International Journal of Advanced Research in Engineering and Applied Sciences

ISSN: 2278-6252
Impact Factor: 4.817

NAJAFGARH DRAIN-SAMPLING AND ANALYSIS

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Abstract: *Over the past years, due to rapid industrialization and advanced agricultural activities environmental deterioration is becoming a major concern. Water is one of the most important and basic natural resource which is being used in industries, agricultural activities as well as for the domestic and commercial purpose. These activities leads to discharge of wastewater, hence, accurate analysis of wastewater is crucial for maintaining the health and safety of the people. Water from all three sectors i.e. domestic, industrial and agriculture contribute into wastewater loads in the Najafgarh Drain in south-west Delhi. For this purpose the south-west Delhi stretch, near Dwarka, of the Najafgarh Drain was chosen to be analyzed for its wastewater quality parameters. On the same stretch of the Drain, treated wastewater from the Najafgarh Wastewater Treatment plant is also disposed. The present study deals with the comparison between the wastewater quality before and after the input of the treated drain water in the Drain. The flow and velocity of the drain water is estimated during the sampling period. The comparative analysis of the quality of wastewater before and after the Najafgarh Wastewater Treatment Facility indicates that there is positive improvement in the quality of water after the input of the treated wastewater, which is expected. These results can provide a basis for further studies and planning of facilities that can aid to solve the problem of deterioration of the natural resources and environment.*

Keywords: *Water Pollution, Yamuna, Delhi, India*

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1.0 INTRODUCTION

Today, surface water accounts for the majority of Delhi's water supply. In 2005-06, surface water accounted for 88% of the total water supplied to Delhi [1]. The stretch of River Yamuna within Delhi is 22 km long and is considered a major source of fresh portable water [2]. Of the surface water used to supply water to Delhi, 60% comes from the river Yamuna alone. In order to meet the drinking water requirement of the city, no freshwater is released from the upstream barrage at Wazirabad whereas a large quantity of wastewater is discharged further downstream through over 18 drains into the river. It should be noted that the total installed sewage treatment capacity in Delhi is 2,460 million litres per day (MLD) as against the sewage generation of about 3,800 MLD [2]. Presenting the report to a bench of Justices Swatanter Kumar and S J Mukhopadhaya, CPCB counsel Vijay Panjwani said, "Yamuna is a drain. Fresh water does not flow in the river except during monsoon. The entire flow of fresh water is harnessed at Wazirabad to provide drinking water to residents of Delhi." [3].

Najafgarh drain is the major source of pollution for River Yamuna. Najafgarh drain alone discharges about 2,000 MLD of waste water into Yamuna. Of this, only 600 MLD (30%) of waste water is treated through the installed wastewater treatment systems along the Najafgarh drain basin. It clearly indicates that there is huge amount of wastewater (approximately 1,400 MLD) which remains untreated. Further it should be noted that after treatment, the treated sewage from the sewage treatment plants is discharged in the Najafgarh drain. This leads to mixing of the untreated sewage with the treated, thereby defeating the very purpose of waste water treatment [2]. Due to this fact the stretch of area along the Najafgarh drain has become a concern for environment and health.

1.1 NAJAFGARH DRAIN

Najafgarh Drain originates in Alwar-Rewari region of Rajasthan and Haryana in the Arawali Hills. As shown in Figure 1, it enters National Capital Territory (NCT) of Delhi on the south western side and traverses a length of 40 km before joining Yamuna in the north.

