Background:
Seven of every ten Kenyans have access to a cell phone, yet less than one in every ten Kenyans has access to an indoor flushed toilet. This leads to diarrheal disease being the leading cause of death for children under five. Secondly, most Kenyans rely on solid fuel to cook their meals and are struggling to afford the rising fuel prices. At Sanivation, we have developed an innovative model that addresses both the sanitation and fuel crises in East Africa. Sanivation is dedicated to improving the overall health and environment of urbanizing communities in East Africa by unlocking the value of waste. We install modern container-based toilets in the homes of the urban poor for free and charge a small monthly fee to service them. Then, instead of dumping the waste, we treat and combine it with agricultural residue to transform the waste into a clean burning charcoal briquette. Our briquettes perform better than traditional fuels, have lower emissions, and offset 88 trees for every ton sold.

We would like to scale up briquette production and increase our impact by taking waste from pit latrines and septic tanks. This brings up brand new challenges like waste transportation, liquid-solid separation, and monitoring within a larger waste treatment facility.

Three Potential Projects:

1. **Process monitoring**

In conventional wastewater treatment plants (WWTP) (i.e. in developed countries), instruments are used throughout facilities to monitor flow rate, turbidity, head pressure, etc. Information from the sensors is sent back to a supervisory control and data acquisition (SCADA) system that displays live data on computer screens and stores it for future reference. This allows WWTP operators to monitor the plant remotely, see issues as soon as they arise, and look at past data to inform decisions about process adjustments.

As we scale up our treatment system, we are interested in incorporating a small-scale SCADA system. However, conventional monitoring equipment is expensive (by Kenyan standards) and presents maintenance issues that might be difficult to overcome where parts are harder to find, international shipping costs are high, and maintenance personnel are unavailable. Before pursuing a monitoring system, there are a few questions that we would like to answer:

   a. Do existing fecal sludge treatment plants use SCADA systems? If so, what do they look like?
   b. What low-cost options are available for automated monitoring of flow rate, % TS, etc?
   c. What sort of database could we use to collect this information over long periods of time?
   d. Are there remote data collection systems that might be useful and applicable in a place like Naivasha, Kenya?

2. **Waste Transfer**

In Naivasha, pit latrines and septic tanks are emptied by vactor trucks (called VTOs, or honeysuckers by locals) and then delivered to the local WWTP. In theory, this is a safe method for transferring waste, but the load doesn't always make it to the WWTP. VTOs often dump raw waste off the side of the road, directly into Lake Naivasha, or in random locations in the community. This is caused by a few things:

1. VTOs have to pay a tipping fee to dump at the WWTP, dumping illegally is free and no one enforces the law
2. Fuel is expensive (and prices are going up), so if the waste source is far away from the WWTP, the VTO would prefer to just empty their load nearby
3. VTOs sometimes get turned away from the WWTP because it is at capacity

Mobile waste transfer stations are one way to solve these problems, and could also have a positive environmental impact by reducing the number of miles traveled by small VTOs. A team could look at FS transportation costs, energy consumption, how this changes if you use mobile FS transfer stations instead of transporting all the way to the plant.

Example of a mobile transfer station:

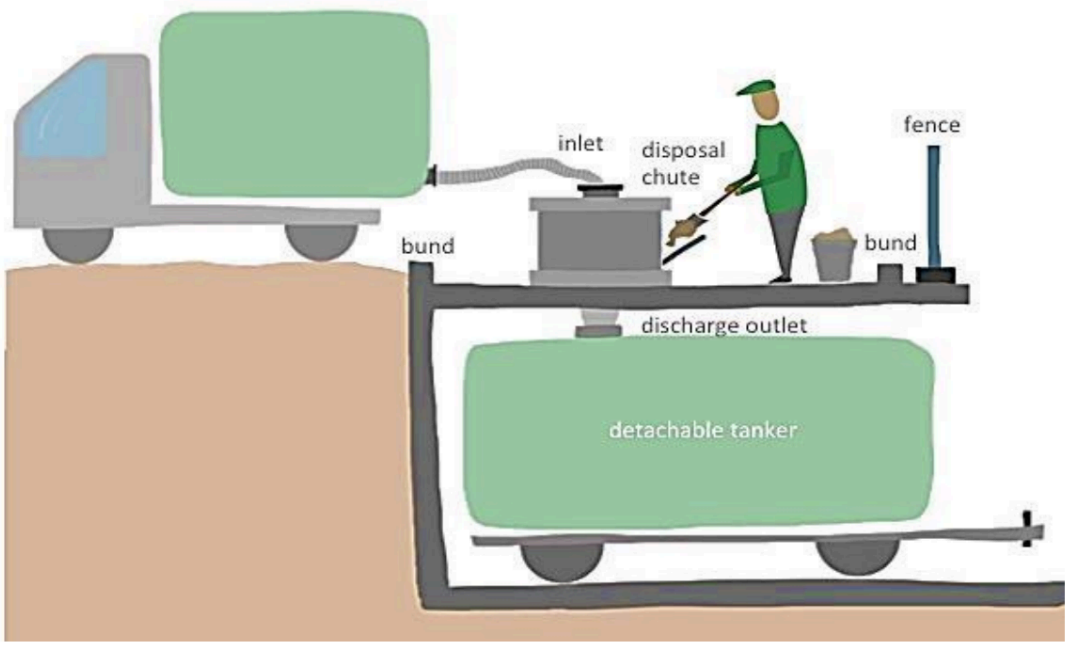

Figure 7: Detachable septage tanker (modified from US EPA n.d.)

3. Chitosan as a conditioner for liquid-solid separation

Conventional WWTPs use chemical conditioners to help with coagulation-flocculation for liquid-solid separation. These conditioners are very expensive and not readily available in many developing areas. Researchers have begun looking at

chitosan (made from shrimp cells) as a low-cost alternative. However, some research has shown that chitosan only works well with septage, not with pit latrine waste.

We are interested in using conditioners because they could allow us to build more efficient treatment systems. A team could research the following:

1. Chitosan performance in different liquid-solid separation processes
2. Chitosan procurement/creation in rural areas
3. Other low-cost, locally sourced conditioners