START UP PLAN

KTP FSTP

Date 22th January -2022

Brief:

UNHCR – OXFAM and MSF have completed the construction of the second large-scale fecal sludge treatment plant which will be serving Kutupalong North-East camps and adjacent host communities with the capacity of a total 180m3/day sludge treatment.

From 1st January ,2022 BRAC has taken over the operational responsibility from OXFAM in collaboration with UNHCR. UNHCR - OXFAM will continue with technical backstopping, KTP FSTP lab establishment, FSM training center and other concentrated FSM related activities throughout the year of 2022.

Around 140,000 Rohingya population live in Camp 1E, 1W, 2E, 2W and Kutupalong Registered camp who will be benefitted in addition to nearby Ukhiya Host community from this plant lessening the chance of getting public health disease and outbreaks.

Brief of the plant

Total Capacity	**180 m3**
Area:	4.6 Acre or 18,700 sqm
Construction and Operational modality:	Whole treatment plant is divided into three modules. Each module has 60 m3/day capacity and are identical in operational modality. MSF constructed module 1 and OXFAM, module 2 and 3.
Coverage area:	Camp 1E, 1W, 2E, 2W, Kutupalong Registered camp and nearby host communities
Projected Population coverage:	200,000 individuals Largely depends on several factors such as; latrine containment, soil type, season, etc.

Objective of the document

1. To provide technical recommendations for the start-up phase, including sludge loading rates and other design parameters which need to be maintained during the first 6 months of operational phase of the FSTP.
2. Highlight the critical points for maintain designed HLR/ SLR to the components at initial phase.

Plan for initial phase

The objective will be –

1. Ensure all the PDBs are saturated with liquid effluent. Check if all the control pipes are with the level of top sand layer and releasing effluent with additional FS charging/fresh water.
2. Monitor the plans physically every day and flag out if dead plants are observed to deviate from below proposed loading if necessary. Above all, survival of the plants are and the most important factor for now.

In top line accepting the fact that, post rainy season is the best time to do plantation but we need to try our best to keep the plants alive and make the PDB ready for full loading.

The following startup plan is recommended for next three months and subject to review depending on the plants' growth.

Mainly two types of plant have been used in all PDB's as per below details -

Particular	Module -1	Module 2	Module 3
Plants type	Canna Indica (Kolaboti)	Packchung (Super nappier grass)	Canna Indica (Kolaboti)
Plantation date	December ,21	December,21	Nov / December 21

Design parameters –

Influent TS – 19,000 mg/l
Solid Loading Rate (SLR) – 250 kg TS/m2/Year
Hydraulic Loading Rate (HLR) - .3 m
Sludge accumulation rate- .15m/year

Start-up phase – 3 months from January to March 2022 (To be assessed)
Solid loading rate – 50 kg TS /m2/yr

Selection of sludge loading under different SLR –

SLR- Solid Loading Rate kg TS /m2/yr	10	20	50(Selected for startup)	100	150	250
Sludge loaded Module - m3/ day (Volume)	2.5	5	12	25	37	60

	January 20th to March 20th	March 20th to May 20th)	3rd quarter (TBA)	4th quarter (TBA)
M1	12	25	37	60
M2	12	25	37	60
M3	12	25	37	60
Total sludge loading /day	36m3	75m3	111m3	180m3

Schedule of sludge loading in different PDB

Module 1 ,2 &3	PDB1	PDB2	PDB3	PDB4	PDB5
Sunday	**12m3**	Rest	Rest	Rest	Rest
Monday	Rest	**12m3**	Rest	Rest	Rest
Tuesday	Rest	Rest	**12m3**	Rest	Rest
Wednesday	Rest	Rest	Rest	**12m3**	Rest
Thursday	Rest	Rest	Rest	Rest	**12m3**

Up for discussion –

1. Proposed alternative loading of PDB as per initial plan
2. Second option can be distribute 12m3 over 5 PDB. This can be activated if plant growth as per Option A in some PDB shows very poor.

Key factors for successful PDB operation

Saturated PDB (Water level within 5cm from top surface

Nutrient input (as raw/diluted sludge)

Regular Watering

Critical indicator –

If plant yellowish leaf / rotten stem is observed in any PDB then check following

1. Reduce the FS load and observe
2. Check if PDB are saturated or not ? Ensure regular watering

Its good to remember that plants can also die for no FS load / excess water .

