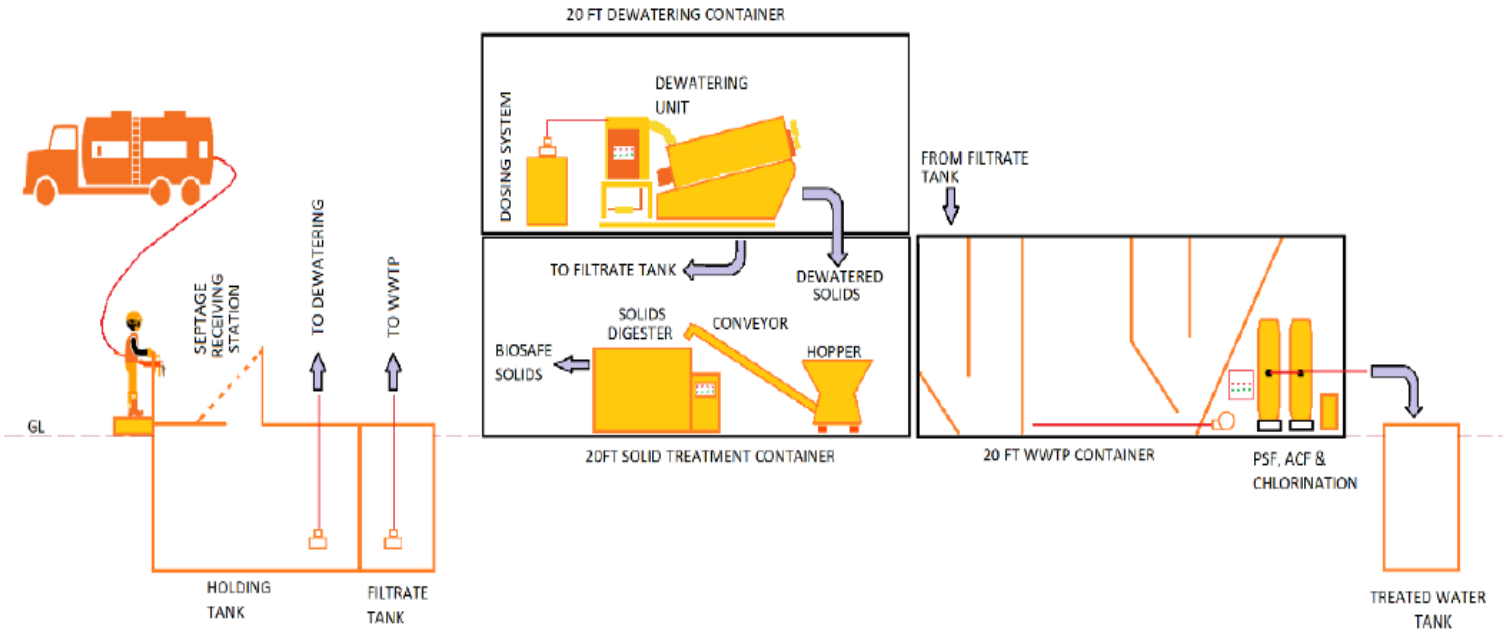
Piloting low-tech Omni-processor

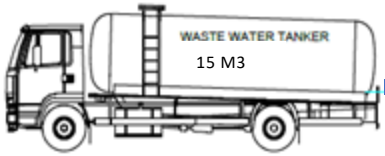
Support to the WWTP- receiving sludge

- Large volume of anoxic/anaerobic wastewater removed from sites every year (+450,000m3/year) and disposed of in overstretched WWTP :
  - Conventional treatment (aerobic | activated sludge)
  - Non or partially operational
  - Operation status has deteriorated with the current Energy crisis
  - Even if Innovative DEWATS is at scale in the country, sludge will still need to be removed from sites and safely managed

UNICEF LCO has been piloting the treatment performance of a LowTech Omniprocessor enabling receiving and treating the Wastewater and sludge from ISs desludging.



