HUMANITARIAN INNOVATION FUND

Final Report

- Please try not to exceed 5 pages (Arial, 12pts) excluding attachments –

Organisation Name	Université Laval

Project Title	Treatment and safe disposal of excreta in emergencies
Problem Addressed / Thematic Focus	WASH
Location	Canada
Start Date	01 July 2014
Duration	6 months (+ 4 month NOE)
Total Funding Requested	18482 GBP

Partner(s)	Single applicant
Total Funding	Total HIF and other contributions to this project

Innovation Stage	Invention
Type of Innovation	Product/Process
Project Impact Summary	A potentially simple and low-cost method for the final disposal of human waste from emergency sanitation systems to safeguard public health.

Reporting Period	**Final**
Total Spent	18482 GBP

ACTIVITIES CARRIED OUT

1. Project kick-off and procurement of materials and equipment (1 month);
2. Laboratory testing of aeration and mixing efficiencies with venturi system (3 months);
3. Design and commissioning of scaled-down prototype (2 month);

4. Exchange ideas with potential end users and NGOs at the 3rd International Faecal Sludge Management Conference in Hanoi (1 week);
5. Proof-of-concept testing of innovation (3 months);
6. Exploration of alternative methods for safe excreta disposal methods;
7. Reporting, dissemination, monitoring and learning activities (1 month).
8. Preparation of follow-up funding proposals (1 month)

ACHIEVEMENTS

The overall objective of this project was the proof of concept of a portable treatment system for human excreta for deployment in emergency situations based on sequencing batch reactor technology. Given its potential operation in a low resource context, this system needed to be easy to deploy and operate. Thus, its innovative element was in the use of venturi aeration. The specific aim of this study was to test the performance of several aeration devices using venturi injectors and compare them to a "conventional" aeration system using compressed air feed in order to assess the viability of venturi aeration for the treatment system to be developed.

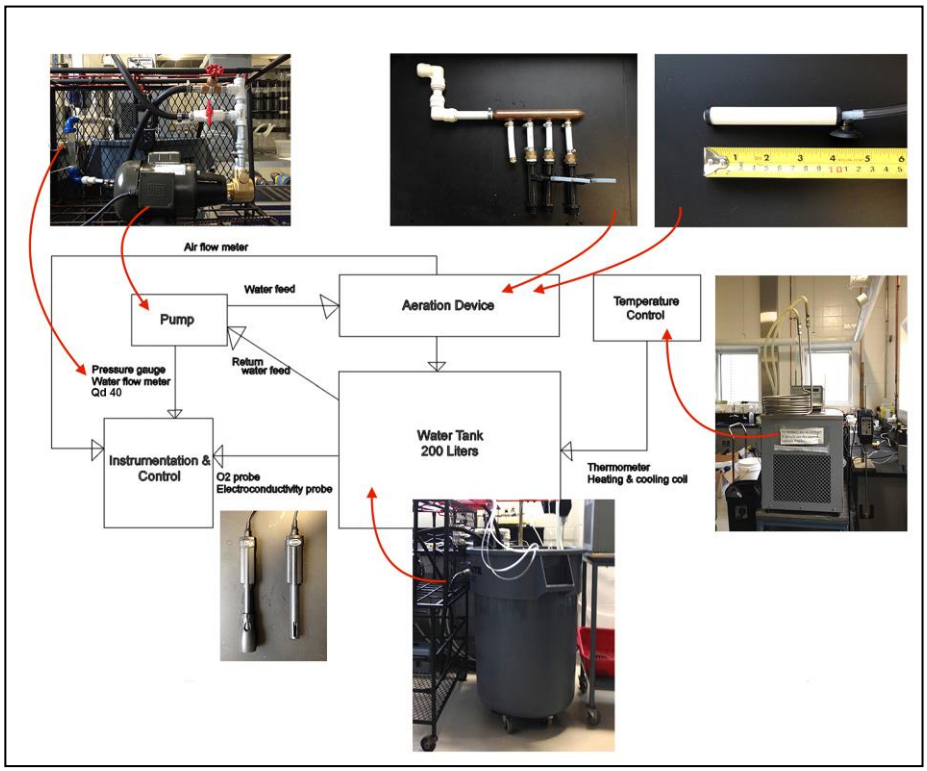

Figure 1 – Experimental system used for proof-of-concept testing.

The controlled laboratory testing of different aeration configurations were performed according to industry standards[1] for the measurement of oxygen transfer rates. This methodology allowed us to compare the performance of both off the shelf and manufactured venturi aerators to conventional aerators which

[1] ASCE (2006) Measurement of oxygen transfer in clean water. American Society of Civil Engineers.

were used as our experimental controls (Activity 2). For this, different configurations with 1, 3 and 4 aerators were tested at different depths and flow rates. Once the most efficient aeration device configuration was found (i.e. number of injectors as well as optimal depth and flow rate), the sensitivity of the aeration system to temperature and salt content were investigated by conducting aeration tests at 10°C, 20°C and 30°C with water conductivities of 250 uS/cm and 800 uS/cm. Overall, results were comparable to those which could be achieved with conventional compressed air aeration. These results were presented at an event sponsored by the Canadian Water Quality Association[2].

