° C in furnace gives the value of MLVSS. With all the tested samples the concentration of MLVSS from the total MLSS was evaluated and standardized.

1. Introduction

MLSS (Mixed Liquor Suspended Solids) are usually expressed in grams per litre (Water online, 2011). Mixed liquor is a mixture of activated sludge, settled sludge, live microbes and even dead cells contained in an aeration basin in the activated sludge treatment. The term MLSS is a general parameter used to design a wastewater treatment plant in the suspended growth process.[1] Most of the Sewage Treatment Plant designs were done with the consideration of MLSS as a critical operational parameter.[2] Different sewage treatment technologies such as Activated Sludge process (ASP), Sequential batch reactor (SBR), Fluidized air bed bioreactor (FBBR), Moving bed Bioreactor (MBBR), Membrane Bioreactor (MBR) etc., consider MLSS as a vital parameter for their design. MLSS concentrations have a direct impact on viscosity of the waste water.[3,4] Proper concentration of MLSS in the aeration zone can create a healthy environment for microbial survival and improves the settling velocities of the solids.[5,6] This study shows the vitality of MLVSS (Mixed Liquor Volatile Suspended Solids) which tend to be the live microbes facilitating a healthy aeration zone in any sewage treatment plant. Sewage treatment plant has BOD (Biochemical Oxygen Demand) as food and MLVSS as Microbes. Hence, always a healthy F/M

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(Food to the Microorganism ratio) to be maintained in any sewage treatment plant to have a better oxidation potential.

1.1. Food-to-microorganism ratio (F/M Ratio)

The aeration zone of waste water treatment unit is carefully controlled based on the food enters the system and microorganism fed on the food. Here the BOD (Biochemical Oxygen Demand) or COD (Chemical Oxygen Demand) considered to be the food entering the system and Bacteria oxidizes the same in the presence of oxygen. The microbes will most efficiently break down the organic matter in water if they are present in the right proportion.[6,7] Hence, the food to microorganism ratio (F/M ratio) should be maintained properly in the aeration zone. Always a comfortable F/M ratio will be considered for different technologies, since the retention time plays a vital role. Proper retention time helps the microorganisms to serve better in oxidizing the organic matter.[1]

1.2. MLSS and MLVSS

The term mixed liquor suspended solids (MLSS) also can be spelled as Total Suspended Solids (TSS) present in the Aeration zone of a Waste water treatment plant. MLSS test is made to find out the total grams of suspended solids available in the aeration system. This can be determined by using a filter disc which can filter the suspended solids and dried it at 105° C for 1 hour in hot air oven. MLVSS in other hand will help in determining the concentration of volatile suspended solids in the aeration basin. MLVSS is critical in determining the operational behavior and biological inventory of the system. The filter used for MLSS testing is ignited at 550°C for 30 minutes. The weight lost on ignition of the solids represents the volatile solids in the sample. On the whole MLSS is the suspended solids present in the aeration tank which include both organics and inorganic. MLVSS, on the other hand observed to be the volatile portion only, which basically means, this is the portion that are considered to be the microbes.[8]

Fig. 1: Stabilized aeration tank

Fig. 2: SSV (Settled sludge volume)

Fig. 3: Aeration zone front view

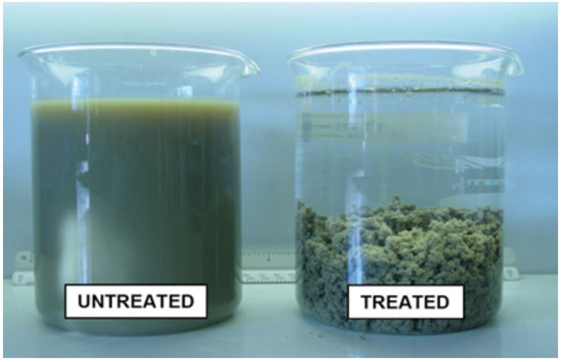

Fig. 4: Settled sludge

2. Materials and Methods

(Methods: APHA, 2012 Standard Methods for the Examination of Water and Wastewater, 22th Edition. 2540 A, D & E).

Procedure:

Step 1: First weigh the filter paper to get baseline weight. Make sure the filter paper is dry.

Step 2: Filter all 6 samples collected from the aeration tank of different STPs in the weighed filter paper.

Step 3: After filtration allow the filter paper to dry in an oven at 105° C for 1 hour.

Step 4: The dried filter paper is weighed in a weighing balance to obtain the MLSS value in grams.

Step 5: The same filter paper is then dried to ash in 550° C in a Muffle furnace for 30 minutes.

Step 6: Flash off the volatile organic fraction leaving inorganic portion of the MLSS.

Step 7: Now measure the volatile organic portion to obtain the value of MLVSS in grams.

2.1. Sewage treatment plant existing

Aeration tank samples from 6 different sewage treatment plants were collected for this study. All the sewage samples were taken from the existing treatment plant in and around the Bangalore location which was erected and commissioned by M/S. Green Enviro Polestar, Pondicherry. The treated water used for toilet flushing and gardening.

Sample 1 Project: Lakshmi Shree group Apartment, Whitefield, Bangalore.

Capacity: 80 KLD (Kilo litres per day) STP.

Technology: Sequential Batch Reactor (SBR)

Sample 2 Project: KERC (Karnataka Electricity Regulatory Commission Building, Bangalore).

Capacity: 100 KLD (Kilo litres per day) STP.