OMNIPROCESSOR ORIGINAL BLOC FLOW DIAGRAM



Reception Area

Solid waste manually removed / Manual bar screen

Raw sewage tank

Mass balance
BOD 500 mg/l
COD 980 mg/l
FOG 25,000 mg/l
TSS 2,400 mg/l

Mass balance
BOD 1320 mg/l
COD 2400 mg/l
FOG 51000 mg/l
TSS 16,000 mg/l

Flocculent

Screw Press

Filtrate

Mass balance
BOD 225 mg/l
COD 460 mg/l
FOG 13,500 mg/l
TSS 1,300 mg/l

Mass balance
BOD 200 mg/l
COD 470 mg/l
FOG 9700 mg/l
TSS 900 mg/l

Sludge dryer

Dried sludge

MBBR

Holding tank

Mass balance
BOD 170 mg/l
COD 400 mg/l
FOG 2,500 mg/l
TSS 350 mg/l

Mass balance
BOD 180 mg/l
COD 400 mg/l
FOG 3400 mg/l
TSS 600 mg/l

Polishing filters

Backwash

Disinfection

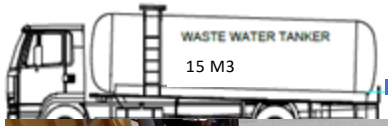
Discharge

Mass balance
BOD 50 mg/l
COD 280 mg/l
FOG 1,300 mg/l
TSS 350 mg/l

Mass balance
BOD 60 mg/l
COD 290 mg/l
FOG 1350 mg/l
TSS 600 mg/l

Irrigation Channel

OMNIPROCESSOR ORIGINAL BLOC FLOW DIAGRAM



Fl

Filtrate

Dried sludge

TSS 1,300 mg/l

TSS 900 mg/l

Holding tank

Mass bal
BOD 60 r
COD 290
FOG 135
TSS 600 r

Mass balance
BOD 170 mg/l
COD 400 mg/l
FOG 2,500 mg/l
TSS 350 mg/l

Channel

Challenges

- Energy Crisis leading to solarize the system
- Original treatment of the MBBR is affected by the low level of solid capture by the Flocculation and too high level of Fat Oil and grease

- Thus, UNICEF with the support of BMGF initiated an upgrade of the system, adding a Coagulation stage and DAF system as per the following scheme

OMNIPROCESSOR ACTUAL BLOC FLOW DIAGRAM

Reception Area

Solid waste manually removed / Manual bar screen

Raw sewage tank

Coagulant

Flocculent

Screw Press

Dried sludge

Sludge dryer

Filtrate

DAF

DAF Scum tank

Scum

Excess floating sludge

MBBR

Holding tank

Polishing filters

Disinfection

Discharge

Backwash

Irrigation Channel

Solid waste ma

Proof of concept achieved

Treated Wastewater reach the ELVs for safe discharge in the environment. And reuse of biosolids is proven possible.

TREATED INFLUENT MEASURED CHARCTERISTICS AFTER TERTIARY TREATEMENT														Lebanese standards for effluent Discharges
Parameters	Units	DAY 1		DAY2		DAY3		DAY 4		DAY 5		DAY 6		
pH	pH units	7.21	7.09	6.2	6.4	6.75	10.82	6.5	6.5	6.85	7.12	7.1	6.88	6-9
Biochemical Oxygen Demand	mg/L as O_2	0.45	0.23	0.16	0.18	1.29	1.11	16.4	8.73	0.5	1.11	0.49	2.1	25
Chemical Oxygen Demand	mg/L as 02	2.5	1.2	0.8	1	5.2	1.9	22.7	15.2	1	1.8	1.9	5.1	125
Total Suspended Solids	mg/L	42	30	12	14.9	64	152	305	118	8970	35	80	67	60
Ammonium	mg/L NH4	0.75	0.26	0.005	0.21	0.65	3.73	0.1	0.1	0.1	0.1	0.1	0.1	
Ammonium Nitrogen	mg/L NH4-N	0.58	0.2	0.005	0.16	0.5	2.9	0.1	0.1	0.1	0.1	0.1	0.1	10
Phosphate	mg/L PO43-	0.05	0.02	0.002	0.002	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	10
Total Nitrogen	mg/L N	2.2	1.8	0.005	0.4	16	33.2	28.5	47.2	1.1	1.1	5	7.8	30
Salmonella	cfu/100 mL	0	0	0	0	0	0	28	32	0	0	0	0	0
Escherichia Coli	cfu/100 mL	0	0	0	0	0	0	84	42	0	0	0	0	0
Fecal Coliforms	cfu/100 mL	0	0	0	0	0	0	190	71	0	0	0	0	0
Mercury	ug/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	50
Cadmium	ug/L	0.09	0.15	0.05	0.1	0.01	0.09	0.05	0.09	0.04	0.09	0.05	0.05	200
Lead	ug/L	1.6	2.37	0.9	1.2	0.01	0.08	0.05	0.9	0.09	0.09	0.08	0.05	500
Arsenic	ug/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	100
Chromium	ug/L	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2000
Copper	ug/L	3.29	5.12	2.1	0.88	0.09	1.8	1.01	2.14	1.8	1.2	4	3.44	500
Nickel	ug/L	2.77	3.65	0.06	0.54	0.14	1.65	1.8	1.04	1.1	2.1	4.1	2.8	500
Zinc	ug/L	0.68	2.05	0.09	0.07	0.25	0.28	0.9	0.09	0.09	0.1	0.22	0.8	5000
Titanium	ug/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	

