Performance Report on

Pilot Scale Plant Study using Eco Bio Block (EBB),

a Japanese product
for Treatment of Wastewater
in an open drain at Mayur Vihar, Phase –I, Delhi

Project study carried out
in collaboration with
Ariake Bio-Tech Solutions, Chennai

Central Pollution Control Board
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Delhi- 110032

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1.0 BACKGROUND

'**Eco-Bio Block' (EBB)** Treatment is a technology with a '**back–to basic'** concept of using environmentally friendly microorganism embedded in a porous concrete block to treat wastewater, The "Eco-Bio-Block", a Japanese invention and a patent product from M/s Koyoh co. Ltd, Japan, with cutting edge technology is widely used for cleaning polluted water sources such as wastewater drains, sewage treatment plants, effluent treatment plants, polluted rivers, ponds, lakes etc.. EBB is an Eco-friendly block using nature's technology to improve and enhance water quality. The blocks are produced by mixing effective microbes with zeolites (volcanic porous stones), and alkaline cement. Zeolites are utilized for maximum efficacy, as the microbes would multiply abundantly in these stones. Once EBB is placed in water, the effective microbes would multiply, treat the wastes effectively in a faster manner and clean the wastewater and polluted natural water bodies without causing any harm to plants and fishes. Also, the EBB effectively destroys mosquito larvae and Escherichia Coli bacteria. It also removes bad odour in wastewater. This treatment technology is also claimed to have been used in Japan, Malaysia, China and other countries.

This product has received international Patent and it is a proprietary product of M/s Koyoh Co Ltd., Japan. M/s Ariake Bio Tech Solutions, Chennai, India has been appointed by Koyoh Co Ltd., Japan, as authorised sole agents for EBB products in the territories of India, Srilanka, Nepal, Bhutan, Bangladesh and Gulf Cooperative Countries in the Middle East and also for USA, Canada and Europe.

1.1 ADVANTAGES OF EBB TREATMENT SYSTEM

EBB is a bio – augmentation product to clean polluted waters like rivers, lakes, drains, municipal waste waters, ponds etc. EBB does not require energy, manpower and maintenance to perform the cleaning process. There is no operational cost practically, whereas other conventional treatments involve huge operational cost viz. energy, manpower, chemicals etc. Thus EBB treatment is claimed to be very cost effective technology compared to conventional treatment methods. It is technically and economically viable for wastewater drains, lakes, ponds etc in India. It has been tested and proved by SIRIM, a State organization of Malaysia, that EBB is very safe to use in natural water bodies as per British Standard Specification 6920 – 2.5 – 2000. Since EBB is an online treatment technology, additional large land space is not required as in the case of conventional methods and it avoids the trouble of land acquisition processes.

1.2 TREATMENT OF EBB SYSTEM IN INDIA

Considering the advantages of the EBB treatment technology in Indian context as well as its national importance, M/S Ariake Bio Tech Solutions, Chennai, India**,** approached NRCD(National River Conservation Directorate), Ministry of Environment and Forests(MoEF), Government of India for promoting the technology in India. As per the directions of NRCD(MoEF), the EBB product was tested in the laboratory of CPCB during June to August, 2005 and the performance was found encouraging. Further the performance of the product was discussed by the officials of MoEF and CPCB on 6th October, 2005 and it was decided to explore its feasibility of treating wastewater by a pilot scale study in a natural drain at Delhi. Accordingly, CPCB identified a drain at Mayur Vihar Phase– I, Delhi and obtained permission from Irrigation and Flood Control Department, Govt. of NCT of Delhi for Pilot Scale Treatment study using Japanese Eco-Bio –Blocks.

In view of the above proposal, a project has been formulated and executed as a Pilot scale plant study in collaboration with M/S Ariake Bio Tech Solutions, Chennai, using Eco Bio Block , (a Japanese product) for Treatment of Wastewater in an open drain at Mayur Vihar, Phase –I, Delhi during the period from December 2006 to April, 2007. The EBB product has been imported by M/S Ariake Bio Tech Solutions, Chennai and performance study was carried out by CPCB.

2.0 OBJECTIVES OF THE STUDY

The main objective of this Pilot Scale Plant Study using Eco Bio Block (EBB), *a Japanese product for Treatment of Wastewater in an open drain at Mayur Vihar, Phase –I, Delhi,* is as follows:

- To assess the performance efficiency of the Eco –Bio-Block treatment technology for treatment of domestic wastewater in an open drain

3.0 DESCRIPTION OF AND SPECIFICATIONS OF EBB

Eco-Bio Block, a new biotechnology product from Japan is capable of treating the wastewater. 'Eco-Bio Block' (EBB) is a technology with a 'back–to basics' concept of using environmentally friendly microorganism embedded in a porous concrete block. The EBBs available in different models are described below:

		
Product: EBB Wave **Size : 390x190x90 mm** **Weight: 10.5kg**	**Product: EBB 1020** **Size : 390x290x60 mm** **Weight: 2 kg**	**Product : EBB OCT** **Size: 90x90x80 mm** **Weight: 0.85 kg**

FIG 1. Different models of EBB products

Composition:

The Eco-Bio- Block(EBB) is consisting of

I) Volcanic Porous Stone;
II) Cement;
III) Nutrients for EBB microbes
IV) Microbes

Features:

- No Operation & Maintenance Cost
- Natural , Eco Friendly
- No Power Consumption
- No Separate Space required

Application:

- Treatment of Polluted rivers, lakes, ponds and drains etc.
- Sanitization, deodorization and waste treatment for livestock farms, Aquaculture and domestic house hold poets.
- Wastewater Treatment Plants.
-

These different shapes & sizes of EBB Wave, EBB 1020, EBB OCT, are to be placed in the drains with suitable engineering designed pattern for treatment of wastewater.

