Wastewater Treatment in IDPs Camps

Piloting septic tanks as a long-term containment and treatment option
In Northwest Syria

UN IOM Turkey Shelter and WASH Cross-border Programme

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INTRODUCTION

UN IOM Turkey's cross border programme has been implementing shelter and WASH interventions in Northwest Syria over the past years among other interventions. The UN considers the Syrian displacements as the largest worldwide. Over 6 million people are displaced inside Syria, with over a million displaced late 2019. The majority, about 2,7 million, are displaced inside Northwest Syria and live under overcrowded conditions with big shelter and WASH needs. Shelling and displacements continue to escalate ten years after the Syrian civil war started. Therefore, IOM in 2019, decided to start planning for long-term sustainable WASH solutions and interventions. Early 2020,IOM initiated a research to pilot and investigate the potential of adopting communal septic tanks as a long-term wastewater treatment option for internally displaced persons (IDPs) and or refugee camps.

The study piloted multi-chamber (3 chambers) septic tanks in about 14 IDPs camps, 10 planned camps and 4 informal camps. With tanks having a capacity of at least 50 m³ and maximum of abut 166 m³, flow rate ranging from 0.8-2.6 m³/h and retention time of about 2-15 hours. The project was carried out in partnership with 3 implementing partners, Watan, Bonyan and Saed NGO's, and with surge support from ACU and Dutch Surge Support Water (DSS). ACU was responsible for wastewater sampling and analysis in the camps. Watan and Bonyan IPs adopted a 3-chamber communal septic tank and Saed a 2-chamber septic tank connected to an infiltration pit. Watan was in charge of informal sites whilst Bonyan and Saed implemented septic tank interventions in planned camps.

The septic tank is an old technology that has been traditionally used as an onsite solution to contain wastewater or fecal sludge. The technology is a popular primary treatment method. Despite being an old and popular method, there is relatively not much information or studies about the technology and its effectiveness. Therefore, IOM piloted the study to inform and plan future long lasting wastewater treatment interventions in IDPs camps. The study found out that septic tanks achieve good treatment , 90% TSS removal, 65% COD removal and 50% BOD removal but only if a minimum retention time of 24 hour is met, depending on the daily flow rate. Nutrient an d pathogen removal was negligible, ≤20%. The 3-chamber tank proved efficient in comparison to the 2-chamber tank. However, efficiency can be further improved by adding a holding tank or equalization basin to equalize flow and concentration as well as to help in attaining optimum retention time in the septic tank. Adopting an upflow septic tank is also a favourable option to enhance influent contact with biomass and improve treatment as well as a long first chamber, possibly 0.5 to 0.6 of the total length.

METHODS

The study was conducted for 6 months during summer and winter periods. Focus was on monitoring the septic tank's performance in relation to suspended and settleable solids, COD and BOD. This was related to the measured operational parameters, temperature, pH, flow rate and hydraulic retention time.

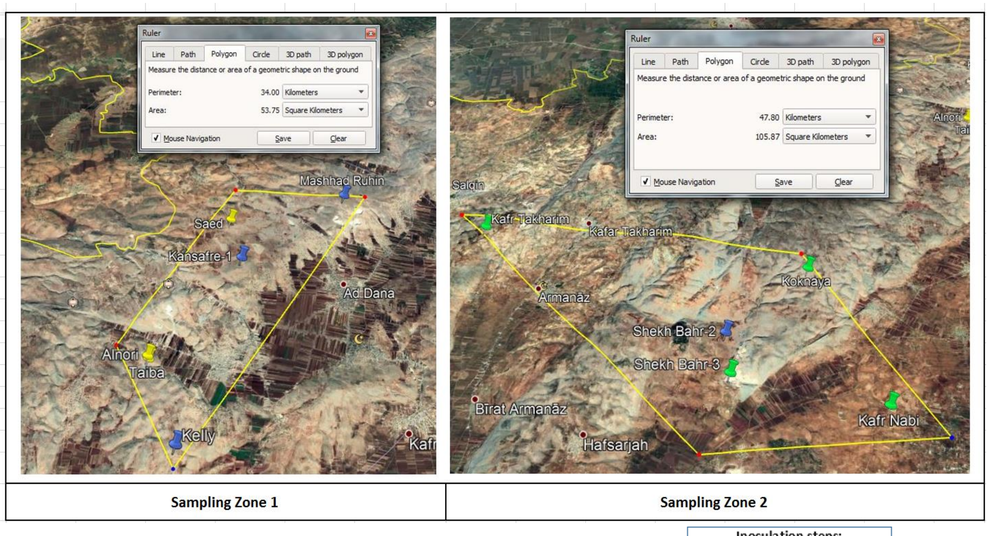
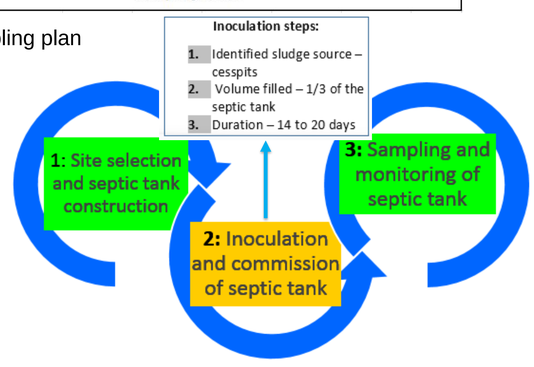


Figure 1 – Sampling plan

The septic tanks were inoculated before operation for about 20 days. The sludge inoculum was collected from cesspits within IDPs camps. Performance comparison with available wastewater treatment technologies in Northwest Syria were conducted. These technologies include UASB, ABR and constructed wetlands. Sampling was conducted bi-weekly and both operational and performance indicators were monitored.



