CETP Bangladesh Biological System Restoration with Microbe-Lift® Remediation

Location: **Dhaka**

Background: **CETP** is an industrial wastewater treatment plant in Dhaka treating textile industrial wastewater. Existing flowrate is 24,000 m^3 per day with greater variation between day and night. The WWTP commenced operation in Feb 2012. Existing design is based on 2 aerated biological treatment systems with about 10 hour HRT with two rectangular clarifier in series. This is followed by 6 sets of **ECR** (Electro Contaminant Remover) each 250 m^3 per hr/65% COD remover rate, averaging 4 machines in operation most of the time. This is followed by eight rectangular clarifiers to extract sludge using poly acrylamide polymer. The effluent after **ECR** is further treated at 3 aeration tanks 15A, 8A and 14B with total 12 hrs HRT mainly to increase DO for the final effluent.

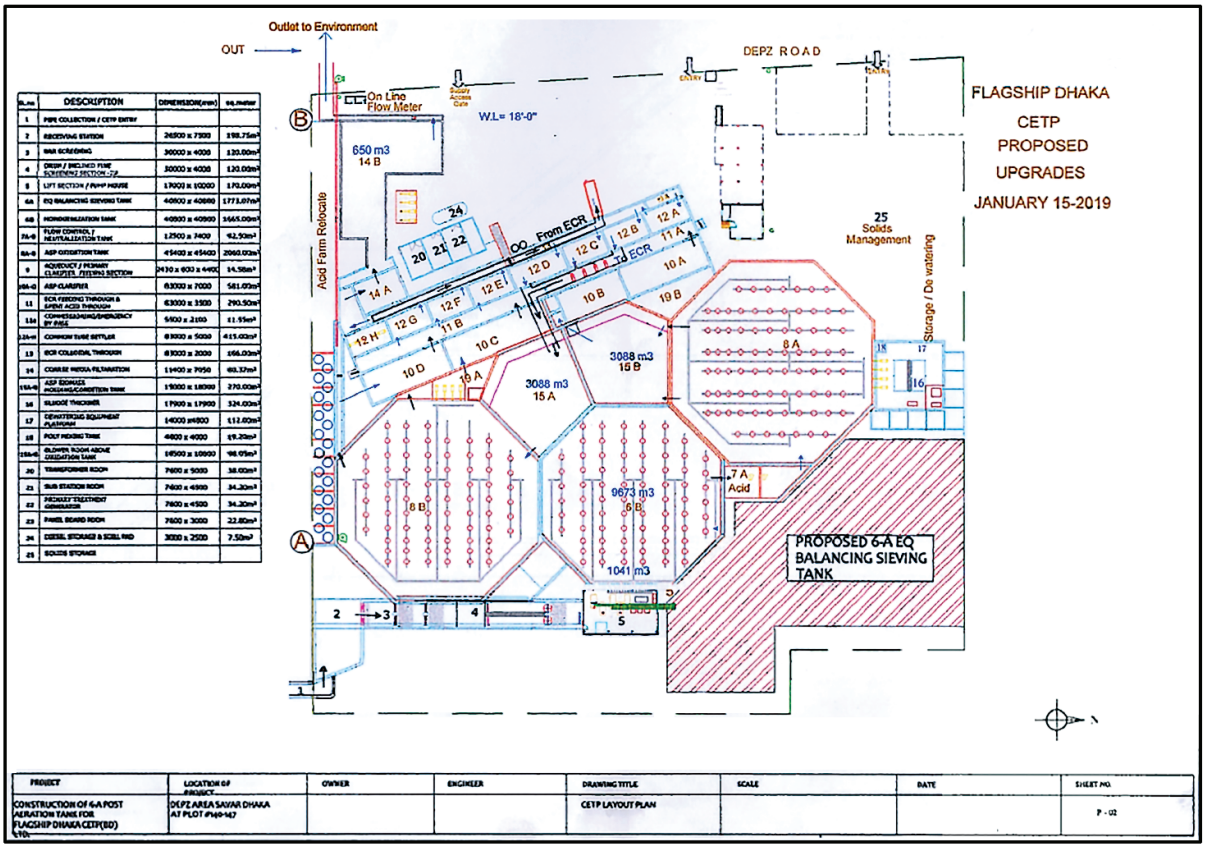

Fig. 1 - *Existing Layout Plan*

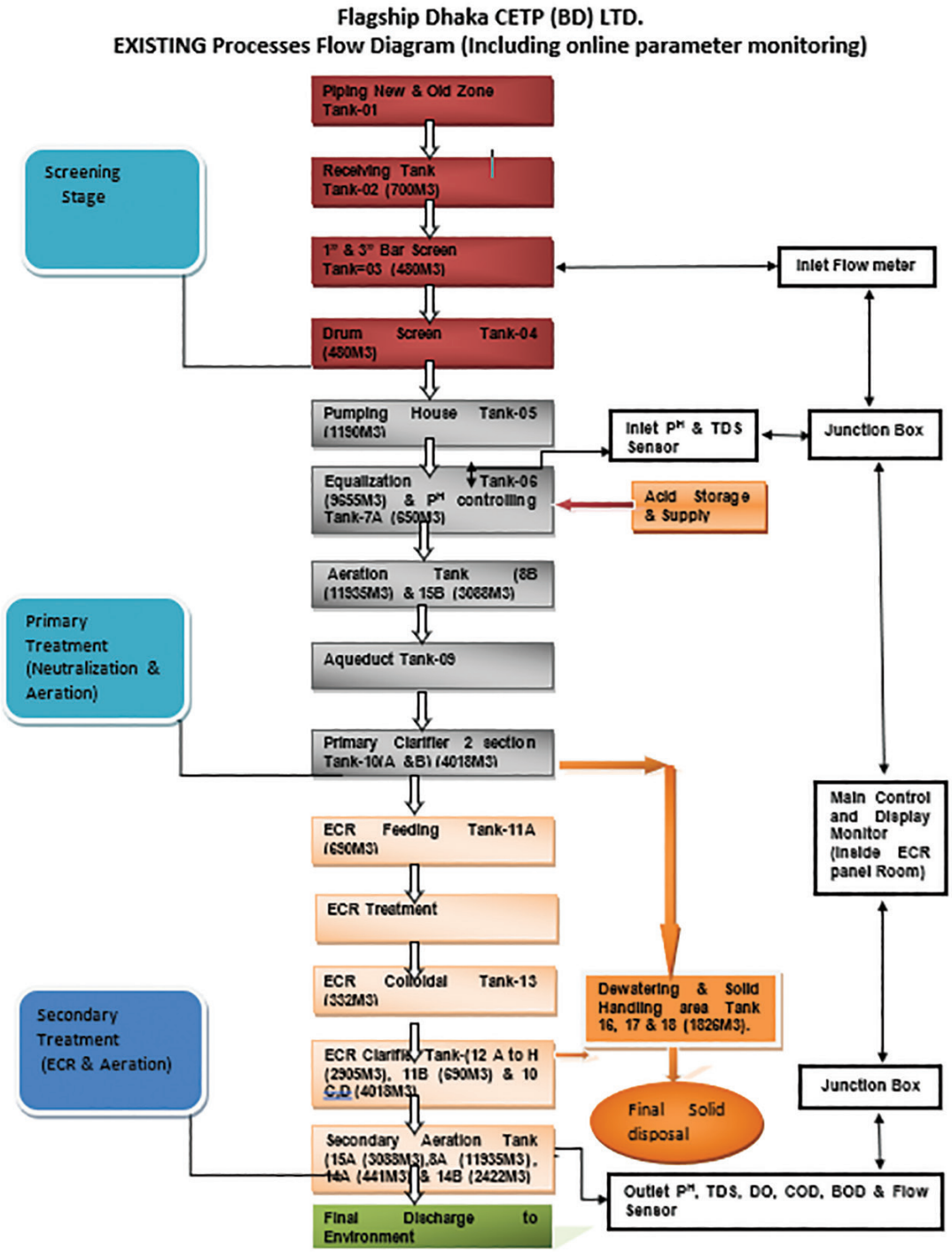

Fig 2: *Existing Schematic Diagram*

The average daily flow rate range's from 22,000 m^3 /day to 27,000 m^3/day with an average of 24,000 m^3/day. There is also desired to increase the flow rate to 35,000 m^3 per day to meet future treatment capacity.