4.0 DESCRIPTION OF THE STUDY DRAIN

The drain selected for pilot scale treatment of wastewater using EBB is located at Mayur Vihar Ph-I, Delhi which starts from Noida Mode bridge(near Akshadharm Temple) to Mayur Vihar-Noida border road. The layout of the open drain is depicted in figure 1. The drain has been selected after surveying many drains in Delhi, for the study purpose due its long rectangular symmetrical stretch. The drain is under the possession of Flood and Irrigation Department (Govt. of Delhi, NCT- Delhi). The drain carries domestic wastewater originating from Ganesh nagar and joins with Shahadra link drain near Mayur Vihar phase- I – Noida road border. Finally the combined wastewater joins in River yamuna at Okhla barrage. The physical features of the drain and velocity and flow characteristics (24 hrly. variations) under the study stretch are as follows:

Length of the drain	:	3.5 km	
Width	:	2.5 m	
Depth	:	0.40 to 0.80 m	(average, 0.60 m)
Velocity	:	0.10 to 0.24 m/s	(average, 0.20 m/s)
Flow	:	0.30 M^3 /sec ;	(say 26 MLD)

The physico-chemical characteristics of the wastewater, before placing the EBB reactors in the drain, monitored during January and February, 2007 are given below:

Table 1. Physico-chemical characteristics of the wastewater, before placing the EBB

S.No.	Parameter	Unit	Values		
			Min.	Max.	Mean
1	pH	--	7.00	7.37	7.22
2	Colour	Hazen	135	146	140
4	TSS	mg/l	196	286	252
5	COD	mg/l	371	503	416
6	BOD	mg/l	114	203	162

Fig.: 2. Photograph showing the drain before partition, after partition and placement of EBB reactors