Technology: Sequential Batch Reactor (SBR)

Sample 3 Project: NCBS (National Centre for Biological Science, GKVK Campus Bangalore).

Capacity: 200 KLD (Kilo litres per day) STP.

Technology: Moving Bed Bioreactor (MBBR)

Sample 4 Project: Pyramid Banksia Apartment, Jakkur, Bangalore

Capacity: 280 KLD (Kilo litres per day) STP.

Technology: Moving Bed Bioreactor (MBBR)

Sample 5 Project: NPS (National Public School, Devanahalli, Bangalore)

Capacity: 40 KLD (Kilo litres per day) STP.

Technology: Activated Sludge Process (ASP)

Sample 6 Project: Homely Homes Tranquil Apartment, Hegde Nagar, Bangalore

Capacity: 25 KLD (Kilo litres per day) STP.

Technology: Activated Sludge Process (ASP)

3. Results and Discussion

The selected waste water samples from 6 different STPs were tested for the content of MLSS and MLVSS as elucidated in (METHODS: APHA, 2012 Standard Methods for the Examination of Water and Wastewater, 22th Edition. 2540 A, D &E). The obtained values of all the samples were tabulated separately. Triplicates of both the MLSS (Mixed Liquor Suspended Solid) and MLVSS (Mixed Liquor Volatile Suspended Solid) values were determined to get a standard result. Mean values were taken and sorted as the standard values for the future research. The results show that 68.85% of MLVSS concentrations available in all the selected STPs total MLSS Value.

Table 1: Sample 1: Lakshmi Shree group apartment, Whitefield, Bangalore

Sample 1				
	STP Capacity : 80 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x / n$) (mg/l)**
MLSS	3652	3451	3345	3482.66
MLVSS	2410	2456	2234	2366.66
MLVSS/ MLSS %	65.99	71.17	66.78	67.95

Table 2: Sample 2: Karnataka electricity regulatory commission building, Bangalore)

Sample 2				
	STP Capacity : 100 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x / n$) (mg/l)**
MLSS	2545	2322	2356	2407.66
MLVSS	1650	1453	1324	1475.66
MLVSS/ MLSS %	64.83	62.57	56.19	61.29

Table 3: Sample 3: National centre for biological science, GKVK campus, Bangalore)

Sample 3				
	STP Capacity : 200 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x / n$) (mg/l)**
MLSS	2844	2322	2541	2569
MLVSS	1866	1562	1654	1694
MLVSS/ MLSS %	65.61	67.26	65.09	65.94

Table 4: Sample 4: Pyramid banksia apartment, Jakkur, Bangalore

Sample 4				
	STP Capacity : 280 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x / n$) (mg/l)**
MLSS	3241	3427	3355	3341
MLVSS	2657	2451	2224	2444
MLVSS/ MLSS %	81.98	71.52	66.28	**73.15**

Table 5: Sample 5: National Public School, Devanahalli, Bangalore

Sample 5				
	STP Capacity : 40 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x$ / n) (mg/l)**
MLSS	2882	2754	2840	2825.33
MLVSS	1524	1850	1922	1765.33
MLVSS/ MLSS %	52.87	67.17	67.67	62.48

Table 6: Sample 6: Homely homes tranquil apartment, Hegde Nagar, Bangalore

Sample 6				
	STP Capacity : 25 KLD			
Description	**Replicate 1 (mg/l)**	**Replicate 2 (mg/l)**	**Replicate 3 (mg/l)**	**Mean Value($\mu = \sum x$ / n) (mg/l)**
MLSS	3850	3744	3785	3793
MLVSS	3210	3114	3044	3122.66
MLVSS/ MLSS %	65.61	67.26	65.09	82.32

Table 7: Average MLVSS % obtained from all samples

Description	Obtained Mean Value of MLVSS %	Average MLVSS %
Sample 1	67.95	
Sample 2	61.29	
Sample 3	65.94	**68.85 %**
Sample 4	73.15	
Sample 5	62.48	
Sample 6	82.32	

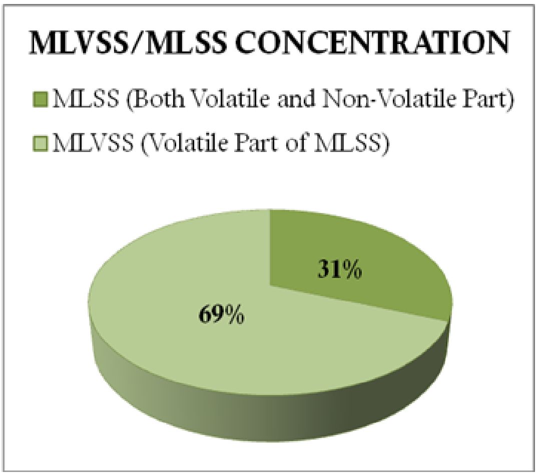

Fig. 5: Concentration of MLVSS present in the total MLSS

4. Conclusions

Both MLSS (Mixed Liquor Suspended Solids) and MLVSS (Mixed Liquor Volatile Suspended Solids) plays a critical role in the aeration tank design of any waste water treatment plants. MLVSS preference in aeration tank design can be most effective than the MLSS preference. Although most of the sewage treatment plant designs were made using MLSS value as a base line parameter scale, MLVSS value consideration will give high productivity and consistence. Hence, this study concludes that MLVSS standard value can be considered between 60% to 65% to get a high system efficacy.

5. Source of Funding

None.

6. Conflict of Interest

The authors declare no conflict of interest.

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