ISSN: 2278-6252
Impact Factor: 4.817

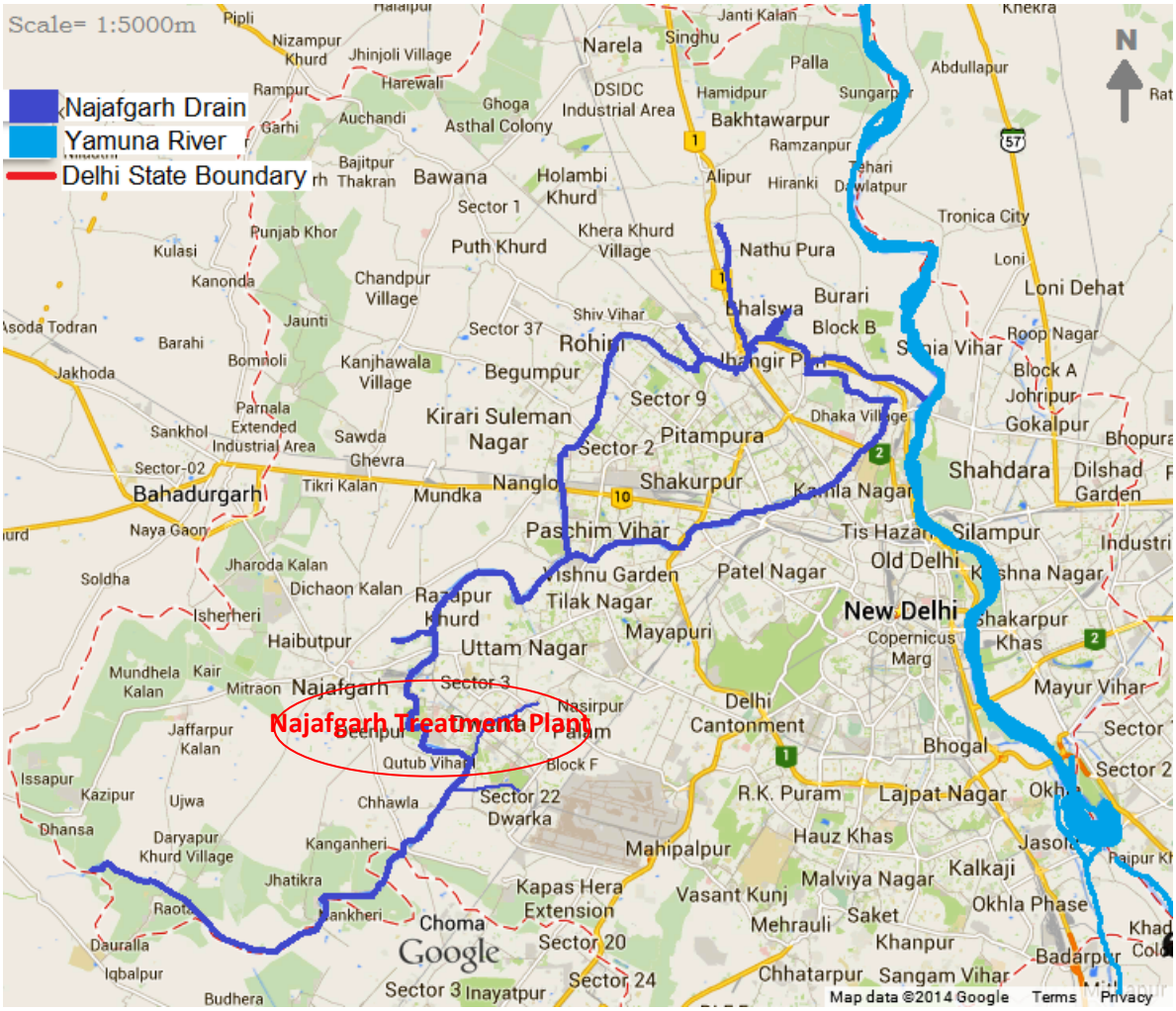

Figure 1: Location of Najafgarh Drain in Southwest Delhi

The severed catchment area of the Drain is approximately 400 km^2. Due to severe constraints in the sewerage system, the Najafgarh Drain carries large amount of raw sewage. Figure 2 shows the dirty water presently flowing through the Drain.

Figure 2: Dirty water in the Drain

In addition, it receives treated effluent from various Sewage Treatment Plants (STP's) and freshwater from Western Yamuna Canal. The combined discharge is over 2100 Million Litre per Day (MLD) out of which about 600 MLD (30%) is treated which represents 50% of hydraulic load and over 25% of inorganic load from NCT Delhi into river Yamuna [4].