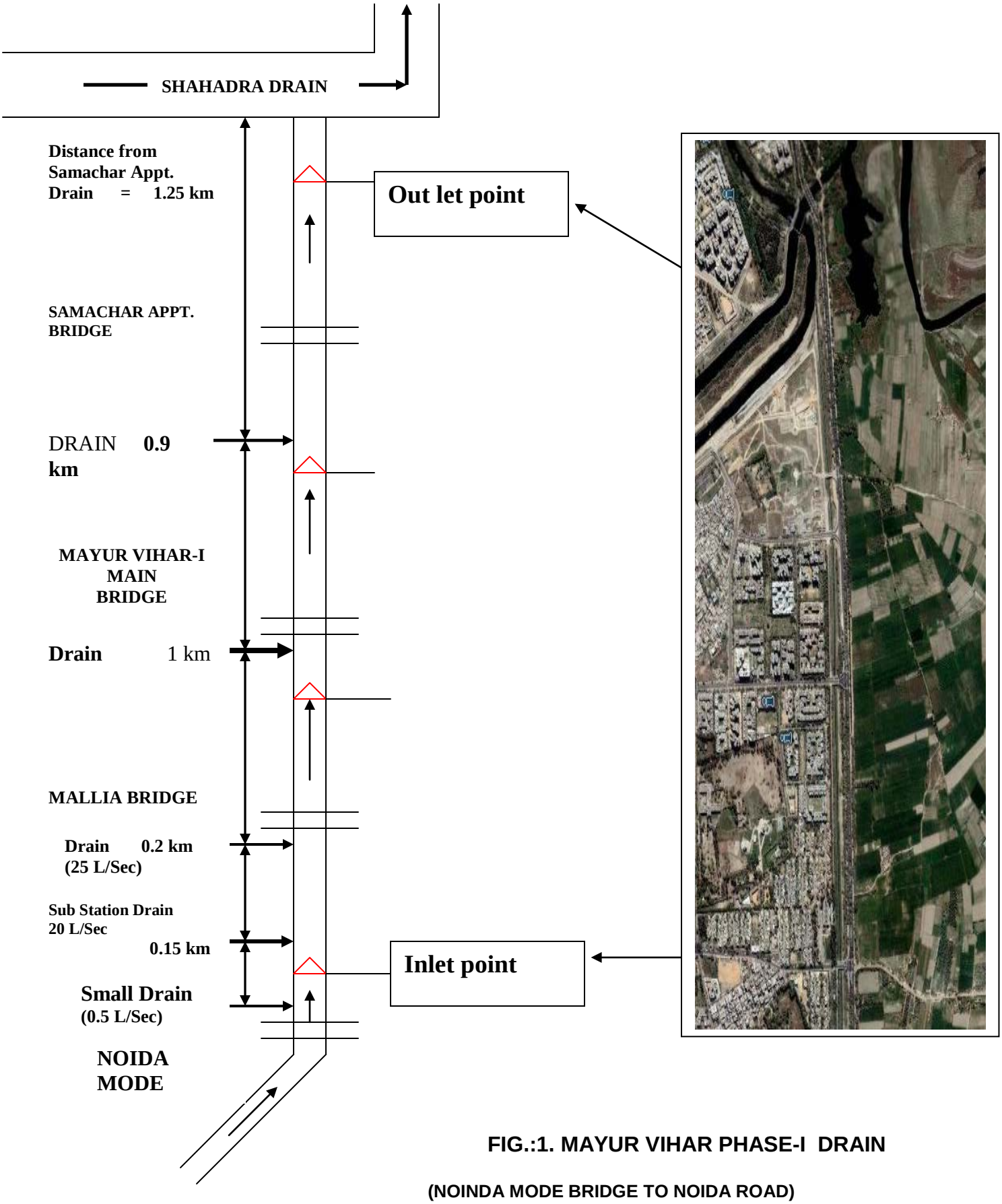


FIG.:1. MAYUR VIHAR PHASE-I DRAIN

(NOINDA MODE BRIDGE TO NOIDA ROAD)
Length- 3.5 Km ; Width-2.5 m ; Avg. Depth 0.60 m
Avg. Flow-0.30 m^3 / Sec, Avg. Velocity - 0.20 m / Sec
Discharge- 26 MLD

5.0 EXECUTION OF PREPARATORY WORK

The pilot scale study is proposed for 10 MLD (total average flow is 23 MLD), since it is a pilot scale study. Moreover, there are four lateral drains carrying domestic wastewater from Mayur Vihar housing colonies also joining the main drain at various places on left side . Hence, it is decided to have a partition of the drain for 0.60 m width on the right side so as to avoid the mixing of lateral drains flow and at the same time to take up the treatment study of around 10 MLD flow. Accordingly, it is designed to carry out partition of the drain for a stretch of 3.5 km with G.I sheets and proper anchoring provision. To execute the civil, mechanical, fabrication works etc. an open Tender was floated and the work was carried out.

The scope of the tender work involves following components:

1. Partition of drain using GI sheet with support system.
2. Fabrication and placing of baffles and bar screen with shutter door.
3. De-silting of partitioned drain
4. Preparation and placement of Eco Bio Blocks (EBBs)- reactors in the drain (3.5 km stretch).
5. Carrying out Performance monitoring studying terms of Phsico-chemical and bacteriological parameters
6. Dismantling the set-up and restoration of wastewater of the drain.

Partition of drain

Partition of the drain for the entire length of 3.5 kms. with a portion of 60 cm. width only (total width of the drain in 2.5 mts.) using Corrugated Galvanized Iron (GI) sheet with suitable support system has been made.

Corrugated Galvanized Iron (GI) sheet

Length : 3500 m
Height : 1.22 m
Gauge : 26 swg

Suitable mild steel support plates with angles (1.5 m x 50 mm x 4mm) as shown in figure has been provided at every two meter interval so as to withstand firmly during the study period of 4 months. The partition has been made in such a way that there was no be any leakage/intrusion of waste water between the partition portions in the bottom to top of the water level. Water Leakage testing using colour dye chemical was carried out to check any leakage and found leak proof. Additional anchor support using wooden rod and rope on both sides tying with GI sheet at top was provided.

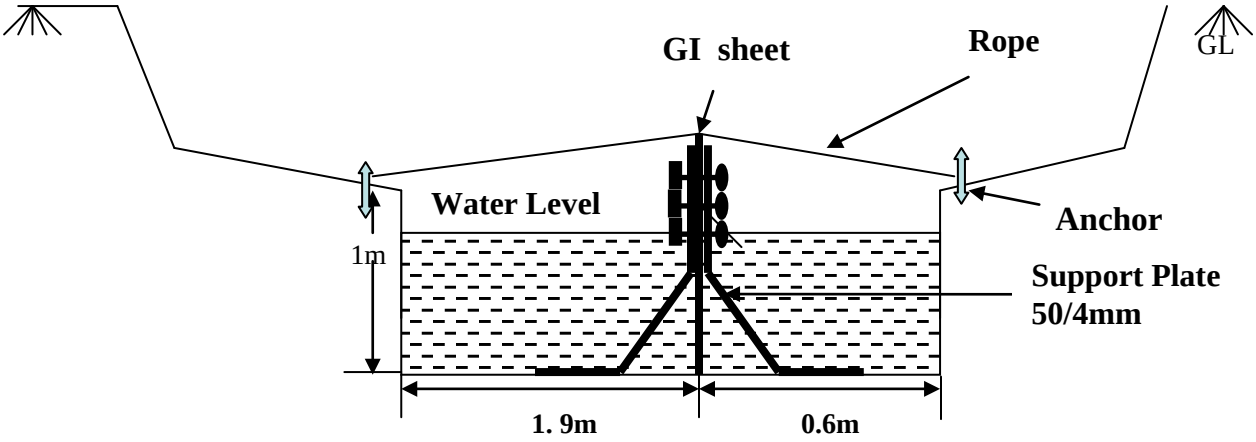


FIG 3. C/S OF PARTITION OF THE DRAIN

Baffle Arrangement in Drain

Two Baffle sheets made of GI have been provided in the drain at the starting point as per the figure shown below. It was kept at 30^{o} inclined position with steel frame support so as to withstand the water flow pressure.

