SANIVATION AND MOSAN TOILET 4 WEEK SERVICE PILOT

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KENYA, KARAGITA NAIVASHA
AUGUST – SEPTEMPER 2013

A COOPERATION BETWEEN SANIVATION AND MONA MIJTHAB

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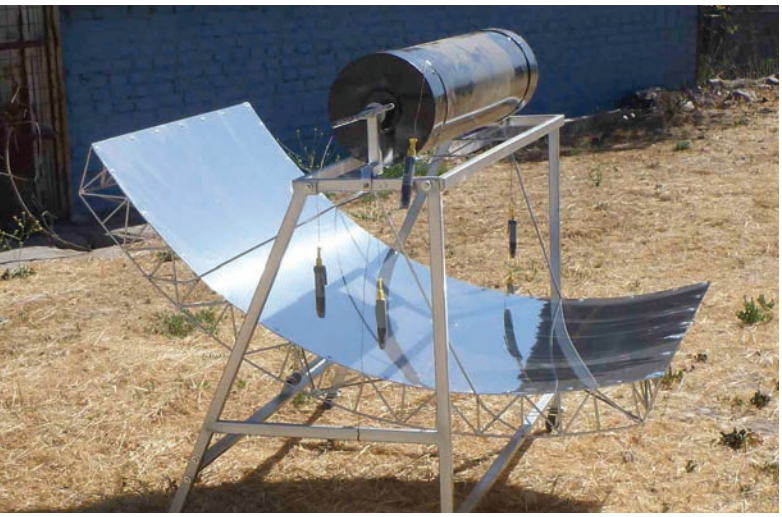
SANIVATION - SOLAR TREATMENT

IMPROVING HEALTH THROUGH SOLAR SANITATION SERVICES FOR PEOPLE EARNING LESS THAN $2 A DAY

- More than 99.9% (3 log) of pathogens in faeces inactivated in less than 5 hours
- Capital costs $300 per solar concentrator for waste treatment of 100 households
- Minimal operator expertise required
- No infrastructure required, easy for transport and up-scaling



MOSAN - MOBILE SANITATION

USER FRIENDLY DRY URINE DIVERSION TOILET FOR IN-HOME USE IN DENSE POPULATED AREAS

- Dry separation of urine and faeces
- Avoid of smell by tightly closing lid and covering faeces with dry material (e.g. ash)
- Removable inner containers for easy emptying
- Container collection as required (daily, biweekly)
- Suitable for households of different sizes, especially for elderly and disabled people

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INTRODUCTION AND OBJECTIVES

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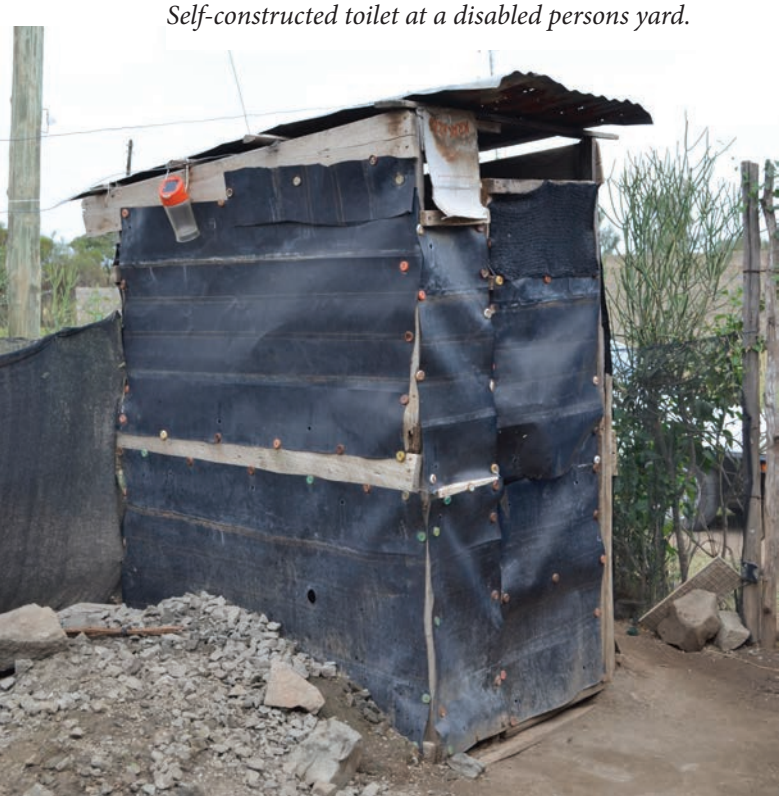
Having worked in Naivasha since November, 2012 the Sanivation team became aware that in-home toilets could provide an alternative solution to the standard pit latrines in the area. Sanitation practices in the area, while not as dire as some areas of Kenya, include the use of expensive and often unclean outdoor pit latrines, which often leave residence (especially women and the disabled) feeling unsafe and uncomfortable. To address these expressed concerns, Sanivation, Hana Lokey and Emily Woods collaborated with Mona Mijthab, the designer or the MoSan mobile toilet, to conduct a 4-week pilot test of the toilet and the sanitation service in peri-urban villages of Mirera and Karagita outside Naivasha, Kenya. Within this report, "the team" will be used for some combination of Hana, Emily and Mona.