Prerequisite-

1. All PDB is saturated.
2. All plant shoots have minimum level of organics
3. Regular watering in all plants.

Reason of plantation –

Macrophytes therefore play an essential role in the following (Source - Ives Magloire Kengne and Elizabeth Tilley, Planted Drying bed)

- Establishing the beds to prevent media erosion and clogging, and improving the drainage;
- increasing moisture loss (through evapotranspiration, in contrast to only evaporation in unplanted
- drying beds);
- Providing a surface area for microbial growth within the sludge layer;
- Transferring oxygen to the sludge layer (i.e. within the rhizosphere); and
- Absorbing heavy metals and nutrients.

Recommendation for Planted Drying Bed:

Some important recommendation given below

1. **P**lantation growth is most important factor for functional PDB. Liquid need to be reserved in PDB so that plant roots can take necessary nutrients from liquid. The objective is to ensure moisture for plant root during the start-up period.

2. Liquid must be controlled by controlling pipe which can be found in the PDB controlling chamber. Following actions are suggested –
    a. Remove all the elbow from the top of the pipe for easy inspection.
    b. Take the level of the filter media top and mark at the controlling chamber wall so that from outside operator can visualize where the filter media top is.
    c. Currently all control pipe's are extended but further than required. Suggested to cut all pipe with same level of PDB media top. Meaning any excess water above the filter media surface level can drain out and that's our maximum level required.
    d. For further lowering observe how many days is require to infiltrate all the raw sludge. If you observe liquid sludge is not draining from PDB surface for more than 1 /2 days then lower the control pipe by 5 to 10 cm and observe again.


Figure 1: PDB liquid Controlling chamber

This controlling mechanism is critical only for the acclimation phase, when there will be rain / plants root will be strong enough all the controlling pipe to be lowered for easy drainage of the PDB leachate.

3. Marking scale is suggested to be done for each PDB inside wall with 5cm interval for easy inspection of sludge layer height.
4. Dead plants and leaves should be removed from beds especially in Module 3 where large trees exist near / inside PDB.
5. Where plants are dying, replace them with new plants. Suggested to coordinate with NGOF for additional plants if needed.

Figure 2: Suggested plant watering everyday (Until full plant growth)

Mass balance (Design) of PDB

Parameter	Influent -PDB	Effluent – PDB
Q	60	
COD_i	14,000	**2100**
BOD_i	3,500	**525**
FC_i	5,000,000	**1.50E+06**
TSS_i	15,500	**1550**
TS_i	19	**4.75**

Distribution Chamber

Critical Part will be adjusting the V notch for equal distribution to both AFR unit.

But critical point is to ensure equal flow rate to both unit of AFR and which can be dealt in coming months when plant will get continues effluents. In the meantime, can put same cover net for resisting vector breeding.

Anaerobic Filter reactor

Max Upflow Velocity inside filter voids =	0.82	m/h
Specific surface area of filter =	250	m^2/m^3

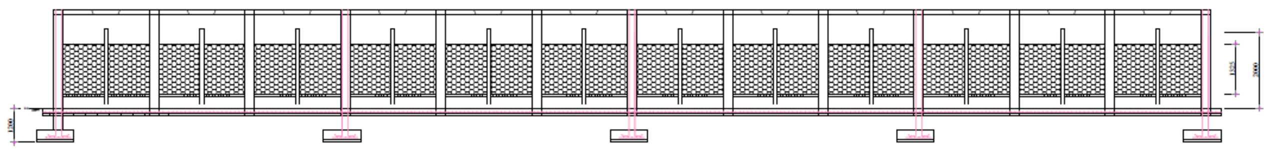
Since we had previous discussion and concern about the efficiency of Cocohusk media based on the result of both MSF (FSTP-1) and OXFAM (FSTP-2) .

Module -1 = MSF has installed cocohusk without bags and small piece of chopping.

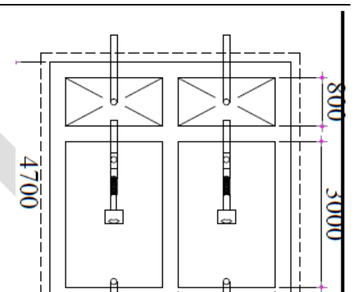
Module 2 and 3 = OXFAM has installed both layer of packed and unpacked chopped (40 to 80 mm and 20 to 30mm size pieces) cocohusk media.

