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REMOVAL OF TOTAL DISSOLVED SOLIDS AND SUSPENDED SOLIDS FROM VISHWAMITRI USING ANSYS FLUENT

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ABSTRACT:
Rivers all round the world are pressurized due to growing industrialization and urbanization. Rivers of Gujarat are also bound to this pressure, this paper discusses about study conducted on Vishwamitri River flowing through Vadodara city. Significant difference has been observed in the water quality of the river before it enters the Vadodara city and after is leaves the city limits. This paper aims to find the amount of total dissolved solids (TDS) and suspended solids (SS) present in the Vishwamitri River through its course of flow in Vadodara and design a coagulation tank using Ansys workbench. In this project, the software is used to model a coagulation tank and study the flow of water, mixing of coagulant and formation of scum and sludge inside the tank.

Keywords: Total Dissolve Solids, Total Suspended Solids, Coagulation tank.

Introduction:

Water pollution in rivers is posing a major threat to flora and fauna residing in the rivers. It is estimated that nearly 80 percent of the world's population lives in areas where rivers are highly polluted. Rivers of Gujarat are no exception to this global scenario. Rivers like Sabarmati, Vishwamitri, Tapi and Aji are loaded with tons of industrial pollution, sewage and garbage every day.

Vishwamitri River flowing through Vadodara has turned into sewage and the river cannot support life as it used to 60 years back. Vishwamitri is a seasonal river which flows east to west between the Mahi and Narmada rivers in Gujarat. The Vishwamitri flows west through the city of Vadodara and joins with the Dhadhar and Khanpur River and empties into the Gulf of Khambat. As it flows through Vadodara, the Vishwamitri River is subjected to the drainage of the city's sewage and effluents from nearby industries. The river is a home to crocodiles. The water quality degradation has seriously affected the survival and habitat of crocodiles in various ways.

The total domestic sewage generation from Vadodara city is about 215 MLD out of which the treatment is being given to only 180 MLD of the sewage. The treated and untreated wastewater is let out into the river. The major water quality issues are high organic, nutrient and dissolved solid load. (Central Pollution Control Board) CPCB has categorized Vishwamitri River as one of the most polluted river in India.

In this paper, samples of Vishwamitri River water were collected from three locations across Vadodara City and studied for Total dissolved solids (TDS) and suspended solids (SS) present in the samples. And a coagulation tank has been designed using ANSYS workbench. This model shows the movement of river water inside the tank when mixed with the coagulant and removal of TDS and SS by formation of sludge and scum respectively.

Experimental Work:

PRESENCE OF SS AND TDS IN VISHWAMITRI:

Samples of Vishwamitri river water are collected from three locations across Vadodara namely from

- Location 1: Karelibaug
- Location 2: Kirti Mandir, Sayajigunj
- Location 3: Vadsar Bridge, Manjalpur

Two samples are collected from each location and amount of TDS and SS is found out in the laboratory.
A well-mixed 10ml sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish on a water bath and dried to constant weight. The increase in dish weight represents the total dissolved solids. The residue which remains after filtration is also dried in an oven. The increase in weight of filter paper represents total suspended solids.
W1: Weight of clear porcelain evaporating dish
W2: weight of the dish and residue

Total Dissolved Solids (per 10ml of sample)

Set 1

Location	W1(gm)	W2(gm)	W=W2-W1
Karelibaug	57.596	57.602	0.006
Kirti Mandir	66.079	66.083	0.004
Manjalpur	62.758	62.749	0.009

TABLE 1 Readings of TDS

Set 2

Location	W1(gm)	W2(gm)	W=W2-W1
Karelibaug	61.646	61.649	0.003
Kirti Mandir	67.417	67.424	0.006
Manjalpur	49.990	49.974	0.007

TABLE 2 Readings of TDS

Total Suspended Solids (per 10 ml of sample)

Set 1

Location	W1(gm)	W2(gm)	W=W2-W1
Karelibaug	1.1000	1.1007	0.0007
Kirti Mandir	1.1125	1.1129	0.0004
Manjalpur	1.0954	1.0960	0.0010

TABLE 3 Readings of SS

Set 2

Location	W1(gm)	W2(gm)	W=W2-W1
Karelibaug	1.1111	1.1119	0.0008
Kirti Mandir	1.0792	1.0805	0.0013
Manjalpur	1.0715	1.0723	0.0008