The goal of Mona is to further develop the design and the usability of the MoSan toilet and improve it's performance within the service. Therefore user feedback was collected throughout the pilot phase.
Overall, the goal of the pilot was to evaluate the scalability of the sanitation service. Specifically the team wanted to explore and improve:

1. **User friendliness and acceptance of a household toilet**
2. **Efficiency of the sanitation service, including house-to-house collection and solar treatment**
3. **An evaluation tool for in-home toilets***

* The evaluation tool will be published online at the SuSanA forum end of 2013

Self-constructed toilet at a disabled persons yard.



CURRENT SANITATION SITUATION

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Naivasha, Kenya currently struggles with vastly inadequate sanitation. The majority of the population uses shared pit latrines, usually sharing one toilet between 20 and 80 people. The toilet design usually does not meet the needs of the elderly or people with disabilities.

Beyond diarrheal disease caused by improper sanitation, there are other crucial problems. In Naivasha, latrines are costly to build, costly to exhaust (remove the waste) and take up a fair amount of space that is not available to everyone. The standard salary of a day laborer is 350 Kenyan shillings a day (about 3.5 US dollars a day) while the construction cost of a toilet is commonly 60,000 Ksh to 200,000 Ksh. No treatment method is currently being used for the safe disposal or reuse of waste, due to the fact that the one waste treatment center in town is over 30 minutes away from the villages and usually not functioning properly. Most landlords and residents choose to excavate very deep pits to last as long as possible. Once full, the pit is covered and another is dug on the plot. Not only does this require more and more space, but significant investments are required to constantly build new toilets, and the large amount of untreated waste is a source of disease. In some of the slum-like areas where this is no room for latrines, residents may resort to open defecation, or other unsafe methods.

Additional problems exist for people who are physically disabled or elderly. Using shared outdoor facilities can be a struggle for people with limited mobility. Usually no support structure is provided; therefore people experience going to the toilet as a time-consuming, strength-sapping and often degrading process. The elderly and persons with disabilities are also more vulnerable to violence while using a community toilet. These problems occur for shared and private latrines alike.

The approach of this pilot was to receive in-depth qualitative information about users' experiences with the Mo-San toilet. The team was constantly in contact with the users to receive feedback and be aware of any problems to make necessary adjustments. The team visited users at their homes to observe habits, behaviors, and current problems. The primary tools for data collection were informal focus group discussions (one before the start of the pilot and one after three weeks) and one-on-one interviews with a representative from each household approximately every week throughout the pilot.

- **Over 70% of people surveyed in 2012 by WSUP in peri-urban villages surrounding Naivasha were not satisfied with their current sanitation facilities.**
- **About 77% of toilets are owned by landlords who do not reside on the plot, leaving the responsibility of maintenance unclear and unattended.**
- **Only 15% of plots have a toilet that meets "acceptable status" by UN standards.**

One of the participant's house and roofless latrine in the yard.

