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Innovative Sludge Management Techniques for Developing Nations

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Abstract

In municipal centers of developing nations, most households are served by means of on-site public health systems like septic tanks as well unsewered toilets, besides the faecal sludges gathered from these methods are usually discarded unprocessed into the city and peri-urban environment which posing great dangers to water resources and municipal health. Contrary to wastewater administration, the development schemes to handle faecal sludges that can adapt to the prevalent situations in unindustrialized nations, have long been deserted. The authors outline the existing situation and converse on certain novel issues of faecal sludges management like the Omni Processor, reinvented toilet, Solar-Powered Poop Blaster, *Power of pee prototype;* Self contain toilet and sewage system, Duke's Community Stand-alone waste facility and Nano- membrane toilet or waterless toilet. At the completion cusp, cities can think about substituting sewer systems with more ecologically friendly devices.

Keywords Sludge management; Omni Processor; Bill gate foundation; Nigeria

Introduction

Globally, one might say that there is unique family item that splits the fortunates from the unfortunates, meaning out of more than seven billion people in the World, roughly two point five billion did not have access to a toilet [1]. Especially districts, where uncontaminated water is scarce with poor sanitation will generates easily inevitable diseases, for instance typhoid and cholera, at full-blown epidemics which causes death of approximately one point five million children annually [2]. Human faeces is rife with odorant volatiles, pathogens, parasites besides about 75% water and for most underprivileged communities especially in some parts of South Asia as well as Africa only sewage plants are not the resolution [3]. Households are frequently forced to utilized contaminant-ridden substitutes such as latrine pits or open defecation, hence for toilets to be useful, it must be self-powered and waterless as well inexpensive for people that make as small as a dollar per day [4].

Human waste mishandling has few rivals when it comes to misery and poverty creation but demonstration of a simple, economical new approach can heighten development, safeguard the environment and help lessen sanitation problems that initiating one-tenth of all sphere illnesses [5]. In spite of being conversant with the hygiene problem in developing nations, numerous conference-goers had snubbed the water-depleting and energy-draining actions of united sewer systems [6]. Advanced or developing communities cities that make it a precedence to apprise their waste disposal schemes will surely be more prepared for imminent environmental challenges, since cities that invest in non-sewer health are going to be far more irrepressible both today and future even in the face of climate change [7,8]. Bill and Melinda Gates Foundation organized a race in 2012 about "Reinvent the Toilet Challenge," as well awarded a team of scientists one hundred thousand dollars ($100,000) to create an archetype competent of resolving one of the most awful health disasters in the developing nation. Currently, the way humans manage feces disposal can be improved in some way almost everywhere. For most people, toilets and sewage systems are readily available and the end-result of feces is out-of-sight, for this type of situation, waste can be better processed and recycled to minimize the environmental impact [9,10].

Literature Review

Effect of currently practicing human waste management on communities in developing countries

Open defecation means humans shit outside openly typically in pits or directly into water bodies such as oceans, lakes and rivers etcetera without treating the feces in a way that removes and minimizes pathogens, so it contaminates waterways, the soil, and it pollutes the air besides is the most awful system of waste management. Not all the waste were discharge into water bodies is an outcome of open defecation, but some zones with waste collection plans may also release untreated sludge which turns rivers and lakes into swamplands festering with infection, however since nonexistence of sanitation is normally paired with shortage of clean water, populaces living in these regions end up drink this polluted water, which leads to extensive disease and death. Secondly water closet toilet (WC), the recent sewage system comprises of connecting toilets to immense pipes network which is impressive in the way that it eliminates the instant health risks of feces but when soak away and septic tank full it is not managed in a sustainable manner.

Some Innovative Way of Handling Human Sludge

Reinvented toilet

The objectives is to offer cheap, sanitized and small-water ingestion hygiene toilet methods that will not depend on sludge sewage plus electric grid connections but functions as its own treatment plant. Unlike old-style sewer schemes, the reinvented toilet can produce energy from actual human waste to eradicate germs in the water itself and the outcome is sterile water that's not dangerous to wash with besides re-purposed healthy and odorless fertilizer (Figure 1). The core issue is keeping costs low enough to practically implement the toilet throughout cities, with this in mind, the Water, Sanitation and Hygiene Program has valued it at no more than five cents per consumer per day, which is the same fee as numerous community toilets in developing countries. The first two phases has been successfully executed, the next stage is targeting hygiene technology solutions on a huge scale such as manufacturing of a large scale processing plant in Dakar, Senegal, for the discarding of the faecal sludge to get drinkable water, electricity and fertilizer.