The flow in Najafgarh Drain is divided into three Stages. The Background Flow is about 150 MLD before the drain enters into NCT Delhi. Almost 40% flow is untreated while the rest 60% is discharged after conventional treatment [5]. This water has a BOD of around 100 mg/L.

Next is the flow that originates from Delhi. Due to limited sewerage systems, large quantities of untreated sewage from the secondary drains enter the Najafgarh Drain. As per a study, 38 out of the identified 48 secondary drains carry significant flows [6]. Water from all three sectors i.e. domestic, industrial and agriculture contribute into wastewater loads in the Najafgarh Drain. The largest contributor is the domestic sector due to a large population living around the drain. Around 1340 MLD wastewater is discharged from the domestic units followed by 150 MLD from industries and a negligible contribution from agriculture. Approximately 78% of BOD is contributed by the Domestic sector. All these sources and various anthropogenic activities are adding harmful substances, oxidized organics, inorganic, suspended solids, sewage and harmful pathogens into the Najafgarh Drain.

In the final stage, dilution of waste water takes place due to addition of 450MLD fresh water from the Western Yamuna Canal. Here BOD dilution of about 65% takes place just at the outfall into river Yamuna and is reported to be 125 mg/L [6].

2.0 SCOPE OF THE PROJECT

A number of wastewater treatment plants have sprung up around the Drains in Delhi yet no significant impact has been observed on the overall water quality in the drains.

Therefore, the scope of the project was to analyze Najafgarh Drain for its water quality in order to contribute to studies concerning wastewater monitoring and management. This study also aims at providing a vision to encourage further studies and planning of facilities that can aid to solve the problem of deterioration of the natural resources and environment.

3.0 SAMPLING

3.1 SAMPLING LOCATION

Two sampling locations were chosen, the 1st Sampling Station was after the Najafgarh Sewage Treatment Plant, named as, *After Confluence* and the 2nd Sampling Station was before the Najafgarh treatment plant, named as, *Before Confluence*, in the rest of the paper. The locations of the sampling points are shown in Figure 3.

Figure 3: Locations of sampling points

3.2 SAMPLING PROTOCOL

The protocol adopted for sampling was taken from the CPCB's "*Guide Manual: Water & Wastewater Analysis, 2011*". The method adopted for sampling was "Composite Sampling". Composite Samples provide a more representative sampling of heterogeneous matrices in which the concentration of parameters of concern may vary over short periods of time or space. Composite Samples can be prepared by combining portions of multiple "Grab Samples".

In this study, 8 samples were collected on hourly basis once in a week over a period of 6 weeks, from 10:30-17:30 hours. A representative sample was then prepared by mixing 100ml of each sample obtained over the day [7]. A sampling depth of 0.6m (i.e.2ft) was maintained during sampling.

3.3 SAMPLE TESTING

The Sample Testing Procedures were taken from the CPCB's "*Guide Manual: Water & Wastewater Analysis, 2011*". The samples collected were tested for various Wastewater

parameters like Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) by Open Reflux Method and Nitrates by UV Spectrophotometer at 220 nm. The other parameters which were tested were pH, Dissolved Oxygen (DO), and Total Dissolved Solids (TDS).

4.0 MEASUREMENT OF FLOW AND VELOCITY

The flow of the drain was determined by "Velocity Area Method", taken from the CPCB's "*Guide Manual: Water & Wastewater Analysis, 2011*". In this method the discharge of water (m^3/s) was estimated based on the velocity of the water and the cross-sectional area of the drain. Velocity was calculated using a floating Ball which acted as a surface float. The float was allowed to float over a length of 20 m and time taken by the ball to travel this distance was recorded. Furthermore the cross-sectional area of the drain was calculated by measuring the dimensions (width and depth) of the Drain. Hourly flow measurements were carried out on the days of sampling itself and the results were noted.