INTEREST IN AN IN-HOME TOILET

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The Sanivation team and the designer of the MoSan toilet worked with local resident Nancy Wambola, a community health worker in the village of Mirera, to discuss with people in the community and gather a list of interested individuals. In August the team was able to meet with potential users and learn about their living situation, income, and current sanitation situation. An initial product presentation was conducted to explain the MoSan toilet, it's use and handling and the provided service. Ten people, one man and 9 HIV positive women, attended the meeting.

The main reasons expressed for the interest in private household sanitation were safety at night, convenience of not sharing, comfort of sitting, and easier use for people with limited mobility. Many of the women, especially the elderly, were afraid to use the latrine at night for fear of being attacked or raped. One women reported that children are afraid of falling into the opening of pit latrines and therefore practice open-defecation. All of the participants had heard stories of attacks in the area and one woman had even escaped once herself. The sanitation team became aware that many families were already using a small bucket to relieve themselves at night rather than going outside to a latrine, regardless of whether the latrine was shared or private. Those buckets are emptied into pit latrines in the morning. None of the people used a separation toilet before and only some had experiences using a toilet in sitting-posture.

People were very excited about the prospect of getting to try this new toilet, but were concerned about the issue of payment. The team decided on a deposit method of payment. Users were asked to pay 300 Ksh. (approx. USD 3.50) at the time of receiving the toilet, and another 300 Ksh after 2 weeks if they wanted to continue using it.

Nancy explaining the MoSan toilet during a meeting.

User Hannah showing the previous night-bucket

This number was determined by assessing the typical household income in the area, the income level of potential users and the potential cost of collection. Upon completing the pilot and returning the toilet, users would be returned their 600 Ksh. The deposit method illustrated the future concept of paying for sanitation, learn about the willingness, but also acknowledgement that the product and the service are still under development. All users agreed to the deposit and Hannah, a 60-year old women excitedly paid her deposit one week ahead, saying: "I want to pay now. It is good and otherwise I will spend my money on other things"

SELECTING USERS

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Demographic data from interested people was collected and used to select users for the 4-week-pilot. Five Mo-San toilets were given to people varying in age, gender, number of people in the household, and employment. The location of the house was important to design routes and simplify the logistics of house-to-house collection. The following three users were selected:

DORKAS (38)

Dorkas lives in a 6-person household, one husband, 4 children (18, 14, 10, 5 years old), 3 rooms in her own house, private pit-latrine on mud-ground, 15m distance, full time work at her own vegetable stand.

ISABEL (40)

Isabel lives in 4-person household, one husband, 2 children (13, 8 years old), 4 rooms in her own house, private pit-latrine on mud-ground, 10m distance to house, part time work as farmer.

HANNAH (60)

Hannah has 2 adult sons and 1 adult daughter who visit frequently and leave their children (8, 5 years old) while they are working, 2 rooms, private pit-latrine without rooftop, 30m distance, part time work washing clothes or other day jobs.

Many of the interested individuals from the first meeting had similar profiles: age, number of kids, current latrine situation, religion, employment, and HIV status. Nancy notified these three women while the team looked for users that would diversify the pilot. Ideally the team would have liked to add one disabled person, one anal washing user, and one man with a stable job outside of the home to the pilot. In Naivasha the only anal washing individuals are Muslim and they make up only a small fraction of the population.

The team met with two potential users, one Muslim and one man who worked outside of the home, but upon understanding that the toilet was a sitting-posture toilet, they were uninterested in participating. The idea of sharing a seat, even with their own family, was not appealing.

Sanivation had previous connections with a disabled persons' group in the area and met with two disabled men from this group who were very excited about the new toilet and service. Both were interested in participating in the pilot. These two disabled men are:

PETER (39)

Peter has a leg-disability, lives by himself in a rented one-room apartment, wife and children in Nairobi, shared pit-latrine for 10 people approx. 15m distance, full time work at his own clothing shop.

THADIUS (34)

Thadius has a leg-disability, 5-person household with his wife and 3 daughters (15, 8, 2 years old), rented house with 2 rooms, self-constructed private pit-latrine, wife and husband run a grocery shop.