Details of baffles

Length	:	2.5 m
Height	:	0.7m
Thickness	:	16 swg
Distance between babbles	:	5 m

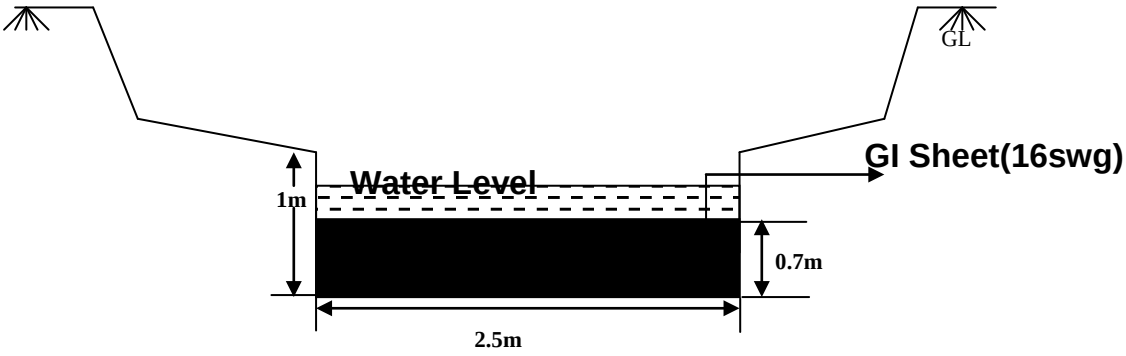


FIG.4 BAFFLE ARRANGEMENT IN DRAIN

Bar screen setup

One tubular type made of GI pipes-bar screen with Double door shutter arrangement as shown in figure given below has been provided at the starting point of the partition for arresting debris, floating materials entering into drain.

Details of Bar Screen

Length	:	0.6 mts.
Height	:	1.5 mts.
Bar screen Space size	:	1.5 cms.
Bar dia GI Pipe	:	5.0 cms
Inclination	:	30^{o}

Details of double door Shutter (GI plate 16swg)

Length	:	0.6 mts.
Height	:	1.5 mts.

Suitable Hinges provided for opening and closing

Suitable support system with mild steel plates to withstand the water flow force has been provided for arresting debris, floating materials entering into drain.

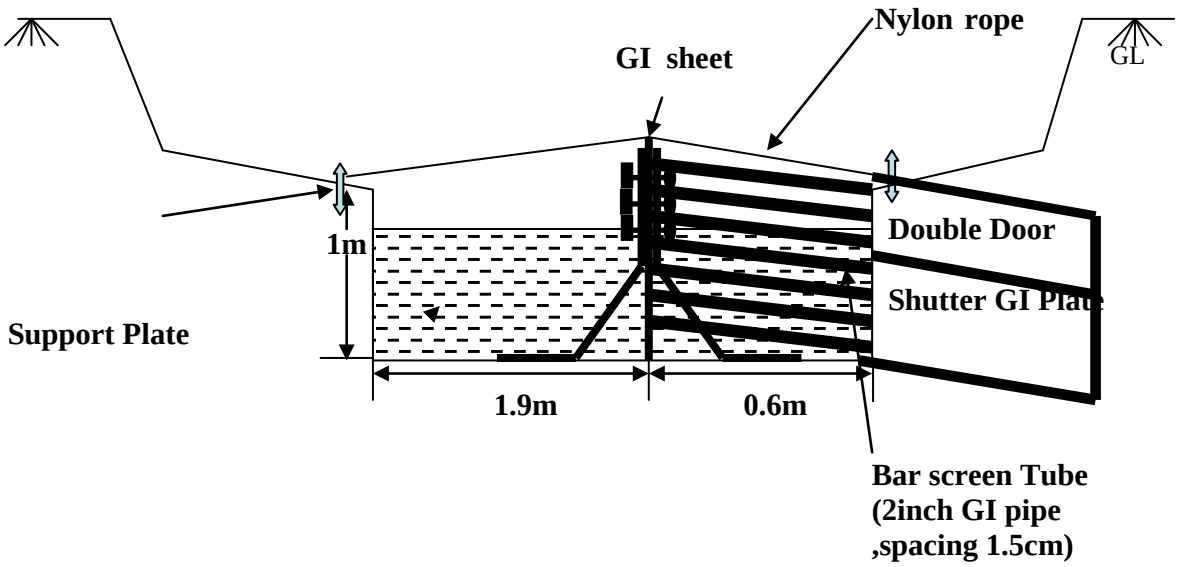


FIG 5 ELEVATION OF BAR SCREEN WITH SHUTTER DOOR ARRANGEMENT FOR FLOW CONTROL(no to the scale)

De-silting of partitioned drain

De-silting of the entire drain was carried out manually by engaging labour before and after the partition of drain.

A temporary store at the bank of drain has been constructed for storing materials and other appliances.

6.0 DESIGNING OF EBB REACTOR

Preparation of Eco Bio Blocks

Preparation of EBB reactor has been carried out by M/s Ariake in consultation with Malaysian experts as per the drawing shown below:

