



## Anaerobic Baffled Reactor



26 September 2023

### Organisation that implemented the case study

World vision Bangladesh

### Geographic location

Camp 8E  
Cox's Bazar -  
Bangladesh

### Main treatment objectives

BOD / COD Reduction  
Nutrient reduction  
Pathogen reduction  
Solid/liquid separation  
TSS and TDS reduction

### Technologies employed

Activated sludge  
Sedimentation and Thickening Ponds  
Settler

Planted drying beds  
Sedimentation tank  
Polishing pond  
Anaerobic baffled reactor  
Infiltration  
Gravel filter

#### Design population

5720 persons

#### Source of sludge

Flush toilet  
Health facilities  
Unlined pit latrines

#### Final outputs

Effluent  
Sludge

#### Time construction and commissioning

10 week(s)

#### Opex per real input flow

5.00 USD/m<sup>3</sup>

#### Required space

24.34 m<sup>2</sup>/m<sup>3</sup> of design input flow

#### Design input flow

10.00 m<sup>2</sup>/day

#### Local constraints

Only locally available materials  
No road access  
No permission to build a permanent structure  
No connection to the water network  
No connection to the electricity network  
Limited space  
Landslide  
Heavy Rain or monsoons  
Earthquakes

#### Skills level

Communitarian operation  
FSM specialist for construction  
FSM specialist for design  
FSM specialist for operation and maintenance  
Local contractor for construction

#### COD Reduction

98.00 %

### Resources needed for operation

Electricity  
Engine  
Water

### Capex / design input flow

13500.00 USD/m<sup>3</sup>/day

### Real input flow

10.00 m<sup>3</sup>/day

## Description of the emergency context

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Currently, there are 929,606 Rohingya refugees residing in 33 congested camps that have been officially designated by the Government of Bangladesh. This population surge occurred as a result of the extreme violence outbreak in Myanmar's Rakhine State on August 25, 2017, which led to an estimated 687,000 Rohingya refugees crossing the border into Cox's Bazar, Bangladesh. The Rohingya refugees have repeatedly sought refuge in Bangladesh due to ongoing persecution. Previous significant influxes occurred following acts of violence in Rakhine State in 1978, 1992, 2012, and once again in 2016. However, the largest and most rapid refugee influx from Myanmar into Bangladesh began in August 2017.

Operating within highly congested settings, such as the Rohingya camps, WASH actors face numerous challenges in implementing effective faecal sludge treatment processes that can efficiently remove pathogens. These challenges primarily stem from space limitations, which impose constraints on the inclusion of appropriate, safe, and sustainable processes for treatment.

## Description of the treatment process

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### Storage Tank:

The sludge from toilets is emptied into the transfer points which are connected to FSTP from different directions using motorized equipments like super sucker or centry focal pump. The dumping chamber has capacity of 10000 Ltr. These points are situated in high elivation in order to transfar the sludge to settler tanks using gravity follow.

### Settler Tank:

Solid and liquid seperation occurs at settler tanks and the liquid enters the baffled reactors for next level of treatment.

### Anaerobic Baffled Reactor:

ABR consists of a tank and alternating hanging and standing baffles that compartmentalisethe reactors and force liquid to flow up and down from one compartment to the next, enabling an enhanced contact between the fresh wastewater entering thr reactors and the residual sludge, containing the microorganisms responsible for anaerobic digestion of the organic pollutants.

### Gravel Filter Bed:

It contains stone, sand and canna Indica(Kolaboti) plants with a capacity of 55m3. Microbal treatment in the effluent forms gelatin, while plant roots reduce pathogenic organisms, At the end of the filtration waste water pass through a coarse land layer and moves to polishing pond before final discharge to environment.

### Polishing Pond:

The stored water in the polishing pond comes direct contact with sunlight and some pathogens are removed. Pond water is taken for lab testing of indicators like BOD, COD, TSS, FC, TDS. Finally treated waste water disclosed to the environment if the results are satisfactory.

### Sludge Drying Bed:

The drying bed is situated adjecent to the settler

and ABR tanks. When solid portion of sludge occupies 50% of tank volume, it is transferred to the drying bed where it transforms to soil like substance and also helminths are removed.

## Assessment & design (feasibility)

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The total cost for implementing the ABR system is USD 13,600, which covers all the necessary materials, such as Bricks, sand, Cement, stone chips, PVC pipes, GI Net and fencing. It also includes the construction work, such as site preparation, digging infiltration trenches and sludge pits, and installing hardware materials for the tank. All the materials used in this system are locally sourced and readily available worldwide.

FS characteristics: values were obtained from the WASH cluster

During the site identification stage of the project, it is crucial to find a suitable location considering the challenging and crowded nature of the camps. Several key parameters need to be taken into account during the assessment.

Population: The targeted population should be considered, keeping in mind that each system can serve a maximum of 5720 users.

Latrine Coverage: 225 doors

Surface area: Approximately 235 m<sup>2</sup> of land is required for the total Treatment.

Soil infiltration rate: Testing and calculation of the soil's infiltration rate is necessary for each site.

Groundwater levels: Here they are avoidable.

Flood-prone areas: It is imperative to avoid locating the system in flood-prone areas.

Proximity to water sources: Infiltration trenches should be at least 30 meters away from the nearest water point.