RESULTS

The septic tanks achieved some treatment with high removal efficiency for suspended solids and COD. However, only a few tanks achieved good treatment for all measured parameters. Some of the samples can be distinguished from figure 3.

Figure 2 – Saed camp communal septic tank

Figure 3 – Septic tank inlet and outlet samples examples

Challenges:

1. Limited land space (HLP rights)
2. Low to no flow rate reaching some septic tanks
3. Vandalism of simplified sewer to septic tank
4. Availability of vacuum trucks a necessity for regular desludging

Septic tanks are onsite systems that offer containment and are often used as primary treatment systems. As such, they achieve high solids removal except for dissolved solids. Removal of suspended and settleable solids can be as high as 70-90%. A few septic tanks about 4 achieved high solids removal of about 70% to 84%, with small variations in between weeks. The removal of settleable solids ranged from 30-70%. At times it was as low as 20%, a possible indication of little hydraulic retention time, less than 24 hours.

DISCUSSION

The project piloted a 3-chamber communal septic tank, however, one of the IPs, Saed constructed 2-chamber septic tanks connected to soakaway pits in about 2 camps. The 3 chamber septic tanks were not connected to soakaway pits or infiltration pits in order to allow addition of other possible treatment steps. Both designs offered better containment of wastewater in camps and helped in solving overflow of wastewater from cesspits, which was a common sight. Refer to figure 4. However, the 3-chamber design offered better treatment in comparison to the 2-chamber design, for example 43% and 65% removal for BOD and COD respectively in comparison to 24% and 36% for the 2-chamber tank. The study also managed to compare the performance of the septic tank to available wastewater treatment technologies in Northwest Syria. These include anaerobic baffled reactor (ABR), constructed wetlands and Upflow Sludge Bed Reactor (UASB) among others. Refer to examples shown below.

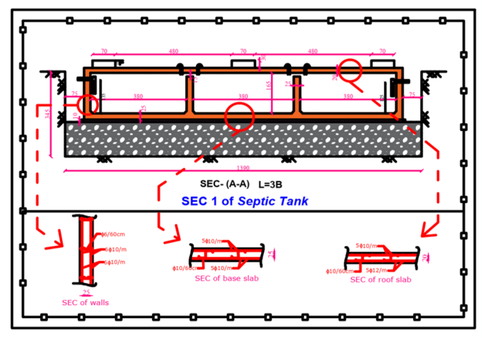


Figure 4 – Wastewater overflow from camps forming a manmade

Technology	Total Suspended Solids		
	Inlet (mg/l)	Outlet (mg/l)	% Efficiency
ABR	490	56	88.6
UASB	490	362	26.1
Septic tank	760	126	83.4

Technology	BOD			COD		
	Inlet (mg/l)	Outlet (mg/l)	% Efficiency	Inlet (mg/l)	Outlet (mg/l)	% Efficiency
ABR	284	278	2.1	1210	920	24
UASB	556	279	49.8	1000	985	1.5
Septic tank	602	341	43.4	1550	550	64.5

The multi-chamber septic tank has a comparative advantage and efficiency to the UASB and ABR, despite the difference in wastewater quality and possibly operational conditions. It can be observed that the septic tank had a higher COD removal efficiency and second best TSS and BOD removal. However, this might be dependent on other factors such as lack of granular sludge of the UASB, low biodegradability of wastewater for example the ABR influent had a BOD:COD ratio of about 0.2.
Despite, better performance, the septic tanks achieved unsatisfactory results in some instances and failing to attain a minimum retention time of about 24hours. Also the processes involved (sedimentation and anaerobic digestion) had negligible removal of pathogens and nutrients as shown in the table above.

Camp	In_N (mg/l)	Out_N (mg/l)	% Eff	In_Total Coliforms (mg/l)	Out_Total Coliforms (mg/l)	% Eff
Shekh Bahar-3	20	12	**40**	50	60	**-20**
Kafr Nabi	21	18	**14**	70	60	**14**
Koknaya	24	17	**29**	80	80	**0**
Kafr Takharim	27	24	**11**	90	70	**22**
Mashhad Ruhin	26	20	**23**	80	50	**38**
Kelly	29	21	**28**	60	60	**0**
Tiba - Alnori	28	25	**11**	70	60	**14**
Saed	54	42	**22**	96	82	**15**

The study, therefore, recommended a holding tank or equalization tank before the septic tank in order to have a uniform flow and concentration as well as to achieve at least a 24 hour retention time. This may optimize sedimentation and anaerobic digestion processes. In addition, adopting an upflow design improves contact of bacteria with organic matter and therefore, may improve performance of the septic tank.

CONCLUSIONS

In conclusion the multi-chamber communal septic tank offers good containment and both primary and secondary wastewater treatment in IDPs and or refugee camps. However, the availability of land space and vacuum trucks or pumps are critical for effective operation and maintenance of the communal septic tanks.

Septic tanks achieve high solids removal 70-90%, 50-80% COD and BOD of about 30-50%. However, effluent from septic tank requires further treatment since it partially removes BOD load and does not kill pathogens or remove nutrients. Reuse of the effluent without treatment is discouraged. Depending with the desired end use or receiving waters, septic tanks can be operated in combination with waste stabilization ponds, constructed wetlands, UASB and others.

In cases where, septic tanks are solely used as treatments units, a holding tank or equalization tank is recommended to allow regulation of flow and achieving optimum hydraulic retention time of about 1 day. In addition, in semi arid and arid areas or other areas with deep groundwater tables, connection of septic tanks to soakaway or infiltration might further improve treatment. Other ways to optimize performance include adopting an upflow septic tank design, longer first chamber and addition of outlet filter inside the septic tank.

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Acknowledgements: