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In-situ treatment of Municipal Wastewater directly discharging to the river Ganga

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Abstract: *Both the central and state Government are spending huge amount of money for abatement of pollutions to the river Ganga. Now G.O.I has introduced a "Namami Ganga Mission" where the sewage from every house, from the municipal drains and canals have been Intercepted and Diverted to the Sewage Treatment Plant via Lifting Stations, and discharging the same after treatment. Constructional activities in all those processes are huge and monetary involvements are also fabulous. So, in-situ treatment in the canals and drains may be a solution to tackle the pollution loads directed to rivers and hence in-situ treatment like Bio-remediation, Phyto-remediation, attached-growth etc. are now used in different locations. But in case of in-situ treatment by Depth Filtration is unique one as the process is cost effective, monetary involvement is very less. The Whole unit may be installed above the HFL of the canal so that it may not affect the normal flow of the canal. The effluent standard obtained from this treatment is quite satisfactory and BOD, COD and TSS removal efficiency in the Depth filter process is 98%, 96% and 99% approximately from highly polluted sewage.*

Key Words: *BOD, COD, TSS, DO, FC, Depth Filtration.*

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I. Introduction:

It is fact that the sewage is directly discharging into the river Ganga which is polluting the river. The pollution load in the river is increasing day by day mainly the Total Suspended Solids, BOD and the feacal coliform. The domestic sewage contains high BOD and TSS with an alarming proportion of feacal coliform coming out from the sanitary sewage. It is the main concern to us to treat that sewage before it falling into the river Ganga or any water body connected with the river. This comprehensive Municipal waste water scheme comprises of house to house connection to the Trunk sewer and diverted it to the sewage treatment plant by the help of Lifting Station and Main Pumping Stations. The dry weather flow in the drains or canals are intercepted and diverted to the sewage treatment plant was done in the GAP Phase – I & II scheme. Now, for executing of the vast process is not only time consuming but also involve huge financial cost. Due to this NMCG and NGRBA has proposed for installation of in-situ treatment of sewage in the canal or drain before it discharges to the river Ganga.

II. Objectives:

Removal of organic and inorganic colloidal and suspended solids is typically accomplished by filtration. The domestic sewage / municipal waste generally contains the constituents require removal are broadly categorized (1) Removal of organic and inorganic colloidal and suspended solids, (2) dissolved organic constituents & inorganic constituents (3) Biological constituents.

Removal by filtration of the organic and inorganic colloidal and suspended solids has been categorized by three classifications- (1) Depth filtration, (2) Surface filtration, (3) Membrane filtration. In depth filtration, the removal of suspended materials occurs within and on the surface of the filter bed. In surface and membrane filtration, the suspended materials are removed by straining surface (i.e. filter cloth) or a thin supported membrane.

In our case some open channels and Nullahs are identified and these are discharging to river Ganga directly and polluting the river heavily. We have inspected most of the sites and it is observed that in most of the cases these are thickly populated slum area along the bank of those Nullahs and there is hardly any space for installing any conventional type of Sewage Treatment Plant.

The raw sewage in some Nullah has been examined and it is seen that the BOD load, TSS and feacal coliforms are the main constituents of the pollution load apart from other marginal pollution from other dissolved solids.

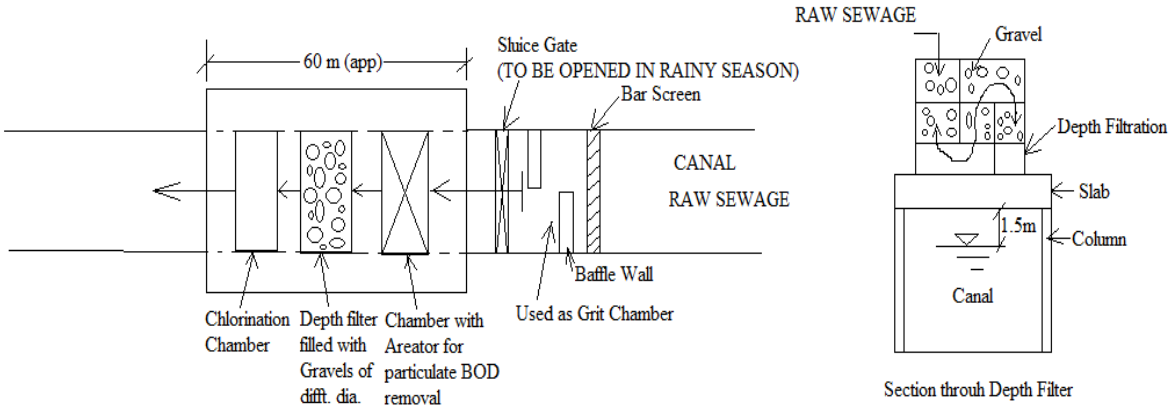
So, we chose the "Depth Filtration followed by surface chlorination" for treatment of the pollutants. Mainly depth filtration by providing of gravels have been proposed with pretreatment by the process of aeration

for reduction of BOD load and lastly the effluent will be treated with "bleaching powder" to minimize the feacal coliforms.