Nancy also supported the recruitment of a collector, who was responsible for the container replacement and transport to the treatment site. Stephen, an adult male lives in the same community was already acquainted with several of the users. He is trusted in the community, available and was willing to work with human feces. He suggested using his own motorcycle for faster transport from house to house. Taking into account salaries for exhausting and other types of work in the area, and the cost of gas, a salary for Stephen was negotiated. For each day of collection Stephen was paid 350 Ksh. The pilot consisted of 3 collection rounds per week – once every two days – for 4 weeks for a total of 12 days. The salary was paid on a daily basis, independently from working hours.

SOURCING ADDITIONAL MATERIALS

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The MoSan toilets shipped to Kenya included sealable 10L plastic buckets for feces collection and 6L plastic containers with screw lids for urine collection. To test the advantages of solar treatment as part of the sanitation service, metal buckets were needed to be able to go from collection to solar treatment without any waste transfers. No metal buckets with lids and with the right dimensions were found on local market in Naivasha. Therefore the team collaborated with a welder to design and produce custom-made buckets that fit into the MoSan toilet with strong sealable lids. For efficient solar treatment the buckets were painted black.

In addition to feces buckets the team bought small plastic rubbish bins for tissue collection, 2 large 20L urine containers, one large funnel, newspaper for bucket lining, black plastic bags for rubbish collection, spray surface cleaner and air freshener. For hygienic collection rubber gloves, tissues, hand sanitizer, soap and a facemask were bought for Stephen.

Nancy's husband, Francis, is a carpenter and was able to build a wooden box to attach to the back of Stephen's motorcycle to transport waste buckets during collection. The box was attached to the bike using rubber ties.

PILOT PROCESS

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INITIAL SET UP

The pilot started on September 19th. Two members of the team went to each house, distributing one toilet, rubbish bin, an informational sheet, and a contact card in case of problems. At each house a brief training on how to use the toilet was conducted. Francis supported the training as a translator when needed.

Instructions included:

- How to cover waste with ash
- What to not put in the toilet
- How to dispose tissue into the rubbish bin
- How to clean the toilet

Families were asked about:

- Availability of ash for covering feces
- Intended place for using the toilet
- Why they were interested to participate
- Expected benefits for them and their families.

Up: Mona instructing Peter on his new toilet.
Middle: Open MoSan prototype with plastic containers.
Bottom: Tin metal container, locally custom-made

With paying the first deposit of 300 Ksh. Users received an agreement that explained their responsibility for the toilet and the service they will receive for 4 weeks. Most users preferred a collection in the evening, when they were home to meet the collector in person. Meetings for collecting feedback on their experience were arranged for the second pilot week.

Stephen with his loaded collection vehicle, ready to head out.

Up: wooden box with collection supplies
Bottom: Household collection at night.

COLLECTION

Stephen, the collector, was familiar with the area. To ensure that he knew precisely where every user lived, one member of the sanitation team drove around to each house the day before the first collection. On the first day of collection, with Francis translating, the team went through a brief demonstration of how to remove and replace the buckets, pour the urine into the large urine container, clean toilets when necessary, and where to bring the buckets and supplies when done. The team explained the steps of collection, how to fill out the log sheet to record information including arrival time, departure time, and condition of toilet (see Appendix 1). He also received contact numbers of the sanitation team in case he experiences problems. Before the first collection, replacement buckets were lined with newspaper and together with the sanitation team he prepared and loaded his motorcycle with materials.

A couple problems occurred during the first collection, including significant delays. Stephen had not understood some instructions but wanted to appear eager and willing so did not contact the team or bring any problems to attention. Several of the users were not at home when Stephen arrived so he had to wait for them (at one house almost 2 hours). This pushed the collection schedule later into the night and other users had to wait.

Stephen also transferred the waste from plastic buckets into metal buckets onsite rather than replacing the full buckets with empty buckets. He explained that we did not want to leave the metal buckets at people's houses. He used the surface cleaning spray as a cleaner as well as an air freshener. After the first interviews the team discovered that users appreciated the clean smell after Stephen finished collecting. Therefore proper air freshener spray for future collection days was provided for the following collections.

The next collection round, one of the sanitation team members went with him to observe and instruct. Collection continued every Monday, Wednesday and Friday evenings, becoming more efficient every time. After the first week, users expressed satisfaction with the collection process.

Full containers before treatment.

WASTE TREATMENT AND REUSE

After collection, the waste containers were dropped out at Sanivation's treatment site, where the Sanivation team weighed, recorded, and placed metal buckets directly on a solar concentrator to be treated. Waste collected in plastic buckets was transferred into 20L metal containers and placed on the concentrator. After each waste transfer, buckets were sanitized using ethanol. All rubbish collected, including toilet tissue, was incinerated at the treatment site.

Sanivation's treatment technology captures solar energy to thermally inactivate pathogens in fecal matter. In previous pilots in Chile and Kenya, Sanivation has demonstrated a 3-log inactivation of the most heat resistant pathogens (helminthes) in 50L of fecal sludge in less than 5 hours [2].

Collected urine was stored and periodically applied with water to corn crops on Nancy's plot. Sanivation is currently exploring various reuse options of human waste. Some of the treated waste was used in making briquettes for cooking. These briquettes are an alternative to charcoal which is often a financial burden on families in the community.

Up: Emily transferring waste to be treated.
Middle: Waste being treated on solar concentrator.
Bottom: Peter holding solar treated and dried feces.

Left: Briquette workshop by disabled people.

RESULTS

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POSITIVE FEEDBACK

People were very receptive to the MoSan toilet. The most common given reasons for liking it were:

1. COMFORT

Users, especially the more elderly, loved being able to sit on their toilet. They remarked at how easy it was on their knees and that the seat itself was very comfortable. The two disabled users loved being able to sit on the sturdy seat and not having to balance on one leg as they must in a pit latrine.

2. SAFETY

Women especially loved having the toilet within their home and not having to go outside in the dark where they are vulnerable. Even going the usual 10-30 meters to a private pit latrine makes women feel insecure.

3. CONVENIENCE

Not only for safety reasons, users also enjoyed not having to leave their houses, or even get fully dressed to use the toilet outside. The disabled users especially remarked at the convenience at night. With a pit latrine, having to get dress and put on a leg brace meant that Peter limited his intake before bed. With the MoSan toilet, Peter and Thadius were able to change their daily eating habits to freely eat and drink at night knowing that a toilet was conveniently available.

For all users the privacy aspect was beneficial as well. Shared latrines are often unhygienic and dirty. Users felt very comfortable to use a toilet only with their family.

Emily presenting the ping-pong ball valve.

CHALLENGES AND AREAS FOR IMPROVEMENT

Throughout the pilot the team discovered the following points for improvements:

1. COMMUNICATION

Communicating clearly, especially with the collector, made parts of the pilot challenging. The language barrier, even with a translator made explaining unfamiliar things difficult. The dialogue improved during the pilot. Another problem of communication was the hesitation of the collector to report problems or to ask for assistance. By taking more time for the schooling and going through the collection process step by step, the sanitation team was able to discover issues and to clarify misunderstandings. Three of the pilot participants spoke little to no English, two of which had no cell phones. This made trying to keep in contact especially difficult.

2. SMELL

All individuals said they experienced some smell using the MoSan, to varying degrees. Some said the smells was only for a moment when they opened the lid and was not a problem. Others reported stronger smell and experienced it as a problem. Most of the users reported it was smell from urine. Because of the smell, Thadius decided to move his family's toilet during daytime outside of the house into the structure of the outdoor latrine where they left the lid off to create more ventilation. At night his wife carried the toilet inside the house into the bedroom, where they would place the lid on the toilet. The family found this the best situation, and was pleased to use the MoSan under these conditions. Thadius has expressed that in the future, he would like to construct a small room inside his home for a toilet, where the whole family can access it day and night and the smell will not be a problem.