Having the concern of removal efficiency for AFR of both modules, close monitoring of effluent result and operational aspect (Hydraulic and Organic Loading) to be monitored over first year.

In addition, the floating nature of cocohusk media is also another concern for operating the AFR as planned.



Siphon chamber



Critical Part to Look on –

1. Each siphon flushes with 10 LPS .
2. Equal distribution over surface without the Sprinkler.
3. Investigate local option for nozzle for better distribution.

Recommendation

- Until the plant gets fully operational and siphon flushes regularly it's expected that there will stagnant waster inside this chamber which can offer mosquito breeding ground. Suggested to cover the top part with mosquito net, mounted in plastic fence. Alternately very light wight / easily movable ferrocement slab can be placed in.
- It's important to record the time required to fill up the chamber and time required for one flush and volume per flush. Suggesting to record the data from next.

Vertical Flow Constructed Wetland

Suggestion – VFCW

- Regular watering of the plants for passing acclimatation phase.
- Only diluted effluent with no/very low TS (Only TDS) should be charged in VFCW.
- Suggested to install screener at VFCW final outlet to avoid clogging in future.

1. Maintain the ponding/ liquid height at the chamber for plants survival until full loading. May need to add additional water for first few months.

Suggestion –

- Plant canna indica in both module HFCW. Suggested plant density - 4 to 5 shoot per sqm or following a 2'X2' grid .
- Both HFCW is ponded ie. Stone chips are saturated with water,
- Regular watering of the plants for passing acclimatization phase. For HFCW especial care to be taken as top layer of stone won't hold too much organics.
- Only diluted effluent with no TS should be charged in HFCW.
- Suggested to install screener at HFCW final outlet to avoid clogging in future.

- 281m3 X2 Polishing pond will work as final stage of treatment and pathogen deactivation receiving effluent from VFCW of three module.
- Both Polishing pond may need additional water filling for reaching upto outlet level (1m) to avoid getting the pond anaerobic with stagnant water . This may trigger eutrophication at the pond.
- Liquid at polishing pond to be maintained at 1m always . Evaporated quantity and left over (144m3 - Total effluent from 3 module) to be filled with water.

- For first six months its expected that PP wont get (48X3 = 144m3) .But during this period additional fresh water from borehole to be added for maintaining aerobic condition in the Pond.
- Future discussion to be done on installing buffle chambers at both PP to ensure no shortcuts upto effluent and all batch get equal retention time / liquid get exposed to sunlight.

ANNEX

Monitoring Format and Schedule

To be agreed jointly

1. SoP for the FSTP (to be circulated to the desludging Operators)
2. Sludge Receiving Format
3. Sludge Pumping Schedule
4. Internal Component Monitoring (For each)

Baseline data / Design Parameters

Symbol	Description	Unit	Value
Q	Daily flow	m^3	60
COD_i	Chemical oxygen demand	mg/L	14000
BOD_i	Biochemical oxygen demand	mg/L	3500
FC_i	Faecal coliforms	CFU/100mL	5000000
TSS_i	Total suspended solids	mg/L	15500
TS_i	Total solids	mg/L	19000
NH_4-N	Ammonia nitrogen	mg/L	
SVI	Sludge volume index	mL/g TSS	23
t_{op}	Operating hours per day	h	8
T	Mean temperature in coolest month	˚C	20

PDB image from C4 x

Planted Drying Bed – Scenario – B (To be assessed later) when plants will be grown

This plant will receive sludge mainly in following two means –

1. Vacutugs (Mostly will come from Camp 1E, 1W,2E,2W, KTP RC, Other camps or host community)
2. Intermediate Fecal Sludge Transfer Network (IFSTN-2: Camp 1E, 1W, 2E, 2W, Kutupalong RC)