## Construction

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### Pre construction:

- For construction this facilities at first need to check topography level.
- Do need assesment.
- Then do FDG's with beneficiaries/communities about this.
- Besides, need to ready design & BOQ then need to submit this WASH sector.
- After, need to site visit with focule person s likes: govt employee/CiC/SMS/SD.
- There have also checked nearest water source distance.
- Maintain to keep good environment.After all kinds of verification need to start work.

### During Construction:

- After selection vendor, need to do layout to the field by direction from design.
- All kinds of materilas need to be quality checked.
- Ensure, all construction support materilas likes: mixer machine,vibrator machine,water.
- During the construction maintain curing.
- During construction we ensure sfatety equipment likes sorrounding area fenching/ marking cution tape and other equipments.
- All workers maintained safety helmet,gumboat,hand goolves( mask also-during crusial time).
- Ensure all kinds of quality control likes custing & brick working time.
- During construction time, maintain MB book/ daily work record book.
- Ensure proper construction ratio where its needed.
- We ha ve follow govt worker law.
- Don't engage here children workers.
- For daily materilas received & stock maintain

ensur a guard for this.

After Construction:

- After construction work we do all work component checked as per design & BOQ.
- We ensure completed work monitoring by our management and doner level authority.
- All work accepted by EIC
- After work we do vendor billing process

## Operation and maintenance

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ABR Performance Summary:

Parameters tested between inlet and outlet show significant reduction, demonstrating the effectiveness of the treatment mechanism:

COD: 99.5mg/l (Bangladesh Standard 200mg/l) / COD Reduction: 98%

BOD: 27mg/l (Bangladesh Standard 30mg/l) / BOD Reduction: 98%

TN: 140mg/l (Bangladesh Standard 15mg/l)

pH: 8.31 (Bangladesh Standard 6-9)

TSS: 52mg/l (Bangladesh Standard 100mg/l)

TC: 90000CFU/100ml ((Bangladesh Standard 1000CFU/100ml)

Desludging and O&M:

- 1 daily desludging team required (10m<sup>3</sup> per day).
- Use 01 desludging pumps in series:
- Regular monitoring by trained staff is essential for preventive maintenance.
- Monitor the filling process. Be prepared to shut it down in case of broken pipe or separated coupling.
- Workers must be responsible for wearing eye protection and other PPE, especially when mixing lime to form the slurry.
- Periodically cutting the grass on the embankments.
- Repair any type of damage to fence and gates.
- Removal of any materials blocking the chambers inlets and outlets.
- Application of sludge, desludging, control of drainage systems and of the secondary treatment

for percolate or dried sludge. Desludging everyone to several weeks.

-Sludge treatment sites should have facilities for hand washing and bathing, agencies should have provided soap.

## Lessons learned

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-Public health friendly procedure operated which better than LSP.

-Community provide positive feedback that its not spreading bad smell.

-BOD and COD demand results come rapid and correct.

## Strengths

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-Strong Resistance.

-Built from local Materials.

-Biogas can be recovered.

-No electrical energy is required.

-Low operating costs.

-High Reduction of BOD.

-Long service life.

-Moderate Area requirements(can be built underground)

## Weaknesses

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-Long start up phase

-Requires expert design and construction.

-low reduction of pathogens and nutrients.

-Effluent and sludge requires further treatment.

-Clear design guidelines are not available yet.

-Needs strategy for fecal sludge management(effluent quality rapidly deteriorates if sludge is not removed regularly).



## Image Gallery

**Government of the People's Republic of Bangladesh**  
Department of Public Health Engineering  
Public Health Laboratory, Dhaka Office

**Analysis Report**

Request No.	123456789		
Request Date	12/12/2023		
Request Time	10:00 AM		
Requester's Name	ABC Company Ltd.		
Address	123 Street	Dhaka	1215
Phone	01711-1234567	02-9876543	017-1234567
Requester's Signature	[Signature]		
Requester's Stamp	[Stamp]		

Sl. No.	Test Parameters	Unit	Result	Reference Range (Adult Male)	Remarks
1	Glucose	mg/dl	100	70-100	
2	Hemoglobin	g/dl	15	13-16	
3	Hematocrit	%	45	37-47	
4	WBC	10 <sup>9</sup> /L	10	4-11	
5	RBC	10 <sup>12</sup> /L	4.5	4.5-5.5	
6	Platelet	10 <sup>9</sup> /L	150	150-400	
7	Urea Nitrogen	mg/dl	10	7-20	
8	Creatinine	mg/dl	1.2	0.7-1.3	
9	Bilirubin	mg/dl	1.2	0.1-1.2	
10	ALT	U/L	40	7-40	
11	AST	U/L	30	10-37	
12	ALP	U/L	100	40-125	
13	Gamma-GT	U/L	20	1-31	
14	Triglyceride	mg/dl	150	10-150	
15	Total Cholesterol	mg/dl	200	125-200	
16	HDL Cholesterol	mg/dl	50	35-65	
17	LDL Cholesterol	mg/dl	130	70-130	
18	Vitamin D	ng/ml	20	20-60	
19	Vitamin B12	pg/ml	400	200-900	
20	Folate	ng/ml	10	7-17	

**Comments:**

1. The results reported here pertained to the sample received in this laboratory only.

2. Complete and/or query regarding delivered test report should be lodged within one month of report delivery date.

3. The report shall not be reproduced/published partly or fully without prior approval of the authority.

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