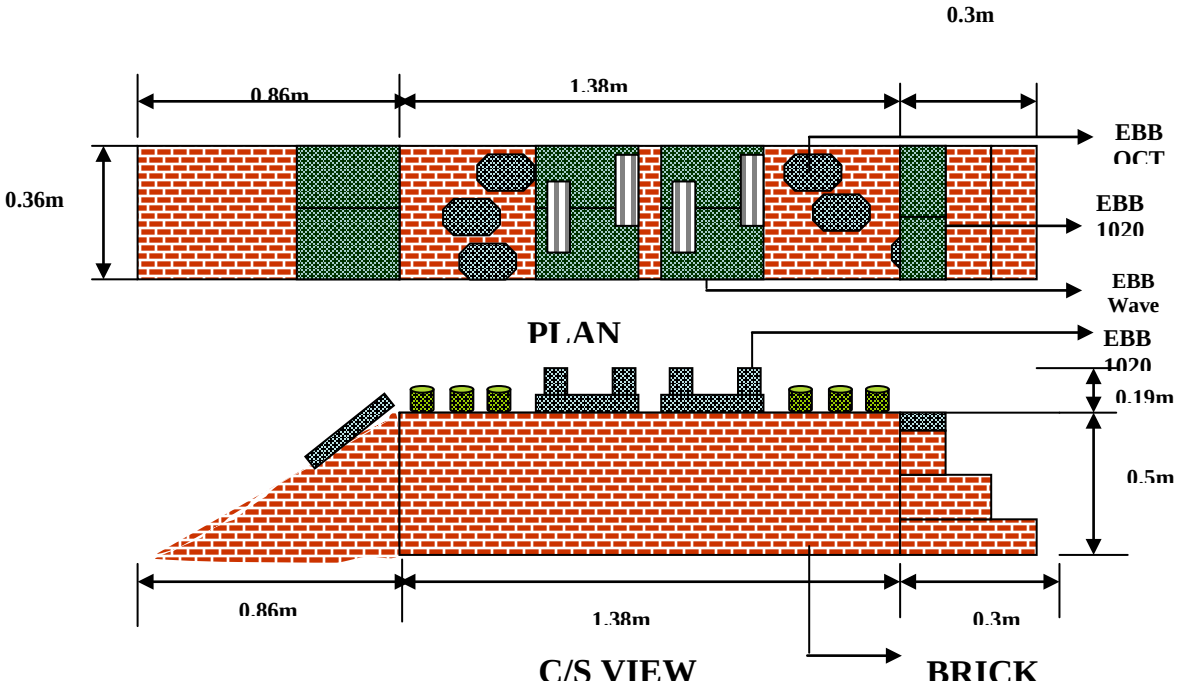


FIG 6. EBB REACTOR

The joining of the blocks and bricks has been made with cement mortar (1:3). The cemented EBB reactors were placed in the drain at regular intervals. The number of EBBs of three types placed in the drain are as follows:

		
Product: EBB Wave **Size : 390x190x90 mm** **Weight: 10.5kg** **No. of Blocks placed: 4500**	**Product: EBB 1020** **Size : 390x290x60 mm** **Weight: 2 kg** **No. of Blocks placed: 4800**	**Product : EBB OCT** **Size: 90x90x80 mm** **Weight: 0.85 kg** **No. of Blocks placed: 9000**

7.0 FINDINGS OF PERFORMANCE STUDY

The civil and mechanical works for this pilot scale were started in December, 2006 and completed during end February, 2007 including fabrication and placement of EBB reactors in the drain

The placement of EBB reactors in the drain was completed in a week's time during 16th to 23rd February, 2007. After acclimatization period of about a month, Performance monitoring was carried out for 5 days (29th March, 16th, 19th, 23rd and 25th April, 2007). On each day, eight 3 hourly samples were collected and a flow based 24 hourly composite was prepared. After placing EBB reactors in the drain, the average velocity of the drain in the partitioned portion has changed to 0.14 m/s from the original condition of 0.20 m/s and the flow to 0.05 m^3/ sec (i.e 4.4 MLD) from 0.30 m^3/ sec. (i.e 26 MLD) The list of phsico-chemical and bacteriological parameters monitored is given below:

1. **Colour**
2. **Total suspended Solids(TSS)**
3. **Chemical Oxygen Demand (COD)**
4. **Biochemical Oxygen Demand(BOD)**
5. **Total Coliform**
6. **Feacal Coliform**
7. **Feacal streptococci**

The results of the performance monitoring of the drain wastewater after acclimatization of EBB, are depicted in **Table 2** and **Figure 7, 8 & 9**. A perusal of the table would indicate the following key findings:

pH:

The pH varies from 6.5 to 7.5 before treatment and the same for after treatment it was found as 7.3 to 7.5 which shows that there is no significant change in pH due to EBB treatment and it meets the effluent discharge standard.

Colour:

The colour expressed in Hazen unit varies from 127 to 162 before treatment and the same after treatment, it was found to be reduced in the range of 105 to 121. The percentage reduction in colour was observed in the range of 17 to 25.3 %,. The reduction in colour is shown pictorially in **Figure 7.** Partial reduction in colour could also be attributed to reduction in velocity of flow and hence settling of suspended matters while flowing in 3.5 km stretch of drain.

Total Suspended Solids (TSS)

The TSS value varies from 262 to 364 mg/l before treatment and same after treatment, was found to be considerably reduced to 34 to 133 mg/l. The percentage reduction was

BEFORE TREATMENT AFTER TREATMENT

FIG.: 7. ECO-BIO-BLOCK (EBB) TREATMENT

found in the range of 49.2 to 88.1 %, which shows that there is significant reduction in TSS due to EBB treatment. Almost all the time, TSS values meet the standard except in initial time, which may be partial incomplete acclimatization of EBB blocks. Partial reduction in TSS could also be due to settling of TSS and increase in hydraulic retention time (HRT) due to reduction in velocity of flow after putting EBB reactors in the drain.

Chemical Oxygen Demand (COD)

The COD value varies from 321 to 445 mg/l before treatment and the same after treatment was observed in the range of 143 to 260 mg/l. The percentage reduction was found in the range of 36.7 to 57.8 % Almost all the time, COD values meet the effluent discharge standard of 250 mg/l except in the initial time, which may to due incomplete acclimatization of EBB blocks. It may be noted from the Table that after 53 days of acclimatization, the COD values are always meeting the standard of 250 mg/l.