TABLE 4 Readings of SS

Following are the readings obtained after taking an average of the above obtained results and converting to per liter of the sample:

Location	Amount of TDS	Amount of SS
Karelibaug	450 mg/L	75mg/L
Kirti Mandir	550 mg/L	84 mg/L
Manjalpur	750 mg/L	90 mg/L

TABLE 5 Amount of TDS and SS obtained

REMOVAL OF TDS AND TSS

Total dissolved solids and suspended solids obtained above can be removed from the Vishwamitri samples using the method of coagulation. Coagulation is the process in which chemicals are added to induce aggregation and settling of finely divided suspended matter, colloidal substances and large molecules. It is known is sedimentation with coagulation or simply clarification.
To design a coagulation tank, the sample of Vishwamitri is studied for the type and amount of dosing of coagulant. A pH test helps in deciding the type of coagulant to be added to an extent amongst other factors. The pH of samples is found out to be 7.2 ± 0.3 and hence alum or aluminum sulphate is used as a coagulant. Amount of dosing is decided using a jar test which comes out to be 20mg/L.

DESIGN OF TANK

Amount of water to be treated: 30MLD
Dose of alum: 20mg/L
Detention time: 30sec

Quantity of alum needed on daily basis = $(20x30x10^6)/ 10^6$
= **600Kg/day**

Maximum discharge= $30x10^6x10^{-3}x1.5$
= **$45000m^3$/day**
= (45000)/ (24x60x60)
= **$0.52m^3$/s**

Volume of tank = discharge x detention time
= 0.52x30
= 15.6
~ **$20m^3$**

Depth of tank is taken as 3m. Design parameters for a sedimentation tank is from 3:1 to 5:1 hence taking 4.4m length and 1.5m breath.
Tank dimensions**: 4.4mx1.5mx3m**