Figure 2 – Testing experimental system with domestic wastewaters.

Based on the encouraging first results regarding the underpinning aeration performance of the venturi aerators, a 200 L pilot-scale system was designed and commissioned (Figure 1) for proof-of-concept testing of the innovation (Activity 3 & 5). This system was tested with domestic wastewaters over a range of loading rates and operational conditions. The most significant challenge encountered during this phase was establishing steady-state conditions following the system start up. That is, given that this is based on an aerobic biological treatment, time is needed for the active bacterial consortia to establish themselves and thrive. Under the conditions tested, steady state was not achieved within the programmed one week runs despite the further testing conducted during the requested no cost extension to the project. It is thought that such results are indicative of the unsuitability of the technology for deployment in the initial phases of acute emergencies.

From the time of proposal submission to the start of the project, the initially planned field visit to Malawi was not possible as testing of emergency sanitation technologies were terminated. The purpose of this activity was to discuss and learn from IFRC and WASTE. Instead of this, we had very fruitful discussions with several other NGOs, academics, and humanitarian agencies during the 3rd

[2] Therrien JD, Laurens JM, Vanrolleghem P & Dorea CC (2014) Development of a venture aeration system for wastewater treatment in low-resource settings. In: 29th Eastern Canadian Symposium on Water Quality Research, Montreal, Canada.

International Faecal Sludge Management Conference in Hanoi (Activity 4). These discussions lead ideas to explore alternative methods for safe excreta disposal methods (Activity 4). The recently presented overview of the existing literature[3] from this activity indicated that chemical methods are perhaps the most promising.

As indicated in this section and detailed in the DISSEMINATION section, relevant results from this project have been presented at different venues (Activity 7). Overall, results may not have fulfilled the initial objective. However, follow-up funding proposal largely based on this project were prepared (Activity 8). Funding from Grand Challenges Canada was secured for a project entitled “Safe excreta disposal in humanitarian emergencies” (in progress). It is worth noting that further testing done outside the scope of this project indicated the potential for this innovation to work under more stable conditions without the time constraints of humanitarian emergencies. The potential for this innovation is currently being explored for wastewater treatment in remote locations, as the venturi-based systems require less mechanical parts and are thus possibly more economical to construct and operate, demonstrating their potential for simplified wastewater treatment.

METHODOLOGY

A pivotal indicator of the potential success of this innovation is the aerating and mixing efficiencies that can be achieved by the venture aerator/mixer. To this end, we successfully applied and adapted industrial standard methods currently adopted in conventional wastewater treatment. Trials were modified to simulate conditions (i.e. temperature, solids content, operating conditions & times, etc.) that are likely to be faced in the field. This is of paramount importance, as most standard industrial protocols have been designed for conventional (i.e. non-emergency) purposes. It is believed this was the right approach to take as it was also used in the proof-of-concept testing. In this case, the “go/no go” point was whether an adequate level of steady-state treatment performance could be achieved within a week of operation. The testing strategy allowed us to exhaust variable analysis and conclude that for emergency contexts (i.e. rapid deployment), this innovation may not be adequate. However, as indicated, this innovation is being explored in non-emergency wastewater treatment applications.

MAJOR OBSTACLES

The major obstacle encountered was the longer than expected time it took to achieve steady-state treatment. Although, as indicated, several operational configurations and conditions. The premise of the project was to have a simple, low-cost, and efficient system for rapid deployment in humanitarian emergencies. Whereas, most of these criteria were fulfilled, the fact that the system could not

[3] Laurens JM, Vanrolleghem PA & Dorea CC (2015) An overview of options for humanitarian emergency sanitation. In: 50th Central Canadian Symposium on Water Quality Research, Burlington, Canada.

be operational under a week, it is believed that this could lead to an inadequate performance in the field in humanitarian conditions. This project is currently being continued, but for non-emergency contexts.

BENEFICIARIES/HUMANITARIAN INTERVENTIONS IMPACTED

This project was experimental in nature and was conducted in controlled laboratory conditions. As a result, no beneficiaries were directly impacted by these results. However, our findings show that the process that was developed may be more suitable for other (non-emergency) sanitation applications, such as for the seasonal treatment of human waste in remote locations.

PARTNERSHIPS AND COLLABORATION

This project was done with ULaval as the single applicant. During this project our research group managed to consolidate and expand partnerships with the IFRC, WASTE, Oxfam GB, EAWAG/Sandec, and University of Kwazulu-Natal.

DISSEMINATION

1. Laurens JM, Vanrolleghem PA & Dorea CC (2015) An overview of options for humanitarian emergency sanitation. In: 50th Central Canadian Symposium on Water Quality Research, Burlington, Canada.
2. Therrien JD, Laurens JM, Vanrolleghem P & Dorea CC (2014) Development of a venture aeration system for wastewater treatment in low-resource settings. In: 29th Eastern Canadian Symposium on Water Quality Research, Montreal, Canada.
3. Therrien JD, Vanrolleghem PA & Dorea CC (2016) Venturi aeration for wastewater treatment in low-resource contexts (manuscript in preparation for publication in Environmental Technology).

TRANSFERABILITY

This project is currently being continued, but for non-emergency contexts.