Biochemical Oxygen Demand (BOD)

The BOD value varies from 132 to 209 mg/l before treatment and the same after treatment was reduced in the range of 63 to 127 mg/l. The percentage reduction was found from 28.7 to the maximum of 64.6 %. The BOD values after 53 days and beyond,

(after installation of EBB in the drain), were found to be in the range of 63 to 74 mg/l, which although exceeds the effluent discharge of 30 mg/l BOD when discharged into drain or other receiving water bodies, but it is within the standard limit of 100 mg/l when effluent is to be used for irrigation purpose. The increasing trend of % reduction for TSS, COD and BOD with reference o time after acclimatization is depicted in **Figure 8.**

Table.2 Results of performance monitoring of pilot scale study on the efficiency of Eco-Bio_Block(EBB) in treating wastewater in an open drain at Mayur Vihar phase-I , Delhi

24 hourly Monitoring Date	No. of days *	Mean Temp (0^C)	pH		Colour (Hazen unit)			TSS (mg/l)		
			BT	AT	BT	AT	%	BT	AT	%
29/30-03-2007	**35**	26.4	7.27	7.26	143	116	18.9	262	133	49.2
16/17-04-2007	**53**	32.6	7.10	7.30	154	120	22.1	262	71	72.9
19/20-04-2007	**56**	31.5	6.70	7.31	162	121	25.3	288	63	78.1
23/24-04-2007	**60**	32.2	7.48	7.33	135	112	17.0	285	34	88.1
25/26-04-2007	**62**	32.9	7.45	7.54	127	105	17.3	364	59	83.8
Min.		26.4	6.7	7.3	127	105	17.0	262	34	49.2
Max.		32.9	7.5	7.5	162	121	**25.3**	364	133	**88.1**
Mean		31.1	7.2	7.3	144	115	20.1	292	72	74.4

24 hourly Monitoring Date	No. of days *	Mean Temp (0^C)	COD (mg/l)			BOD (mg/l)		
			BT	AT	%	BT	AT	%
29/30-03-2007	**35**	26.4	411	260	36.7	178	127	28.7
16/17-04-2007	**53**	32.6	321	177	44.9	132	73	44.7
19/20-04-2007	**56**	31.5	330	143	56.7	138	63	54.3
23/24-04-2007	**60**	32.2	429	181	57.8	209	74	64.6
25/26-04-2007	**62**	32.9	445	203	54.4	180	68	62.2
Min.		26.4	321	143	36.7	132	63	28.7
Max.		32.9	445	260	**57.8**	209	127	**64.6**
Mean		31.1	387	193	50.1	167	81	50.9

Monitoring Date	Total Coliform (10^5)			Feacal Coliform (10^5)			Feacal streptococci (10^5)		
	BT	AT	%	BT	AT	%	BT	AT	%
29/30-03-2007	7810	5101	34.7	1034	891	13.8	111.5	92.20	17.3
23/24-04-2007	1430	890	37.8	660	310	53.0	57	37	35.1
25/26-04-2007	2500	260	89.6	540	230	57.4	31	12.1	61.0
Min.	1430.0	260	34.7	540.0	230.0	13.8	31.0	12.1	17.3
Max.	7810	5101	**89.6**	1034	891	**57.4**	111.5	92.2	**61.0**
Mean	3913.3	2084	54.0	744.7	477.0	41.4	66.5	47.1	37.8

BT – Before Treatment; AT - After Treatment; * No. of days after placing EBB in drain
% -- Percentage reduction w.r.t Before Treatment

For further improvement of wastewater quality, treatment efficiency can be further improved by prolonging the treatment retention time in longer drain length or providing suitable aeration either by natural or mechanical process as is followed in STPs, for the EBB treatment system.

Bacteriological parameters:

Regarding bacterial reduction, it is observed that there is a reduction of 34.7 to 89.6 % for Total Coliform, 13.8 to 57.4 % for Feacal Coliform and 17.3 to 61.0 % for Feacal streptococci after EBB treatment, which shows that there is a considerable reduction in bacterial counts though it is not meeting the standard value of 5000 MPN for river water quality standard.

TABLE : 3 **Minimum, Maximum and Mean percentage of reduction (w.r.t Before Treatment) observed (based average of 24 hourly monitoring days for 5 days) in efficiency of EBB in treatment of wastewater in an open drain at Mayur Vihar Phase I, Delhi**

S.No.	Parameters	Minimum %	Maximum %	Mean %
1	Colour (Hazen Unit)	17.0	25.3	20.1
2	Total suspended solids(TSS)	49.2	88.1	74.4
3	Chemical Oxygen Demand (COD)	36.7	57.8	50.1
4	Biochemical Oxygen Demand(BOD)	28.7	64.6	50.9
5	Total Coliform	34.7	89.6	54.0
6	Feacal Coliform	13.8	57.4	41.4
7	Feacal streptococci	17.3	61.0	37.8

Control data obtained before placing EBB blocks (but after partitioning) and just after placing EBB blocks are given in **Table 3 & 4** respectively.