Parameters	Units	Day 1 Result	Day 2 Result	Day 3 Result	Day 4 Result	Day 5 Result	Day 6 Result	ELVs (EPA 40 CFR 503.12(e)(2))
pH	pH units	7.5	7	6.9	7	7.2	7.12	
Moisture Content	%	15.1	8.2	12.8	10.21	9.54	12.1	
Bulk Density	g/cm^3	1.42	1.65	1.54	1.28	1.29	1.25	
Total Nitrogen	mg/Kg N	10220	4820	5000	4822	10500	10200	
Phosphate	mg/Kg PO_4^{3-}	2500	1522	1850	1500	1540	9000	
Conductivity	dS/m	0.69	0.62	0.671	0.55	0.612	0.623	
Fecal Coliforms	MPN/g dry weig	<1	<1	<1	<1	<1	<1	
Salmonella	MPN/g dry weig	<1	4	<1	1	<1	<1	
Escherichia Coli	MPN/g dry weig	<1	<1	<1	<1	<1	<1	
Mercury	mg/Kg Hg	0.1	<0.01	<0.01	0.5	0.8	0.44	75
Cadmium	mg/Kg Cd	0.5	0.22	1.2	1.45	1.81	3.17	85
Lead	mg/Kg Pb	0.99	5.08	0.55	16.74	2.24	3.22	840
Arsenic	mg/Kg As	10.2	2.1	1.1	20.9	21.5	15.4	75
Chromium	mg/Kg Cr	101	72.3	17.3	12.79	11.34	33.63	85
Copper	mg/Kg Cu	184.35	128.51	96.44	137.23	157.55	272.36	4,300
Nickel	mg/Kg Ni	39.98	15.33	62.4	41.22	20.18	50.07	420
Zinc	mg/Kg Zn	115.71	37.44	139.08	82.89	140.9	113.58	7,500
Titanium	mg/Kg Ti	5.2	2.11	1.8	<1	2.1	<1	

Handover to the BWE

ج.م

الجمهورية اللبنانية
وزارة الطاقة والمياه
مؤسسة مياه البقاع
BEKAA WATER ESTABLISHMENT

رقم الصادر : ٤٨١/ص

التاريخ : ٢٠/٤/٢٠٢٤

جانب منظمة UNICEF المحترمين

الموضوع: إستلام محطة Omni Processor والأشغال والمعدات الجديدة المنفذة والطاقة الشمسية ومولد كهربائي في محطة ايعات.

المرجع:- كتابكم المسجل لدى مصلحة الديوان في المؤسسة بالرقم ١٣٢ تاريخ ٢٠٢٤/٢/٥.
- إتفاقية هبة من جانب وزارة الطاقة والمياه بالرقم ٢٠٩٢ تاريخ ٢٠٢٠/٩/١٤.
- تقرير لجنة إستلام مشاريع تشغيل وصيانة شبكات ومحطات الصرف الصحي بتاريخ ٢٠٢٤/٤/٢٤.
- إحالة مصلحة المحطات والمشاريع بتاريخ ٢٠٢٤/٤/٢٥.

بالإشارة إلى الموضوع والمرجع المبين أعلاه،

تبدي مؤسسة مياه البقاع موافقتها على إستلام محطة Omni Processor والأشغال والمعدات الجديدة المنفذة والطاقة الشمسية ومولد كهربائي في محطة ايعات وفق تقريري مصلحة المحطات والمشاريع ولجنة إستلام مشاريع تشغيل وصيانة شبكات ومحطات الصرف الصحي .

ربطاً: جدول بأسماء المكلفين بتشغيل المحطة

مع التقدير

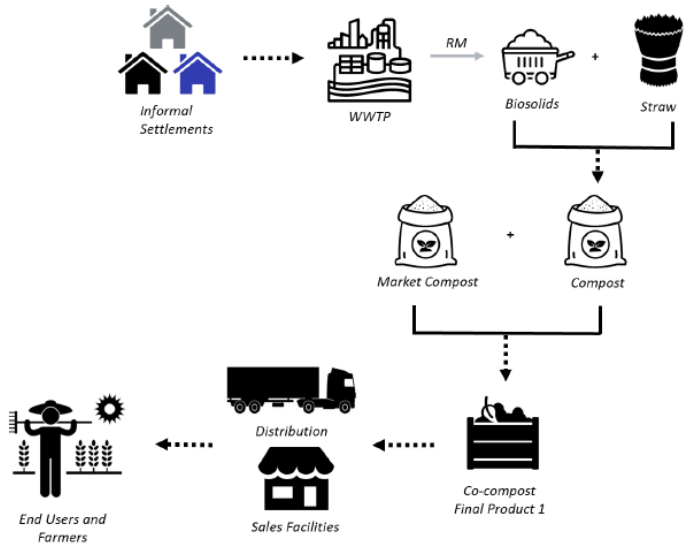
المدير العام بالتكليف
المهندس بولا اميل حاوي