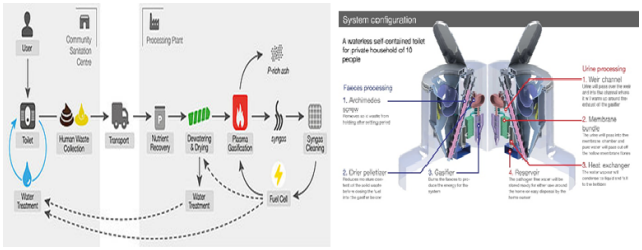


Figure 1: Reinvented toilet (Source: Bill gate foundation).

Solar-powered poop blaster

A solar-powered toilet is a self-contained type that combine toilet and a sewage system as well works equally to what's found in the moderate septic tank sewage methods common in country side regions of the United States. With moderate flush, the feces are sent to a holding chamber where it's pass through a modern sanitation system that eliminates contagious, disease-triggering bacteria. The panel controls the entire hygiene process by distributing energy to a biochemical reactor situated underneath the floor that's engineered to disinfect the waste through the electrodes usage. When feces and urine pass through this chamber, an electrochemical reaction between the cathode and anode breakdowns the substance into separate constituents for instance, hydrogen, fertilizer and hygienic water. Waste were filtered by another mechanism as well divert the hydrogen toward a section that stores it as energy in fuel cells. Also the fertilizer is gathered for farming purposes, while the remaining water is propelled back into a reservoir for reprocessed and it's a completely closed-loop system.

It was invested by Researchers at Caltech, to serve at least 500 people per day with huge dual benefit, powered by the sun; and produces hydrogen, electricity besides water for flushing the toilet again with noticeable difference of a roof-mounted photovoltaic panel addition compared to standard toilets (Figure 2).

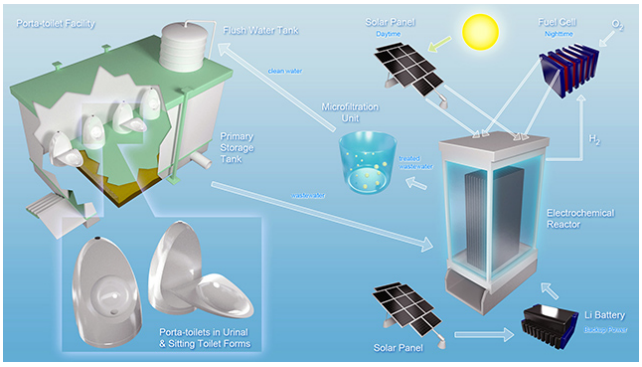


Figure 2: System diagram of the poop blaster or Porta-toilet Facility (Source: Caltech researchers).

Power of pee prototype

This is a urine-diversion toilet that separate urine from feces through drying of feces in a solar dryer and then burned. Urine evaporated as heat burned feces which generates dual key products: water and fertilizer because urine contains copiously amount of potassium, nitrogen and phosphorus and in the end, the outcome are fertilizer, ash and water which can all be utilized in agriculture. Main advantage of this method is that it's manually operated no need of electricity and was discovered by Researchers at the National University of Singapore (Figure 3).

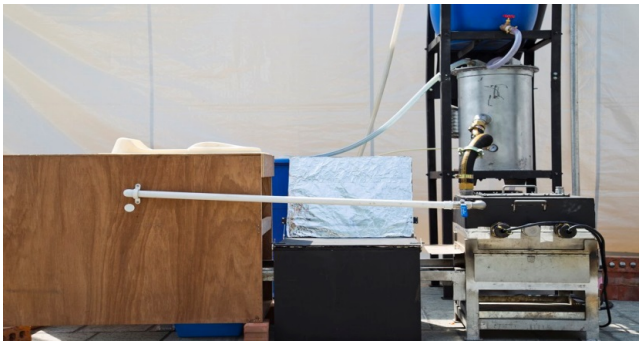


Figure 3: Power of pee prototype.

Self-contained composting toilets

These can be fit directly in the bathroom; they are obtainable in both electrical and non-electric types. Electrical units plug into a consistent three-prong vent to power a fan and a thermostatically-controlled heating element in the unit base. Unit should be unplugging when not utilized for some days, depending on the unit size; power usage differs between eighty to one hundred and fifty watts. Also composting capability varies with the Bio-drum size with the higher electric unit's capacity than non-electric units since they have spare heat and air movement to improve bacterial action. Its units need no plumbing needed because is dehydrated, no plumbing or water connection is needed with twenty five year guarantee and Electrical Requirements (Figure 4).