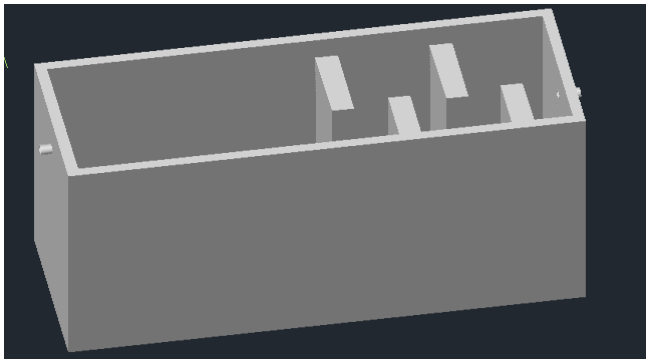

Figure 1. Geometry of tank

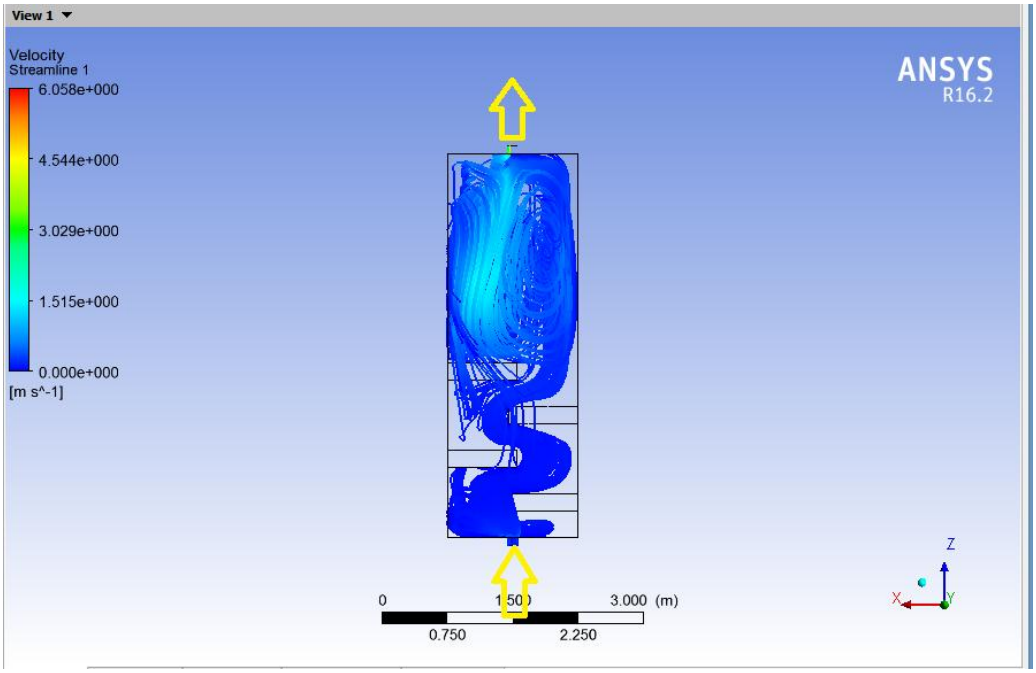

Figure 2. Plan view of tank

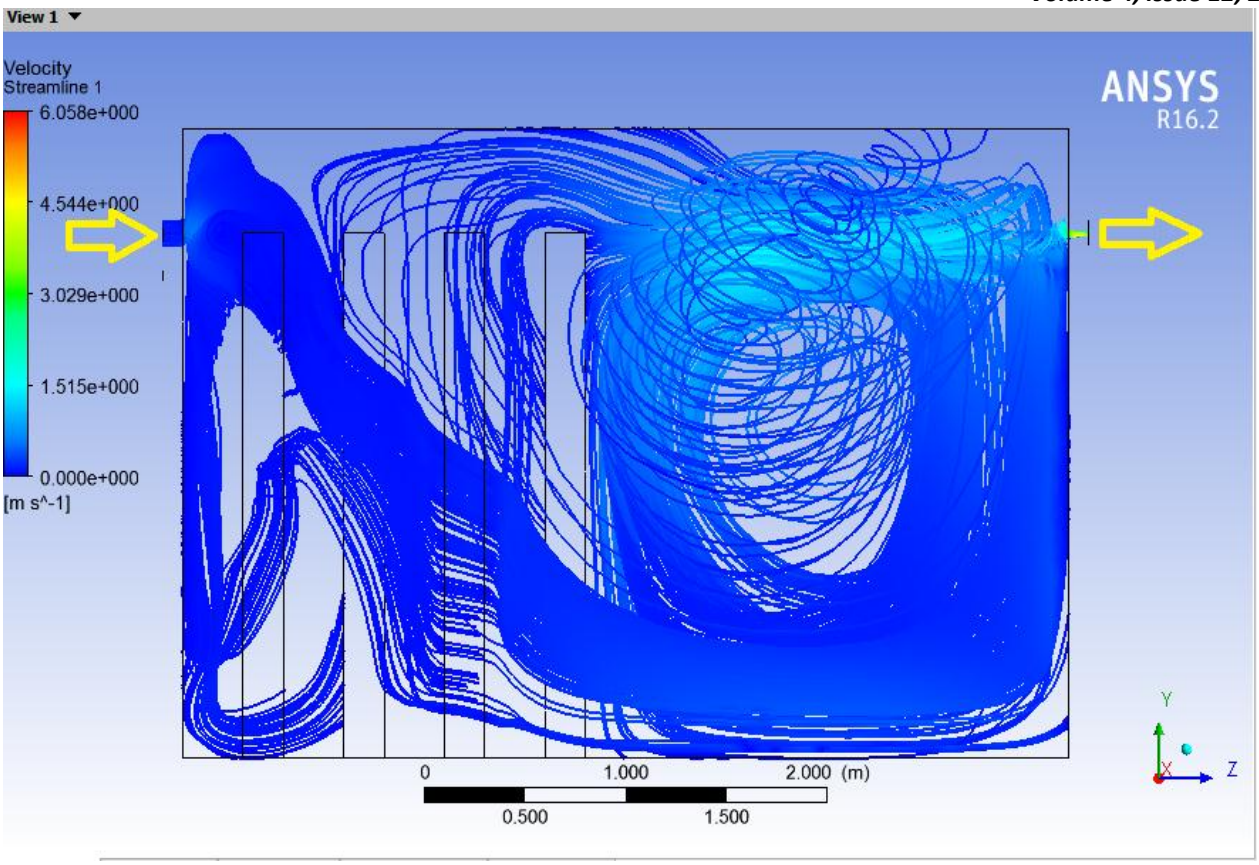

Figure 3. Isometric view of the tank

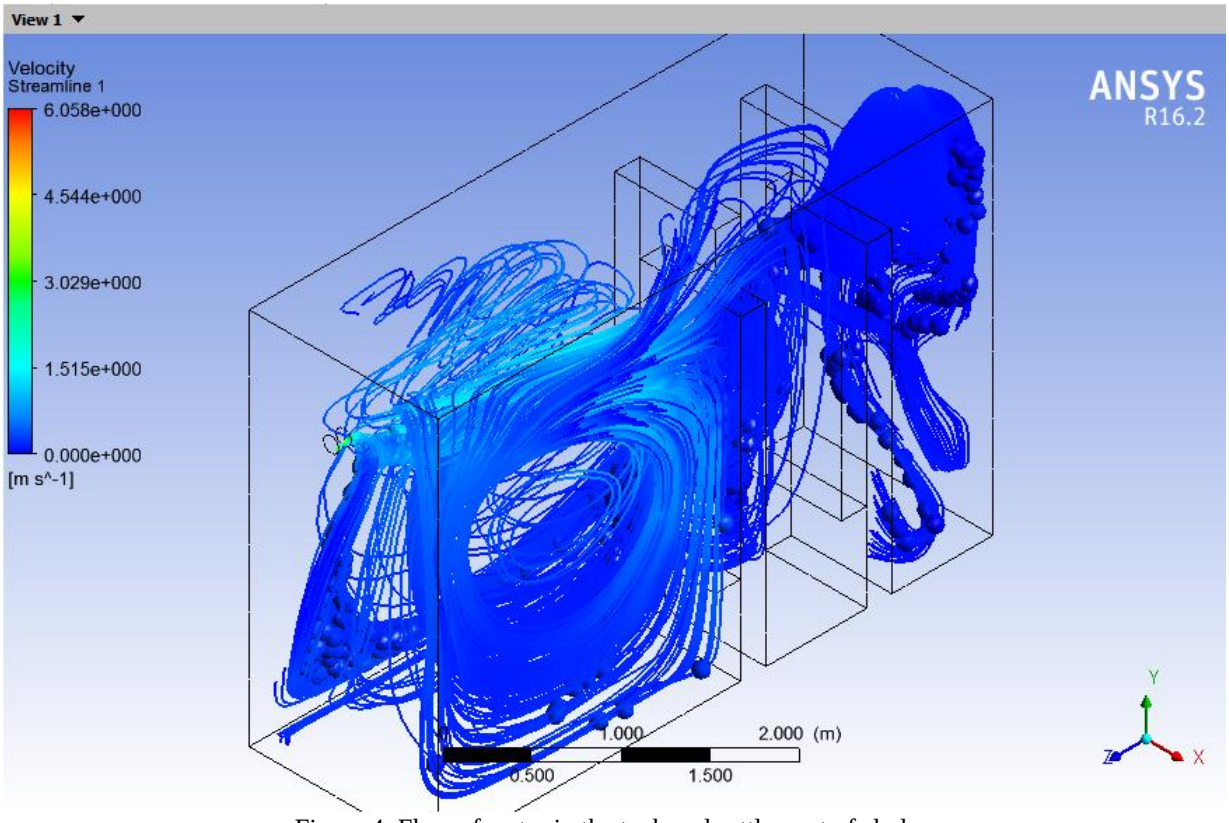

Figure 4. Flow of water in the tank and settlement of sludge

CONCLUSION

The present study concludes that the water of Vishwamitri River showed good quality and low pollution before entering the Vadodara city. From the locations studied it is observed that TDS and SS amounts are minimal at Karelibaug from where the river enters the city and maximize as it reaches Manjalpur.

If coagulation is applied to the river water as proposed in the report, 40% of suspended solids can be removed, i.e. **the efficiency of the tank is 40%**

It is recommended that proper disposal of sewage through sewage lines should be done out of the city limits to improve the water quality of the river. Solid waste dumping along the river bank should be avoided through proper identification of dumping sites and better mechanism of door to door collection of garbage.

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