Influent and effluent water parameters and discharge requirement are as follows:

	INFLUENT	EFFLUENT	STANDARD
COD (mg/L)	800 -1000	100 - 150	<200
TDS (mg/L)	1700 - 2700	1700 - 2700	<2100
pH	10 -11.5	8 - 8.2	6 - 9
TSS (mg/L)	300 - 430	40 -120	<150
BOD	200 - 250	25 - 30	<50
DO	0	6.5	>4.5

There is hardly any biological activities in the biological system. There is no biofloc developed in the aeration tank and the two clarifier connected in series is only 1/3 the capacity also unable to achieve effective settling. As such, there was no activated return sludge (RAS). Nevertheless, the aeration tank managed to reduce about 200mg/L COD before **ECR** treatment.

Pilot Scale Evaluation

A 2000L pilot scale activated sludge return system was set up to test the viability of MICROBE-LIFT® in reducing the COD of the influent wastewater at CETP in March 2019. The pilot test demonstrate MICROBE-LIFT® is able to reduce 50% of the COD with a ten hour HRT.

Modification made from July 2019 to Jan 2020

A new 11,980 m^3 equalization tank was constructed with additional fine screen filter to remove large solid particles. Existing equalizing tank 6B is converted to first aeration tanks.

The existing clarifier tank 10A and 10B with surface area of 287m^2 each is grossly insufficient for a daily flow rate of 24,000 m^3/day. There was no activated sludge return (RAS) or waste activated sludge (WAS) in the biological system. As such, there is no MLSS in aeration tank 8B and 15B. The biological system does not function as such.

An effective clarifier system able to return activated sludge to build up the MLSS at the aeration tanks is very crucial for successful biological treatment. Two new clarifiers were originally proposed for the upgrading. Estimate cost of the additional clarifiers is USD 1.2 million. Existing tank 15B which has bottom hopper system is recommended to convert into a third clarifier in addition to clarifier 10A and 10B. Exact size of clarifier requirement is a complex engineering work and required detail analysis of the type of biofloc settleability characteristics. In the absence of this data, 1m^3 per hour flow should have minimum 1 sq. m surface area of clarifier tank. Existing maximum flow rate 1,100 m^3 per hour. Tank 15B has 540 m^2 surface area, but this tank is not designed as clarifier, so it can handle at most 400 m^3 per hour flow. Tank 10A and 10B has 287 m^2 surface area each. The effluent will be diverted to clarifier 15B, 10A and 10B in parallel operation instead of existing series operation for 10A and 10B with flow rate divided at 40%, 30%, 30% respectively.

Submergible pump 9kW 250 m^3/day with variable frequency drive each to be installed at tank 15B, 10A and 10B to return activated sludge to tank 6B and 8B. Volume of sludge to transfer need to be

monitored manually in such a way that only the sludge portion is return as RAS. MLSS at tank 6B and 8B to be maintained at around 2000~2500 mg/L. When MLSS is reached, access RAS to be pumped to sludge press as WAS.

It is crucial to continuously monitor the sludge settleability at the three clarifiers. Should tank 15B, 10A and 10B found to be insufficient to achieve good settlement, tank 15A may be converted as 4th clarifier.

