Title of Project: Detecting pathogens in sewage sludge

Primary contact for the team

Farhaan Khan, Clinical Medical Student, University of Cambridge School of Clinical Medicine, fak29@cam.ac.uk

Has experience in human biological systems, pathogens and laboratory experiments. Can implement biological design and reach out for collaboration with experts in synthetic biology and microbiology.

Team

Samad Arshad, Engineering Graduate, Samad.arshad@cantab.net

Has experience of working with the sewage sludge system with the Cambridge Development Initiative, can implement technical design, and can reach out for collaboration with the beneficiaries and other engineers.

Summary

The student-led Cambridge Development Initiative (CDI) have designed and piloted an innovative sewage system to bring cheap and safe sanitation to households that are beyond the reach of urban infrastructure. The system gathers sewage and allows it to heat up in a drum using concentrated solar energy, destroying pathogens and generating two primary products: fuel in the form of methane gas and fertiliser in the form of sludge. CDI needs to ensure that all pathogens are killed through this process, so our team aims to design a sensor that can detect the environmental conditions within the drum and test the resulting sludge for pathogens. The sensor will inform users of the fertilising-quality and pathogenic status of the sludge that is generated.

Proposal

CDI's piloted sewage system uniquely aims to be a sustainable and profitable system where products derived from sewage can be sold back into the community at prices that can compete with the current market.

The present state of the 2016 piloted sewage system is that there is a flow of sewage, albeit with unpredictable biogas and fertiliser production, the device for which is still in prototyping stages. Further understanding of the sewage system is needed to diagnose problems and measure the effectiveness of designs.

The solar concentrator aims to 'cook away' harmful pathogens in the sewage for conversion into marketable fertiliser. The cooking process is measured by taking infrared thermal readings of the outside of the drum container. However, there is a need to monitor the environmental conditions within the drum and test the resulting sludge for pathogens.

We are looking to create a product that can rapidly report on the fertilizing quality and safety of heat-treated sewage sludge.

We aim to collaborate with Cambridge Development Initiative who are prototyping this sewage treatment system in Tanzania, and would be the prime beneficiaries of this product. We would collaborate with Cambridge University Department of Biochemistry to better understanding the nuances of the biological problem we are tackling and would also seek collaboration with the Cambridge Machine Learning Group in the Department of Engineering as we anticipate using a multiple-sensor array or an electronic nose. We would also like to create partnerships with *Science Practice* who have produced a low cost paper-based soil quality-measuring product and potentially collaborate with industry mobile-connectivity device leaders, *Eseye*, to make this product with data connectivity features for use out in the field.

Estimate the components and budget that you need to complete the project

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The components are subject to change and further materials may be needed after understanding more about the biological system following discussions with collaborators.

Tools required to make an electronic nose (from A Compact and Low Cost Electronic Nose for Aroma Detection - Macías et al.)

- Arduino and electronics kit (already provided)
- OM11043: ARM mbed LPC1768 Board - £40
- TGS Figaro Gas Sensors - £10 per unit x 4 = £40
- LCD Display - £20
- Electro-valves - £10 per unit x 2 = £20
- Micro-pumps - £25 per unit x 2 = £50

This part of the project will cost around £200.

Pathogen samples and laboratory time will need to be requested, the cost of which is unknown at present.

Mobile connectivity hardware will incur additional costs but will be a feature later on in the project.