Table 4. **Range of Percentage reduction observed <u>before placing EBB blocks</u> (but after partitioning) In drain**

Date of monitoring	Mean Temp (0^C)	TSS (mg/l)			COD (mg/l)			BOD (mg/l)		
		U/S	D/S	% reduction	U/S	D/S	% reduction	U/S	D/S	% reduction
05.01-07	12.6	270	309	-14.4	371	291	21.6	114	101	11.4
09.01.07	10.7	196	174	11.2	395	371	6.1	147	97	34.0
12.01.07	12.1	226	236	-4.4	432	341	21.1	172	132	23.3
25.01.07	14.9	281	214	23.8	381	374	1.8	175	171	2.3
01.02.07	19.2	286	216	24.5	503	344	31.6	203	159	21.7
Min	10.7	196	174	-14.4	371	291	1.8	114	97	2.3
Max	19.2	286	309	24.5	503	374	31.6	203	171	34.0
Mean	13.9	252	230	11.9 *	416	344	16.4	162	132	18.5

Note: * for calculation of mean for TSS , negative values are considered as Zero
U/S - Upstream of drain ; D/S - Down stream of drain

Table 5. Range of Percentage reduction observed just after placing EBB blocks In drain

	TSS (mg/l)			COD(mg/l)			BOD (mg/l)		
Date of monitoring	U/S	D/S	% reduction	U/S	D/S	% reduction	U/S	D/S	% reduction
21-02-07	149	169	-13.4	347	369	-6.34	184	177	3.8
22-02-07	159	169	-6.3	414	313	24.4	191	158	17.3
23-02-07	214	193	9.8	438	325	25.8	220	181	17.7
Min	149.0	169.0	-13.4	347	313	-6.3	184.0	158.0	3.8
Max	214.0	193.0	9.8	438	369	25.8	220.0	181.0	17.7
Mean	174.0	177.0	3.0 *	400	336	16.7 *	198.3	172.0	12.9

Note: * for calculation of mean for TSS and COD, negative values are considered as Zero
U/S - Upstream of drain ; D/S - Down stream of drain

Performance monitoring of drain by EBB treatment system, after taking into account of the control after partitioning of drain but before placing of EBB reactors in the drain with respect to some important physico chemical parameters in terms of percentage reduction is given in **Table 5**

Table 6. Percentage reduction in performance of EBB after taking into account of control data obtained before placing EBB reactors

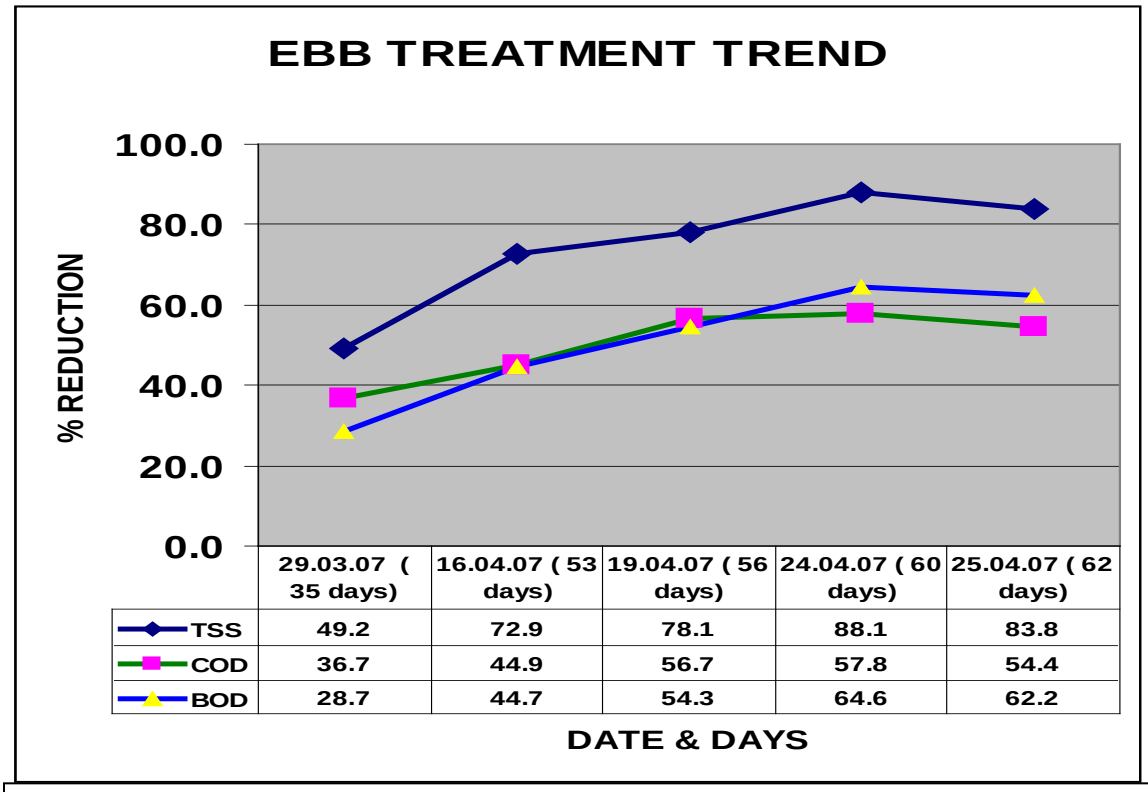
S.No.	Parameters	% reduction		
		With EBB (Mean of 5 days data)	Control- before placing EBB (Mean of 5 days data)	Net Reduction in %
1	Total suspended solids(TSS)	74.4	11.9	62.5
2	Chemical Oxygen Demand (COD)	50.1	16.4	33.7
3	Biochemical Oxygen Demand(BOD)	50.9	18.5	32.4

In the similar manner, as observed by taking into account of control (before placing EBB), another set of control data (i.e just after placing EBB reactors), has been generated and the net reduction is given in **Table 6.**l