5.0 RESULTS AND DISCUSSIONS

The results obtained for various parameters of representative samples tested are discussed below:-

Legends for result interpretation :

[S1 - Sampling Station 1 - After Confluence ; S2- Sampling Station 2- Before Confluence]

■ After Confluence ■ Before Confluence

5.1 DISSOLVED OXYGEN (DO)

The results show that DO varied between 5.3 mg/L to 5.7mg/L in the samples collected after confluence, as shown in Figure 4, whereas in the samples collected before confluence, the DO varied between 3.7mg/L to 4.7mg/L (Figure 4). The higher values of DO obtained after confluence indicate that the water is cleaner as compared to water before confluence. This probably is because of the dilution of drain water after getting mixed with the cleaner discharge from the Najafgarh Sewage Treatment Plant.

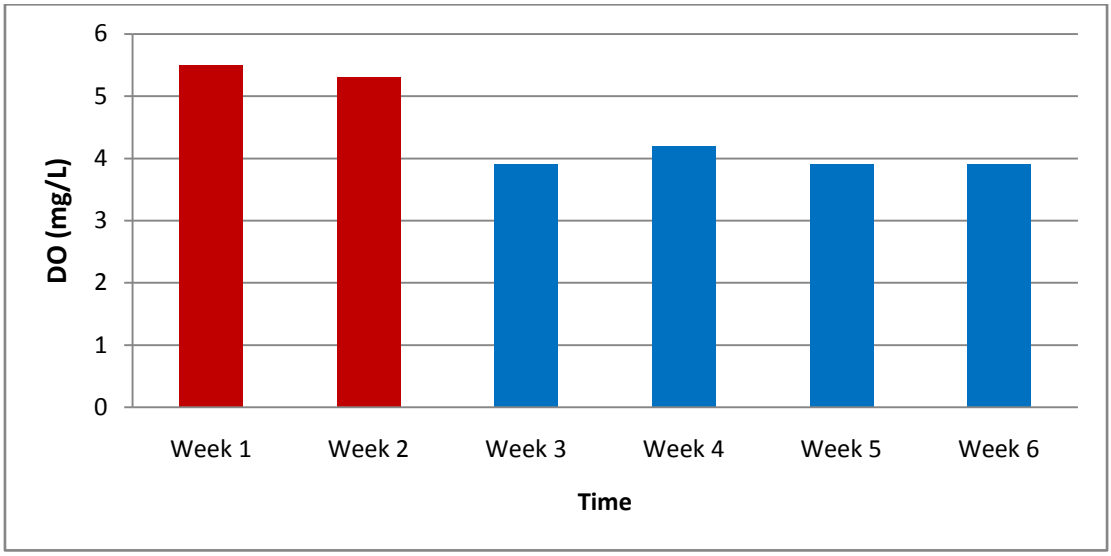

Figure 4: DO Variations

The DO level after confluence is more than 5mg/L and therefore is not expected to contribute stress to aquatic life but the DO values before confluence is less than 5mg/L which may impact aquatic life negatively.

The DO values observed during morning hours were relatively lower than DO values of the subsequent hours. This can be attributed to the fact that during night time photosynthesis does not occur in plants and the oxygen present in the stream is consumed by the microbes to meet the oxygen demand leading to Anaerobic Conditions. Foul smell around the drain was sensed in the morning hours which could be due to the development of anaerobic conditions.

5.2 BIOCHEMICAL OXYGEN DEMAND (BOD_5)

Similar to DO, it was observed that the value of BOD was lower in samples collected after confluence than the samples which were collected before confluence which probably can be attributed to the fact that water after confluence is diluted due to mixing with discharges from Najafgarh Sewage Treatment Plant of capacity 5MLD.

The high BOD value in the samples collected before confluence can be attributed to the presence of high amount of organic waste (Domestic Sewage) and a high concentration of nutrients such as Nitrates and Phosphates which allow the microorganisms to flourish and decompose organic wastes in water [8].

