Emergency Sanitation Project

Pilot of IFRC AFWTU

Excerpted from

The Emergency Sanitation Project

Phase 2

Final Narrative Report

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Centralized Treatment – Development of the IFRC Aerobic Faecal Waste Treatment Unit for Deployment to Acute Emergencies

Background

While decentralized, on site treatment has many advantages, centralized treatment can offer greater efficiency and easier process control oversight, particularly at scale. However, the WASH sector has struggled to provide a solution for centralized treatment of faecal sludge or wastewater in the acute stage of emergencies.

In the first phase of the ESP, the IFRC explored a number of options for centralized faecal sludge and wastewater treatment. While some technologies failed in early trials, others demonstrated potential to improve at least the basic treatment of human waste. None, however, were deemed suitable for stockpiling or use in prepositioned equipment packages that would enable rapid response to FSM needs in acute emergencies. Many view faecal waste treatment as entirely context specific. While noting that no technology is universal, the IFRC believes that equipment packages similar to the ones we stock and deploy for water treatment and basic sanitation are feasible for faecal sludge and wastewater treatment, and at a comparable price point. The IFRC thought that the most viable solution was a system of combined treatment processes to enable large scale treatment of a variety of faecal waste in a range of contexts and, with the groundwork laid out in Phase 1, set out to create such a package.

Work carried out in Phase 2

After a period of review and refinement of previously tested equipment, the IFRC held a 3-day workshop in July of 2017. The workshop brought together 19 engineers and technicians from inside and outside the Red Cross Movement. Equipment was assembled and assessed for its feasibility to deliver results in field conditions. A number of designs were developed and debated. While several, including lagoons, were practical enough for use in emergencies, one design was deemed most in line with the desire for a rapidly deployable package for a wide range of contexts.

While work began to shape the design and procure the different components, less than a month after the workshop the IFRC joined a large number of humanitarian aid agencies in responding the needs of hundreds of thousands of people near Cox's Bazaar, Bangladesh. While the initial plan was to trial the unit in a non-emergency setting, the humanitarian needs and the relative ease of deploying IFRC and Red Cross Red Crescent WASH personnel led to the reluctant and heavily criticized decision to conduct the trial in the Population Movement Operation. While this led to customs and weather delays, the IFRC is confident it was the right decision. Cox's Bazaar has become a hub for FSM innovation and learning. We have been able to learn from others and demonstrate the effectiveness of our approach to a wider audience.

The unit uses existing and novel technology for primarily aerobic treatment of faecal sludge and wastewater. The plant currently operating in Bangladesh consists of two T45 steel tanks (one for aeration and one for settling), pumps, aerator, mixer, glass bead filter, inline chlorinator for supernatant and anaerobic digestor for treatment of accumulated sludge. This unit is currently estimated to serve a population of around 5'000 people with possibility to scale up.

Surface mixing Unit

Surface aerator

Although equipment was in place by April of 2018, the decision was taken to postpone the trial until after the monsoon rains and begin work in September 2018. Unforeseen challenges, particularly with the electrical wiring and the tank panels, have cause significant delays while also providing valuable learning experiences. Not only were these issues resolved, they are unlikely to affect future deployments. The aerator and mixer can be ordered with wiring complete and the tanks are easily reinforced with sandbags to withstand the repetitive stress of the mixing action.

The plant began to take on human waste in November of 2018. The most serious setback occurred in January 2019. Due to an incorrect speed setting on the mixer, large amounts of foam began to build up on the surface of the reactor tank. In the 2-week absence of the process engineer, the operating crew began to turn off the aerator and mixer for extended stretches and the unit went anaerobic in a few days. Once again, this provided extremely useful learning for the future use of the plant. The foam issue was resolved with surface skimming initially and then adjustment to the mixer. The operating protocol was modified to ensure 24/7 operation to maintain aerobic conditions. In the event that the unit once again became anaerobic, the operating manual contains a troubleshooting guide to remove the anaerobic material and restore aerobic conditions.

Results

As this was a pilot, we were unsure whether the process would work at all. We therefore sent less equipment for aeration and mixing than ideal for the size of tanks installed. The dissolved oxygen levels in the unit are within the acceptable range, but the loading rate of wastewater is lower than planned and lower than the tanks could handle if better aerated. Notably, the unit does not produce strong odours or attract insects. Power consumption is low, resulting in low operating costs. The recent review of FSM in Bangladesh carried out by Oxfam and Arup[1] scored the system high on effectiveness and efficiency. We are confident that results would improve significantly with small upgrades to the system

After the January anaerobic incident was addressed, the unit began to function more consistently. As of June 2019, the unit is still running, with steady improvement in performance. COD levels were nearing the Bangladesh standard of 200 mg/L and the unit was achieving near total removal of intestinal parasite eggs. It is hoped that the installation of an anaerobic baffled reactor for pre-treatment will reduce the solids entering the system and increase loading rate and effluent quality. A planned conversion to solar power for energy efficiency has faced internal procurement delays but should be finalized soon.

In addition to the treatment unit, the IFRC also deployed the newly developed Faecal Sludge Field Laboratory (FSFL). Developed with HIF support by a consortium led by the Austrian Red Cross, the FSFL allows the humanitarian sector to determine the nature of human waste, plan appropriate response, and monitor the performance of waste treatment methods in an emergency field setting. The FSFL began analysing samples from the aerobic plant and a British Red Cross run lime treatment facility in January 2019. Samples from other organizations are also tested on a small-scale basis. The FSFL has provided critical data on the effectiveness of the IFRC plant. The IFRC strongly advocates that all organizations engaged in FSM operate a similar laboratory.

Next Steps

The pilot in Bangladesh will continue to run as long as possible, though the field operation may convert the site to another treatment solution. The IFRC is currently seeking support to test a larger unit in a different location. The Fact Sheet for the IFRC Aerobic Waste Treatment Unit, attached to this report and available at the ESP website, contains the specification for the upgraded unit. Although it is larger, it can be packed in a 40 ft container. We are also beginning to develop the necessary pool of human resources needed to operate the treatment plant and laboratory.

While we acknowledge that no system can be suitable for every context, we strongly believe that the unit can function in a wide array of geographical and sociocultural contexts. Aerobic treatment is in use across the globe. Outside of cold climates, its primary limitation is the sustainability issues (cost, spare parts, technical capacity for operation and maintenance) that affect infrastructure in all low-income settings. However, in an acute emergency these considerations can be mitigated more easily.

[1] Available for download at https://arup.sharefile.com/share/view/sb5936ce71df4e85b