Table 7. Percentage reduction in performance of EBB after taking into account of control data obtained just after placing EBB reactors)

S.No.	Parameters	% reduction		
		With EBB (Mean of 5 days data)	Control- before placing EBB (Mean of 5 days data)	Net Reduction in %
1	Total suspended solids(TSS)	74.4	3.0	71.4
2	Chemical Oxygen Demand (COD)	50.1	16.7	33.4
3	Biochemical Oxygen Demand(BOD)	50.9	12.9	38.0

Note: Control EBB study was carried out at mean temperature of 13.9 ^{O} C, while EBB performance study was carried out at mean temperature of 31.1 ^{O} C,



	29.03.07 (35 days)	16.04.07 (53 days)	19.04.07 (56 days)	24.04.07 (60 days)	25.04.07 (62 days)
TSS	49.2	72.9	78.1	88.1	83.8
COD	36.7	44.9	56.7	57.8	54.4
BOD	28.7	44.7	54.3	64.6	62.2

FIG. 8 Trend in EBB treatment after Acclimatization (without correcting for control)

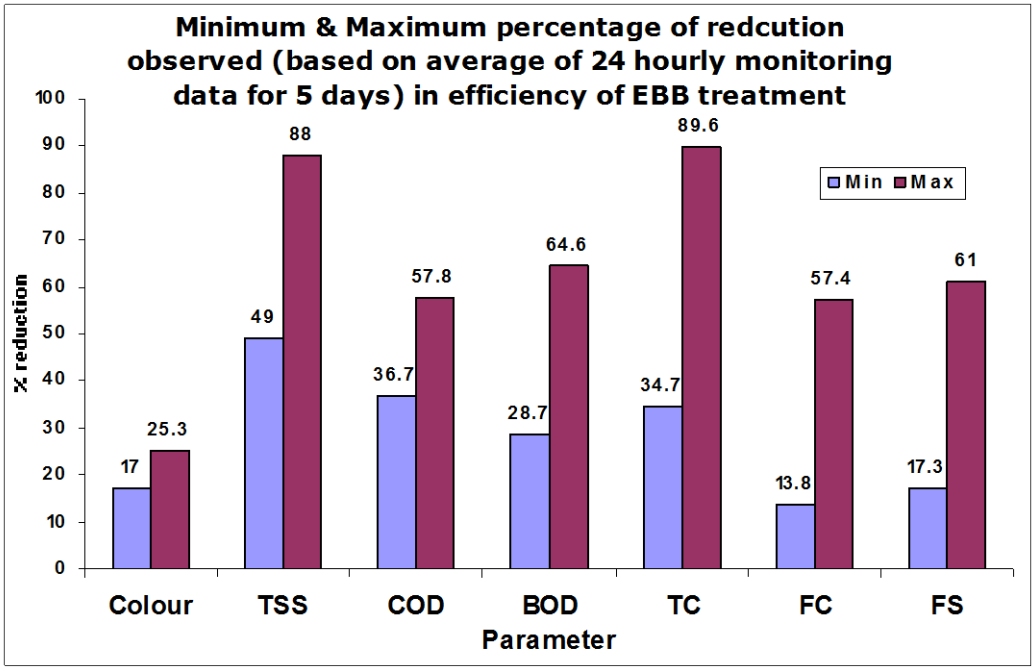


FIG. 9 Minimum and Maximum % reduction observed in EBB treatment

8.0 CONCLUSION AND SUGGESTIONS

The pilot scale treatment study using Eco Bio Block (EBB), a Japanese product for Treatment of Wastewater in an open drain at Mayur Vihar, Phase –I, Delhi, was carried out by Central Pollution Control Board in collaboration with Ariake Bio-Tech Solutions, Chennai during the period starting from December, 2006 to April, 2007. The findings of this study reveal the following conclusion.

1. The mean reduction in terms of absolute values for before treatment and after treatment and % reduction (without taking into account of control data) for various parameters are as follows (mean of 5 readings of 24 hrly monitoring):

S.No.	Parameters	Before Treatment	After Treatment	% reduction	Effluent discharge General Standard
1	Colour (Hazen Unit)	144	115	20.1	No standard
2	Total suspended solids (mg/l)	292	72	74.4	100
3	Chemical Oxygen Demand (mg/l)	387	193	50.1	250
4	Biochemical Oxygen Demand (mg/l)	167	81	50.9	100
5	Total Coliform (10^5)	3913.3	2084	54.0	No standard
6	Feacal Coliform (10^5)	744.7	477	41.4	No standard
7	Feacal streptococci (10^5)	66.5	47.1	37.8	No standard

2. After taking into account of the control data (after partitioning but before placing EBB reactor), the EBB treatment efficiency with respect to following critical parameters are as follows (mean of 5 readings):

TSS 62.5 %; COD 33.7 %; BOD 32.4 %

3. There is a reduction in velocity of water flow due to placement of EBB reactors in the drain, and thereby increase in hydraulic retention time which may lead to settling of suspended solids in the drain. The accumulation of solids in long run may block drain and water flow for which suitable engineering design is to be taken into consideration in such a situation. Further, it may be noted that provision is to be made for removal of floating materials, settable solids etc. at initial point of treatment itself

4. It may be noted that EBB does not require energy, manpower and maintenance to perform the wastewater treatment process. There is no operational cost practically, whereas other conventional treatment systems involve huge operational cost viz. energy, manpower, chemicals etc.

5. Since EBB is an online treatment technology, additional large land space is not required as in the case of conventional methods

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