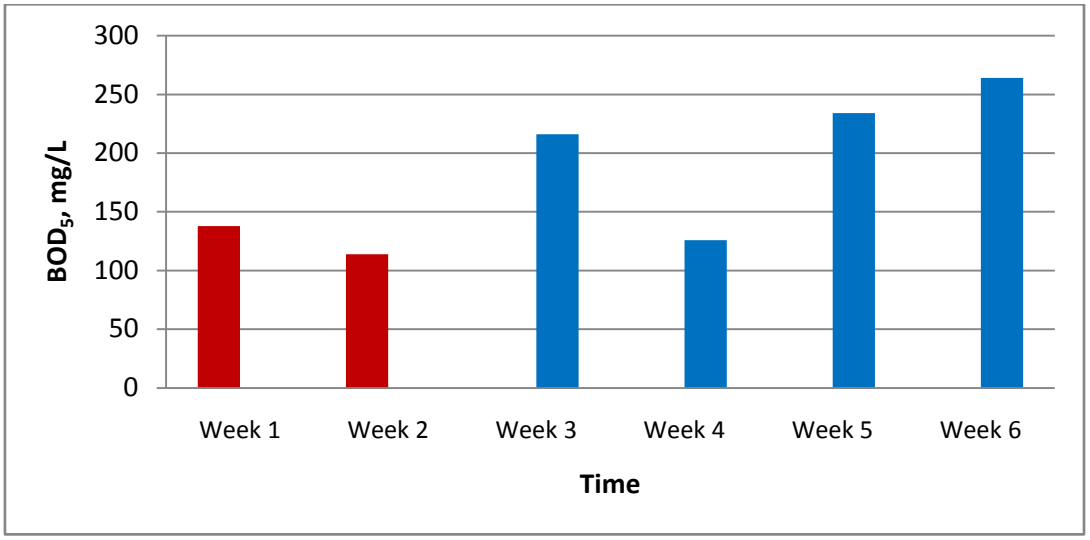

Figure 5: BOD_5 Variation

5.3 NITRATE

It was observed that the nitrate values ranged between 7-8 mg/L (Figure 6). For reference purposes it should be noted that the nitrate levels in the drain is below the discharge limits for nitrate for treated wastewater which is 10 mg/L [9].

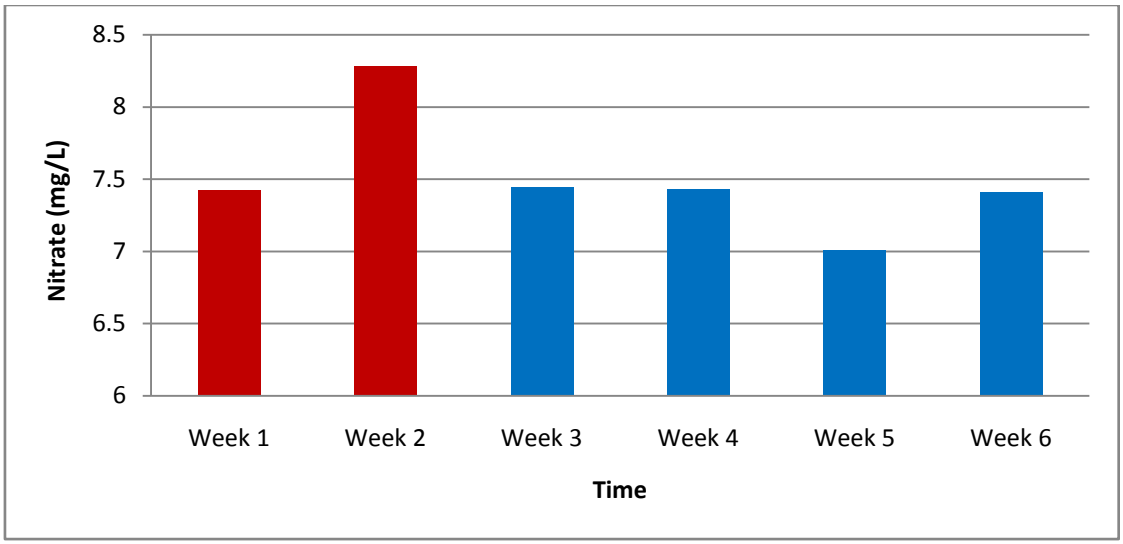

Figure 6: Nitrate Variation

5.4 TOTAL DISSOLVED SOLIDS (TDS)

Similar to DO and BOD, it was noted that the quality of water was improved after the treatment plant. TDS level was found to be almost double at the sampling station before confluence as compared to the TDS of the samples collected after Confluence. This is probably due to the dilution of drain water polluted with high amount of raw domestic

sewage, caused by the mixing of effluent coming from the Najafgarh wastewater treatment plant.