Figure 4: self-contained composting toilets.

Duke's community stand-alone waste facility

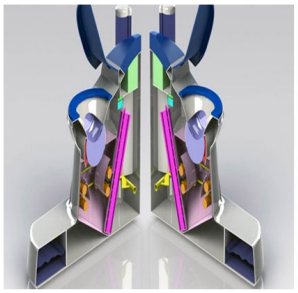
The technology works through usage of corkscrew conveyor belt category to separate solid and liquid waste, then the solids are then dehydrated and burned using a unique combustion unit designed by partners at Colorado State University that generate energy for drying more solid waste and powering the electrochemical sterilization of the liquid waste meanwhile the treated liquid is not fit to drink but it can be safely discharged or reprocessed for flushing (Figure 5).

Figure 5: Textile mill in Coimbatore, India, where the archetype sanitation system applied (left) and model sanitation system treatment hardware (right) (Source: Shamsheer).

High Cost Innovative Human Sludge Management

Nano-membrane toilet or waterless toilet

This toilet uses a method titled pervaporation where liquids mixtures are separated through vaporization, a membrane that removes the water from human waste and leaves solids that can be utilized as fuel or fertilizer. After vapour recovered, it drained into a gathering vessel so it can be recycled for irrigation, family washing or even human ingestion. The creativity of the nano membrane toilet is that it functions without water or electricity that is the dual key services deficient for countless people that are without access to toilets. As a substitute to flushing, the toilet utilize a scraper mechanism that propels the waste from the toilet bowl into a gathering tank below, where the solids accumulate at the bottom as residue and where the liquid waste is cleaned. The solid waste is removed into a gasifier which transforms it into gas besides energy. Agreeing with Alison Parker, a water and health expert at Cranfield University, there should be sufficient surplus power to charge a mobile phone, currently being used in Kumasi district, Ghana and charges fee to collect the waste twice or thrice weekly with almost seven hundred (700) toilets been installed and profiting four thousand and five hundred (4,500) people (Figure 6).



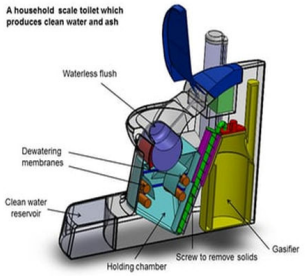


Figure 6: Nano-membrane toilet or waterless toilet functioning in Ghana's (source: Cranfield Water Science Institute).

Omniprocessor

Omniprocessor is an ecologically friendly machine that runs off its own steam engine, evokes misspent energy and puts it to use. It turns human waste to water by pumped in from a local sewage system, boils sewage after divided it into dry waste and water vapor. Subsequently the dry waste is then burned at very high temperature so as to generate steam that powers the generator, after sewage is boiled off by water which then filtered to produce hygienic drinking water. By means of an inventive blend of both steam power and water purification this equipment can convert sewage up to fourteen tons into drinkable water and electricity per day. The model is up and running in Washington now as well recently instigated in Dakar, Senegal using an auspicious pilot scheme with hopes of taking it to India, Africa and other developing nations. Each approximately one point five million dollars ($1.5-million) plant can generate sewage for roughly one hundred thousand (100,000) people in a locality.

This plant was sponsored by the Bill and Melinda Gates Foundation besides designed by Janicki Bioenergy so as to help the developing nations profit from human mess (sewage). The anticipation is that it will turn the nauseating business of sewage handling from a cost center into a gains center with machinists such as governments or humanitarian entrepreneurs charging for the electricity and water created through the machine (Figure 7).

Figure 7: Bill Gate drinking water process by Omniprocessor (Source: Bill gate foundation).

Conclusion

The paper describes the current state also converse on selected issues of faecal sludges management in Nigeria. Innovations proposal like the Omni Processor, reinvented toilet, Solar-Powered Poop Blaster; Power of pee prototype; Self- contain toilet and sewage system; Duke's Community Stand-alone waste facility and Nano- membrane toilet or waterless toilet which is made for a balanced setting of sludge quality or handling standards in cost-effective developing nations was suggested. Hoping that at the end of any nominated unique techniques completion, cities can start to think about substituting sewer systems with more ecologically friendly devices.

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