III. Method And Methodology:

Depth filtration is mainly done for removal of particulate material suspended in sewage by passing the sewage through a filter bed comprising of filter media of different diameter. Depth filter is now used for supplemental removal of suspended solids (including particulate BOD) from the waste water effluent of biological and chemical treatment process to reduce the mass discharge of solids and perhaps importantly as a conditioning step that will allow for the effective disinfection of the filtered effluent. Depth filtration is used as pretreatment unit also before membrane filtration.

Horizontally the depth filtration process developed for treatment of waste water was slow sand filter (typical filtration rate 30 to 60 L/m^2/day) [Frankland (1870) and Dunbar (1908)].



Schematic Arrangement of In-situ Treatment at the Canal

A view of the treatment units

The basics of depth filtration shall comply:
1)Filter medium characteristics
2)The physical features of a conventional granular medium based depth filter.
3)The filtration process by which the suspended materials will be removed.
4)The operative particle removal mechanism that bring about the removal of suspended material within filter.

5)The backwash process in which the retained suspended materials within the filter media is removed.

Before entering into the depth filter the waste water will be first pumped to a hopper bottom type aeration chamber of diameter 1000mm and 1350mm high, where aeration of 3-5 min of waste water will be carried out to raises the D.O. level in the waste water and also some of the BOD load in the waste water will be reduced due to aeration. Then the waste water will be kept ideal for 5 min in the chamber where sedimentation of some inorganic and organic materials will take place. The supernatant of the liquid is being taken to the filler as the influent. The influent rate of raw sewage to the depth filter is 25m/h. The aeration chamber will be cleaned as and when necessary by opening the valve fitted at the hopper bottom and directly put to the "Cease Pool" to carry it to the solid waste dumping ground. The influent waste water in the filler will pass through 4 (four) layers of gravel of different sizes. There will be four compartments in the chamber of the depth filter, the influent waste water will move from one chamber to another as downward movement and upward movement as the case may be. The purpose of making chambers is to increase the travel path of the waste water which will remove the suspended solids particulate BOD and to some extent the feacal coliform which are all the pollutants to be removed from waste water. The size of the depth filter in laboratory scale is 1m x 1m with a height of 1.5m. The depth of filter media in the entire four chambers is 1200 mm keeping 300mm in each chamber. The width of each chamber is 250 mm. The filter box is made of by galvanized iron sheet of 4mm thick partitions are made at a distance of 250mm. The filter media kept here is gravel of different diameter is 1st chamber it is ranging from 25mm to 20 mm, in 2nd chamber 20-15mm in 3rd chamber 15mm to 10mm and at last chamber it is 10 mm - 6mm. The waste water in first compartment will move downward but in 2nd compartment it will move in upward direction in 3rd chamber also as downward direction and ultimately in 4th chamber it will move in upward direction and the effluent will be taken from the 4th compartment. The effluent coming out with a rate of 20m/h is then collected to another chamber where chlorination of the waste water by bleaching powder will be done with a contact time of 5-10 min to destroy the feacal coliform. Then the effluent will discharge to the downstream side of the canal for discharging it to river.

The depth filter will be backwashed from the fresh water tank fitted at a height from the depth filter for exerting a required head and clean water will pass through the depth filter with a specified head and the backwashed water will be collected in the opposite side of the effluent water.

IV. Results & Discussion:

During collection of first fourteen sets of samples from the field samples of raw sewage were also collected and it was observed that presence of different pollutants in the raw sewage was moderate. To increase the presence of pollutants cow dung was mixed with the raw sewage and then it was applied in the treatment system to check its ability to treat heavily polluted sewage. Performance of the treatment unit was analyzed separately for heavily polluted and moderately polluted sewage. Hence values of different parameters of heavily polluted and moderately polluted sewage are shown separately below:

COLLCTION OF FIELD DATA AND ANALYSIS (Parameter wise data obtained from laboratory te

Set no	BOD1	BOD2	BOD3	COD1	COD2	COD3	TSS1	TSS2	TSS3	FC1	FC2	FC3	C1	C2	C3
1	2.8	1.7	1.5	16	10	8	2	1.5	1.3	450	0	0	20	10	10
2	5.4	2.8	2.5	18	10	8	19	2	1.8	68000	2000	1800	10	5	5
3	5.5	1.4	1.2	27	12	10.5	55	26	23	2200	170	110	50	25	20
4	6.4	5.6	2.6	23	18	9	26	3	2.8	4000	20	18	15	10	5
5	6.9	1.6	1.4	34	10	8	68	4.5	3.8	22000	11000	0	25	10	10
6	6.9	2.8	1.9	48	15	12	75	6.2	3.9	15000	8400	2400	25	10	10
7	7.7	3.1	2.8	39	20	18	24	2	1.8	17000	45	0	20	10	10
8	7.9	3.1	2.3	36	16	12	33	3.5	2.8	22000	14000	0	20	10	5
9	8	3	2.8	34	11	9	19	6	4	2200	1100	0	15	10	10
10	11	3.1	2.9	39	10	9.4	26	10	8	93000	2000	1500	10	5	5
11	13	1	0.8	42	6	4.5	56	5	4.3	210	68	58	50	20	15
12	13.4	2.9	2.9	51	12	12	17	2	1.8	6800	6.8	0	20	10	10
13	18	2	1.8	65	11	9	24	11	9	17000	930	700	20	5	5
14	39	2	1.8	72	11	9	42	3	2.6	1400	6.8	0	15	5	5