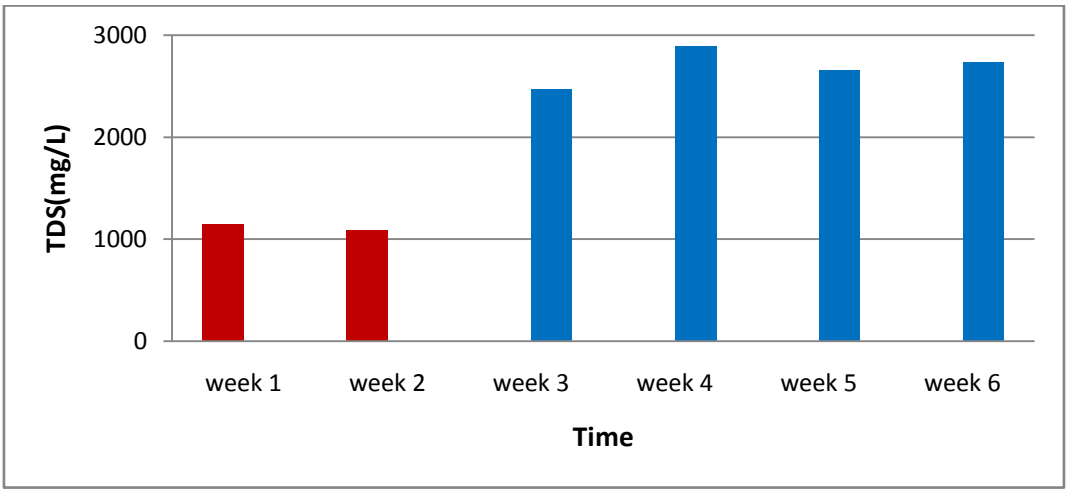

Figure 7: Variation in TDS

5.5 CHEMICAL OXYGEN DEMAND (COD)

The average value of COD before confluence is around 600 mg/L whereas the average COD value after confluence is around 125 mg/L. This shows that the water after confluence is cleaner because of mixing with the discharge from the Najafgarh waste water treatment plant.

All the water quality parameters above show a positive impact of the treatment plant on the Drain water quality.

