291

Faecal sludge treatment plant by lime stabilisation in Cox´s Bazar, Bangladesh

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Introduction

In the refugee camps near Cox's Bazar, Bangladesh, limited space, excessive rainfall, and a high water table mean that simple sanitation facilities are often insufficient for safe disposal of excreta. This can lead to increased incidence of WASH (water, sanitation, and hygiene) related morbidity and mortality, in addition to environmental contamination with pollutants. Faecal sludge treatment plants (FSTP) exist but do not cover the needs; few have laboratory capacity and some pose safety concerns. Chemical treatment carries risks for workers handling the chemicals, and treated effluent may not meet environmental discharge standards. Biological systems risk incomplete pathogen reduction and resultant public health concerns. In September, 2018, MSF constructed an FSTP to serve the camps and surrounding population, with a catchment area of approximately 25,000 people. Treatment using a chemical (lime) stabilisation process was assessed, as well as the best method for disposal/end-use of the resulting faecal sludge.

Methods

The FSTP is a chemical treatment plant consisting of a raw sludge storage tank, a lime stabilisation tank, drying bed, anaerobic baffled reactor, and a constructed wetland. Efficacy of the treatment technologies was assessed using laboratory analysis to ensure the discharged effluent parameters complied with Bangladeshi standards. Parameters measured included major environmental pollutants: chemical oxygen demand (COD), nitrate (NO3-), phosphate (PO4)3-, nitrogen-ammonia (NH3-N), pH, and indicator pathogens: *E. coli* (EC)*;* and helminth ova. A DR-3900 spectrophotometer, EC dry plates, and microscopy were used to analyse raw, post-treatment, and discharge stages, respectively. For faecal sludge management, an incinerator was used to reduce dry sludge to ash, destroying all pathogens including helminth ova. The effectiveness of the ash in the manufacturing of construction materials or as a soil conditioner were explored as options for disposal.

Ethics

This innovation project did not involve human participants or their data; the MSF Ethics Framework for Innovation was used to help identify and mitigate potential harms.

Results

At discharge, effluent measured mean values of 498 mg COD/L, 30 mg NO3-/L, 1.4 mg (PO4)3-/L, 114 mg NH3- N/L, 9.2 pH, 83 *E. coli* CFU/100 mL, and no helminth ova. The results show effective pathogen reduction, but high oxygen demand that could negatively impact the environment. Ash was not effective in manufacturing construction materials; bricks made from it failed strength testing. Ash was deemed most appropriate as a soil conditioner due to the lack of space for storage or further treatment of the dried solids and the relative assurance of total pathogen destruction by burning. In addition, the pH of the ash was slightly basic and the local soil was acidic. It can be speculated that the soil conditioner might improve soil conditions by increasing moisture retention, increasing nutrient availability, or raising the pH. The ash was given to colleagues and the local community. Demand started low but grew to outstrip production. The plant operated for 5 days per week, the cost, including desludging activities in the refugee camp and a laboratory, with a staff of 65 people, was approximately GB £15,500/month.

Conclusion

This plant was intended to be a model FSTP throughout MSF. It met pathogen reduction standards. However, the secondary aim of limiting environmental damage was not fully realised. Results have been used to inform future MSF sanitation projects and strategies. Poor oxygen demand reduction combined with costs and safety concerns of chemicals are steering focus towards a biological treatment approach. Further data collection should compare chemical and biological treatment approaches.

Conflicts of interest

None declared.