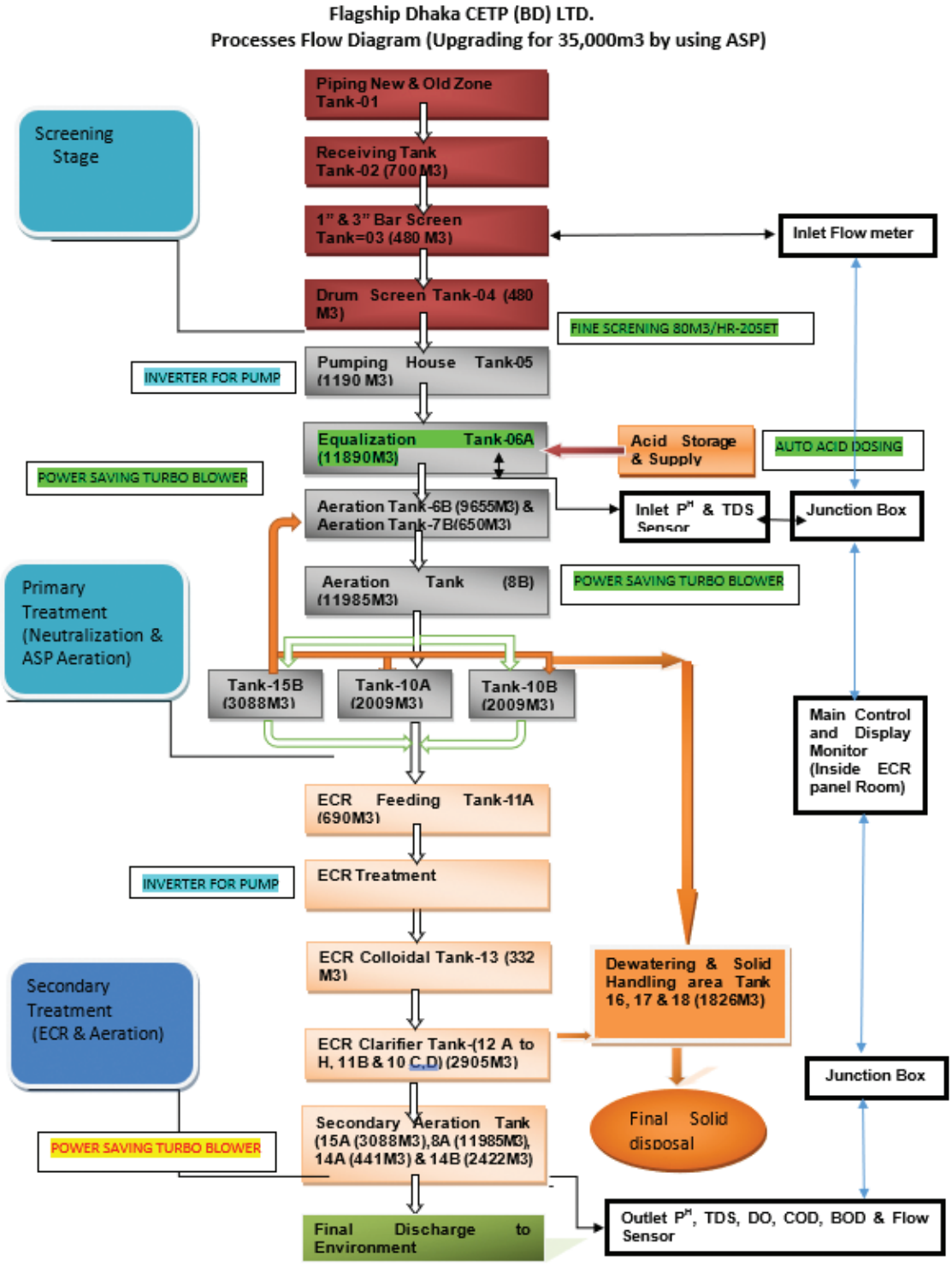

Fig 3: *New Schematic Flow Chart*

Fig. 4: *The New 11,890 m^3 Equalization Tank*

Fig. 5: *Aeration Tank 6B and 8B*

In the absence of a proper clarifier, to ensure at least some bacteria is retained in the aeration tank, a small amount of HDPE cylindrical type biomedia was introduced to both aeration tank.

MODEL: PE05

Spec.:	ϕ25*10 mm
Surface area:	>600 m^3/m^3
Density:	0.94 - 0.97 g/cm^3
Packing Numbers:	118000 pcs./m^3
Dosing Ratio:	15% - 65%
Life span:	>15 years
Nitrification efficiency	400 -1200 gNH_4 - $N/m^3.d$
Material:	HDPE

Fig. 6: *Biomedia Specification from China*

Based on manufacturer's recommendation, 4500 CBM is required for the two aeration tanks, only 210 CMB was introduced.

Fig. 7: *Pouring of Biomedia to Tank 8B*

MICROBE-LIFT® Bioaugmentation

Based on 24,000 m^3 per day flow rate, MICROBE-LIFT®/IND and MICROBE-LIFT® /SA dosing recommendation is as follows:-

	MICROBE-LIFT® /IND	MICROBE-LIFT®/SA
Day 1 & 2 (From 11th Feb 2020)	40 gallons per day	30 gallons per day
Day 3 to 7	20 gallons per day	15 gallons per day
Day 8 to 30	8 gallons per day	4 gallons per day
Thereafter >30 days	4 gallons per day	2 gallons per day
1st month usage	340 gallons	215 gallons
Thereafter per month	120 gallons	60 gallons

Dosing will be directly applied at the inlet area of tank 6B and 8B. For the first week's dosing, 50% each at tank 6B and 8B, thereafter, dosing can be done at tank 6B only.