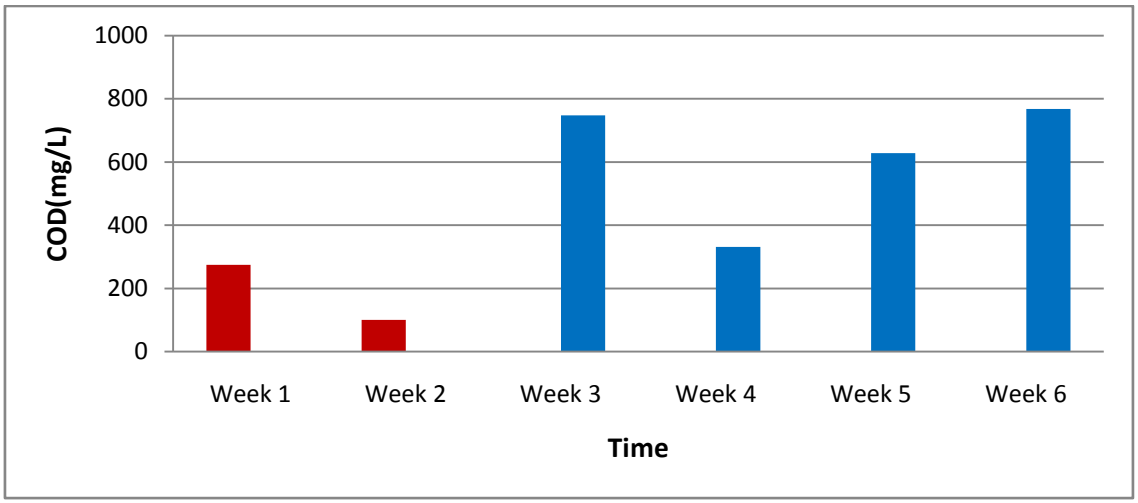

Figure 8: Variation in COD

5.6 FLOW

The velocity and the flow of the drain were calculated using the hourly sample data. It was observed that the flow peaks during midday. The velocity in the drain was observed to be in

the range between 0.27m/s to 0.29m/s. The average flow in the drain was seen to be between 55m^3/s to 65m^3/s.

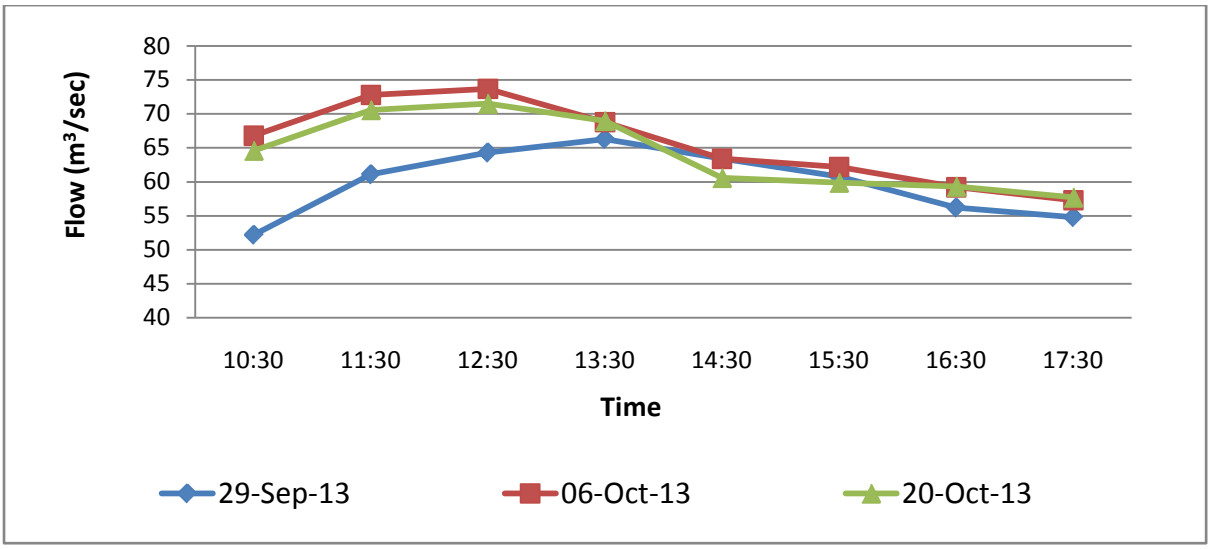

Figure 9: Flow Variation

6.0 CONCLUSIONS

Sampling was done for two months and the results were analyzed. It was also observed that velocity and the flow of the drain was maximum during mid day. The average velocity in the drain was observed to be between 0.27m/s to 0.29m/s. The average flow in the drain was seen to be between 55m^3/s to 65m^3/s.

The values of BOD_5, COD and TDS in the samples collected before confluence were substantially higher than the values obtained in the samples collected after confluence. It was also observed from the results of the samples collected after confluence that D.O. varied between 5.3mg/L to 5.7mg/L whereas before confluence D.O. varied between 3.7mg/L to 4.7mg/L. It should be noted that the water quality before and after the Najafgarh Sewage Treatment Facility differ substantially. All the data conclusively shows that the water in the Drain was comparatively cleaner before the input of the treated wastewater from the Wastewater Treatment facility.

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