Probable loading combination for the 2022

Period	Vacutug	Intermediate Fecal Sludge Transfer Network, IFSTN 2	Total (m3)/ day	Remarks
January to March, 2022	**80 m3** (Camp 1E, 1W, 2E, 2W, KTP RC and others from MSF if any / Other camps with need)	**0m3**	**80m3**	5 vacutugs X 3m3 each, Total routing time – 1 Hr. Each vacutug can supply 3m3 to FSTP within 1 hr, 8 X 3m3 = 24m3/vacutug
April to June ,2022	**120m3** (Camp 1E, 1W, 2E, 2W, KTP RC and others from MSF if any / Other camps with need)	**0m3**	**120m3**	
July to September ,2022	**120m3** (UKhiya Host – 20 m3)	**60m3**	**180m3**	Expecting part of IFSTN-2 to be operational
October to December ,2022	**20m3** (Ukhiya Host)	**140m3**	**180m3**	Fully operational IFSTN-2

Following points to be followed during first few months of the plant operations

- All the planted drying bed to be planted regardless of ensuring full operations or not.
- SLR (Solid loading rate) 250 Kg TS/m2/year with 60m3 max loading has been designed for each PDB.

- Three PDB from each module will be loaded to its full capacity (60m3)
- Total expected sludge – 80m3 / day (Before the IFSTN - 2 construction)
- Concept is to test 1 PDB from each module to its max capacity for monitoring of sludge accumulation rate, infiltration rate / evaporation rate etc.
- For other PDB planting to be done for giving the plants acclimatization phase. In this period regular sludge will be charged in the PDB for nutrients and organic requirements for the plants. All the PDB liquid control pipe to be kept vertical to maintain water level for newly planted shoots. Close monitoring and nurture is required for first few months. Nursery for additional plants to be maintained Camp 4 extension FSTP site.
- Plant Options – Packchung / Canna indica.
- Still rainwater accumulation at PDB during heavy rain and its alternative solution balancing two limiting factor 1. Not washing out bacteria's at AFR with higher HLR , 2. Plants at PDB doesn't get submerged under stagnant rainwater.

Suggested loading pattern. Can review based on the actual sludge received.

	Day 1					**Total**
Module -1`	PDB 1.1 (60m3)	PDB 1.2 (5m3)	PDB 1.3 (5m3)	PDB 1.4 (5m3)	PDB 1.5 (5m3)	80m3
Module -2	PDB 2.1	PDB 2.2	PDB 2.3	PDB 2.4	PDB 2.5	
Module -3	PDB 3.1	PDB 3.2	PDB 3.3	PDB 3.4	PDB 3.5	

	Day 2					**Total**
Module -1`	PDB 1.1	PDB 1.2	PDB 1.3	PDB 1.4	PDB 1.5	
Module -2	PDB 2.1 (60m3)	PDB 2.2 (5m3)	PDB 2.3 (5m3)	PDB 2.4 (5m3)	PDB 2.5 (5m3)	80m3
Module -3	PDB 3.1	PDB 3.2	PDB 3.3	PDB 3.4	PDB 3.5	

	Day 3					**Total**
Module -1`	PDB 1.1	PDB 1.2	PDB 1.3	PDB 1.4	PDB 1.5	
Module -2	PDB 2.1	PDB 2.2	PDB 2.3	PDB 2.4	PDB 2.5	
Module -3	PDB 3.1 (60m3)	PDB 3.2 (5m3)	PDB 3.3 (5m3)	PDB 3.4 (5m3)	PDB 3.5 (5m3)	80m3

	Day 4					**Total**

Module -1`	PDB 1.1	PDB 1.2 (13.5m3)	PDB 1.3(13.5m3)	PDB 1.4(13.5m3)	PDB 1.5(13.5m3)	54m3
Module -2	PDB 2.1	PDB 2.2(13.5m3)	PDB 2.3(13.5m3)	PDB 2.4	PDB 2.5	27m3
Module -3	PDB 3.1	PDB 3.2	PDB 3.3	PDB 3.4	PDB 3.5	

	Day 5					**Total**
Module -1`	PDB 1.1	PDB 1.2	PDB 1.3	PDB 1.4	PDB 1.5	
Module -2	PDB 2.1	PDB 2.2	PDB 2.3	PDB 2.4(13.5m3)	PDB 2.5(13.5m3)	27m3
Module -3	PDB 3.1	PDB 3.2(13.5m3)	PDB 3.3(13.5m3)	PDB 3.4(13.5m3)	PDB 3.5(13.5m3)	54m3