Fig. 8: *MICROBE-LIFT® Inoculation on Feb 11th 2020*

For the biological system to work efficiently, the followings monitoring are very important:

1. Maintain pH at 7 to 8 at all times in the aeration tanks;
2. Maintain DO not less than 1.5 ppm at all time;
3. Regularly check C:N:P ratio for make sure there is nutrient balancing for biological treatment, prepare DAP and urea available for nutrient addition at any time if necessary;
4. Adjust RAS and WAS and monitor the clarifier function to make sure there is good settleability and proper maintenance for the desired MLSS at the aeration tanks.

The flow rate was reduced by 50% to 500 m^3 per day for 5 days after inoculation to allow longer HRT in the aeration tank.

The MICROBE-LIFT® bioaugmented biological system is expected to reduce the COD from 900 mg/L to about 350 mg/L. This will reduce the ECR loading by more than 60%.

Performance Analysis one month after inoculation

The biological system managed to reduce COD from 1000 mg/L to about 300 mg/L from original value of 1000 mg/L to 700 mg/L within one month of MICROBE-LIFT® bioaugmentation. The reduce COD before ECR treatment reduce the ECR electricity and steel plate consumption by 60%. The post ECR sludge was also reduced by half, thereby PAC and sludge disposal cost. Sludge disposal cost is not high, but it is a very messy job that no workers like to handle. The workers are very delighted with the reduce sludge handling.

However, due the low BOD loading, there was insufficient bioflocs to form effective RAS (Return Activated Sludge), hence the aeration tank MLSS remains at only about 400 mg/L. The biomedia helps to retain the bacteria in the aeration tank.

Summary of cost benefits from MICROBE-LIFT® Bioaugmentation on key variable expenses were analyzed and compared to expenses incurred without MICROBE-LIFT® Bioaugmentation are as follows:

CETP Performance Analysis

Item	Description	Unit	w/o Microbe-Lift	with Microbe-Lift
1	Period		Prior to Jan 2020	From Feb 2020
2	Average flow rate	m^3/hr	1,000	1,000
	Total water volume treated per day	m^3	24,000	24,000
3	**Electricity used by ECR**			
	Electricity use by ECR per day	kWh	12,000	4,600
	Electricity Cost per kWh	BDT	8.97	8.97
	Average daily electricity cost	BDT	107,640	41,262
	Electricity Cost per m^3 water treated	BDT	4.49	1.72
4	**Steel plate consumption**	kg	2170	1175
	Steel plate per m^3 water treated	kg	0.0904	0.0490
	Cost of steel plate	BDT	72	72
	Cost of steel plate per m^3 water treated	BDT	6.51	3.53

Item	Description	Unit	w/o Microbe-Lift	with Microbe-Lift
	Period		Prior to Jan 2020	From Feb 2020
5	**Sludge Processing**			
	Sludge disposal cost per day	BDT	8400	4200
	PAC cost per day	BDT	120	60
	Sludge processing cost per m^3 water treated	BDT	0.36	0.18
6	**MICROBE-LIFT®**			
	Long Term MICROBE-LIFT® use per day	gal.		7
	Cost of Microbe-Lift per gal	BDT		6000
	Total cost of Microbe-Lift per day	BDT		42000
	Cost of Microbe-Lift per m^3 water treated	BDT		1.75
7	**Urea**			
	Daily Urea Usage	kg		50
	Cost of Urea per kg	BDT		20
	Cost of Urea per m^3 water treated	BDT		0.04
8	**Biomedia cost**	BDT		3,250,000
	Biomedia cost amortize over 10 years	BDT		890.41
	Biomedia cost per m^3 water treated	BDT		0.04
9	**Total valuable cost per m^3 treated**	BDT	11.35	7.25
	% on cost saving			36%
	Note: USD 1= BDT 85 at time of analysis			

By July 2020, the treatment plant is expected to increase the treatment volume to 30,000 m^3 per day. More biomedia will be introduced into the aeration tanks and we expect the plant can managed the 25% increase in daily flow rate without expanding the aeration system.

For more information on MICROBE-LIFT® Technology contact
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