BOD1- Effluent BOD of aeration chamber, mg/L, BOD2- Effluent BOD of filter, mg/L, BOD3- Effluent BOD of chlorination tank, mg/L, COD1- Effluent COD of aeration chamber, mg/L, COD2- Effluent COD of filter, mg/L, COD3 Effluent COD of chlorination tank, mg/L, TSS1- Effluent TSS of aeration chamber, mg/L, TSS2- Effluent TSS of filter, mg/L, TSS3- Effluent TSS of chlorination tank, mg/L, FC1- Effluent Feacal Coliform of aeration tank, MPN/100ml, FC2- Effluent Feacal Coliform of filter, MPN/100ml , FC3- Effluent Feacal Coliform of chlorination tank, MPN/100ml

During collection of first fourteen sets of samples from the field samples of raw sewage were also collected and it was observed that presence of different pollutants in the raw sewage was moderate. To increase the presence of pollutants cow dung was mixed with the raw sewage and then it was applied in the treatment system to check its ability to treat heavily polluted sewage. Performance of the treatment unit was analyzed separately for heavily polluted and moderately polluted sewage. Hence values of different parameters of heavily polluted and moderately polluted sewage are shown separately below:

Values of different parameters of moderately polluted sewage

Sl no.	BOD mg/L	COD mg/L	TSS mg/L	FC MPN/ 100ml	Colour (Hazen)	Avg BOD mg/L	Avg COD mg/L	Avg FC MPN /100ml	Avg TSS mg/ L	Avg Colour (Hazen)
1.	14	48	26	3300	25	47.33	106.67	201100	155.33	40
2.	58	118	205	260000	50					
3.	70	154	235	340000	40					

Values of different parameters of heavily polluted sewage

Sl no.	BOD mg /L	COD mg /L	TSS mg /L	FC MPN/ 100 ml	Colour (Hazen)	Avg BOD mg/ L	Avg COD mg/ L	Avg TSS mg/L	Avg FC MPN/ 100ml	Avg Colour (Hazen)
1.	615	1548	1240	750000	250	750	1385	863.67	626666	340
2.	1210	1894	1098	680000	450					
3.	425	713	253	450000	300					

In the treatment system the last unit was chlorination with bleaching powder. So effluent from disinfectant tank is disposed to the local drain. Average values of different effluent parameters of the treatment system for moderately and heavily polluted sewage are shown below:

Average values of effluent parameters after treating moderately polluted sewage

Avg BOD mg/L	Avg COD mg/L	Avg TSS mg/L	Avg FC MPN/100ml	Avg Colour (Hazen)
2.09	9.89	3.56	470	10

Average values of effluent parameters after treating highly polluted sewage

Avg BOD mg/L	Avg COD mg/L	Avg TSS mg/L	Avg FC MPN/100ml	Avg Colour (Hazen)
14.74	57.71	9.23	5273	65

Parameter wise removal efficiency of the treatment system is given below:

Parameter	**Removal efficiency for moderately polluted sewage (%)**	**Removal efficiency for heavily polluted sewage (%)**
BOD	95.58	98.03
COD	90.72	95.83
TSS	97.71	98.93
FC	99.76	99.15
COLOUR	75	80.88

It is very clear from the above table that the treatment system has high removal efficiency and it can be used for treating sewage with any degree of pollution. The final effluent is treated with bleaching powder so that the feacal coliform concentration can be reduced and after that the effluent is disposed to the water body or drains without disturbing the aquatic life.

The treatment of sewage with the help of depth filter is a low cost process rather than other processes available for treatment. Moreover the process is easy to install and operation is very easy. The backwashing to

the filters can be done by pressurized clear water injecting from the bottom of the filter tank. Back washing can be done when the head loss increased in such a condition when the flow from the filter tank has been minimized and sedimentation deposited on the gravels. The interval of back washing may be 24 -36 hours according to the flow condition. During filtration in a conventional down flow depth filter, waste water containing suspended material is applied from top of the filter bed. As the waste water passes through the filter bed, this suspended matter in the waste water are removed and the suspended particles starts accumulates in the interstices of the granular material and as they accumulating as the time passes head loss starts to build up beyond the initial value. After some period of time, the operating head loss or effluent turbidity reaches a predetermine head loss or turbidity value, and the filter must be cleaned or backwashed under ideal conditions, the time required for head loss buildup to reach preselected terminal value should correspond to the time when the suspended solids in the effluent reach the preselected terminal value for acceptable quantity. In actual practice, one of the other events will govern the backwash cycle.

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