نسخ تبلغ:
- مصلحة المحطات والمشاريع
- لجنة الإستلام

Opportunities

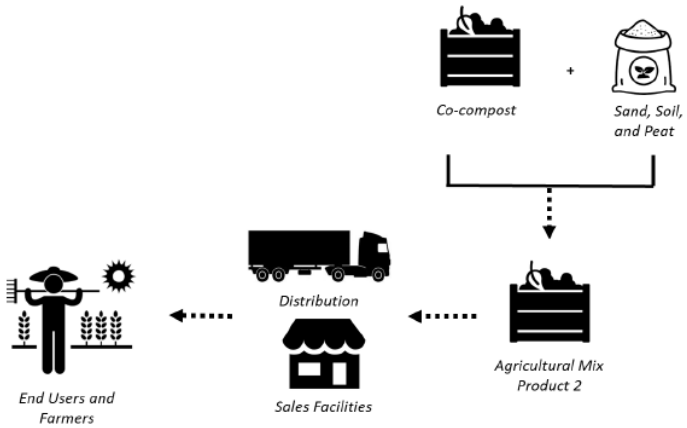
- To sustain the Operation and maintenance of the system with BWE having stretched financial and human resources UNICEF look how to develop a circular economy market to generate revenue from the biosolids produced.

Figure 1 – Operational Model/Product 1



Co-compost bags of 10kg - $6/bag

Figure 2 - Operational Model/Product 2



Agricultural mix bags of 10kg - $10/bag

United Nations COMTRADE database on international trade, Lebanon's imports of fertilizers were US$28.52 Million in 2021.

LIBNOR stds (NL-ISO 19698:2020) reuse of biosolids.

Aarsal Road Map

Image – Wastewater leaking from the existing wastewater ponds in the Jurd of Aarsal

1.Context and background

1. Context and background

Demographics

- A town and the **largest** municipality in Baalbek district of BBH Governorate.
- High proportion of Syrian refugees living across **208** ITSs (approx. **32,000** population).
- Slightly less Syrian refugees living in residential areas (**15,000**).
- **40,000** Host Community.

Wastewater Context

- **No network**, reliant on desludging services.
- Currently **530m3/d** from ISs is discharged.
- High risk of groundwater **contamination** to surrounding villages.
- Governor of BBH collected **full consensus** from community for the UNICEF roadmap (2024).

Image – Ponds filled by wastewater in Aarsal (approx. 500m from households)

3. Medium to Long Term Solutions

3. Medium to long term solution

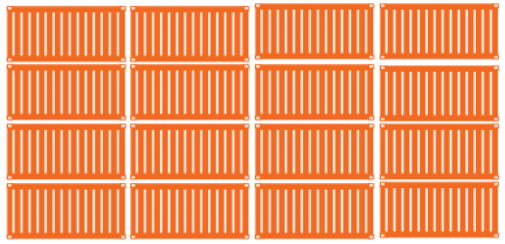
Installation of Fixed Bed BioReactor (FBBR) to enable treatment of 800m3/d of sludge.
m$ 4.6 for the installation of the system including solarization and Composting plant

Rehabilitation of the open pond
$ 800,000 over 2 years

Operation and maintenance
$ 270,000 / year

Desludging Cost
+m$ 1/ year

Potential generation of income
$ 150,000/year Reuse of sludge as fertilizer
$ 50,000/year Reuse of treated water



FBBR is a modular and scalable system enable to be connected to a network
X4 the number of modules
+ m$ 7.5

Network would need to be in place – BTD estimate the cost at **m$ 14** in its 2020 study.

Potential generation of income
Up to **$ 600,000/year** Reuse of sludge as fertilizer
Up to $ 200,000/year Reuse of treated water

Medium term Solution

m$5.4 – Investment (system and rehabilitation)
m$1.3 – Yearly operation cost (Desludging + O&M WWTP)
K$ 200 – Yearly potential revenue generation

Long term Solution

+m$21.5 – Investment (system enlargement and network)
m$1.1 – Estimated yearly operation cost (O&M WWTP - tbc)
K$ 800 – Estimated yearly potential revenue generation

Discussion

For any question, please contact :

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