3. ADDITIONAL TECHNICAL IMPROVEMENTS

Depending on drinking habits and household-sizes the volume of the urine container was in some cases not sufficient. Either bigger containers or extra containers for replacement by users should be provided to allow longer time frames of use. When the urine container is full and the toilet is carried, urine can flood over and enter the toilet. Mona the MoSan designer is working on suitable solutions.

RECOMMENDATIONS FOR FUTURE TESTING

1. URINE "VALVE"

After hearing that there was a noticeable urine smell, each household received a ping-pong ball to place in the urine funnel to act as a valve. The ball allows liquid in run into the container below while at the same time blocking smell from the container. Many users remarked that this noticeably helped with smell and only during and after the process of emptying and replacing containers by the collector was smell noticed. The effect of the ping-pong ball could be used to design a valve that is connected to the MoSan toilet and cannot be lost. Also, other valve designs should be tested to find the most efficient and economic one.

2. TISSUE DISPOSAL INTO THE TOILET

For the first three weeks users were asked not to dispose tissues into the feces bucket, but use the separate rubbish bin. One user reported that this adds steps and he needs more time for using the toilet. For the last week the sanitation team offered all users that they can put paper into the feces bucket. The concern of the team was, that less ash would be used for covering feces, more smell would occur, flies would get in contact with untreated feces and that the efficiency of solar treatment could be affected. After observing the collected buckets, less ash was visible, but users reported no noticeable change in the level of feces smell and preferred this method since it is the behavior they are more used to. The tissue had no effect on solar treatment.

3. PAYMENT

Naivasha residents are not accustomed to paying for sanitation. Most individuals have a private latrine for their home or rent a plot with a shared latrine where access to the latrine is included in rent. The idea of paying for toilets is new and could be an obstacle. The sample user group belongs to the lower end of the social-economic spectrum. Three of the households are headed by women who are HIV positive and without stable income. Therefore paying for sanitation on a regular basis could be a barrier. Further testing should explore various pricing options to test users' willingness to pay.

4. MENSTRUATION

Only one female adolescent reported to have her menstruation at the time of the pilot. The first week her family recognized that she was not using the toilet while the rest of the family was using it at day and at night. Her father said he did not know the reason. The sanitation team was able to speak with her and her mother the following week and learned that she had been having her period and did not want any trace to show on the toilet. She reported that it would be easier to dispose menstruation pads into the pit latrine where nobody else can see it. When the team asked if she would prefer a darker color toilet rather than white in order to hide any signs of her menstruation, she replied that white is a good color for the toilet because it shows that it is clean. She explained that next time she would try using the MoSan even during her period.

Metal feces bucket with newspaper liner and toilet paper.

5. MORE VARIED USERS

While MoSan previously piloted with washers in Bangladesh, no anal washers have been using the MoSan in Kenya. Future tests should include anal washers to gain the most useful feedback for African populations. Other users that would be useful to include in future tests include higher income earners, mentally handicapped people and individuals in their 20s and 30s.

SURVEY RESPONSES- AN OVERVIEW

How do you feel after using the MoSan?
Dorkas "Its yours, you feel clean."

What did you like about using the MoSan toilet?
Peter said, he can finally eat and drink after 5pm, since he doesn't need to worry about leaving the house at night and putting on his prothetic leg.

How did you feel using a toilet in a sitting posture?
Hannah said, she prefers it, because she has problems with her knees and squatting is difficult for her.

Hannah used to use a plastic container at night for peeing inside the house. She explained being able to use a proper toilet now without having to leave her home is a big improvement.

Women felt more secure

People's eating habits changed

Multiple benefits for people with limited mobility

Thadius "I like to have tea before sleeping, now I can have tea in the evening."

Isabel "Before having the MoSan, my daughter (13 years old) urinated in the bed most nights, she had nightmares. Now she stopped it and I don't need to clean the bed every morning anymore."

Dorkas described that in the past her children would lose their shoes into the pit latrine, are afraid of using it and therefore practice open defecation. During the pilot her children went to the MoSan toilet.

Because of ergonomics of small children a potty was more suitable than the MoSan.

Who else used the toilet?
Hannah's 5 year old grandson didn't manage to sit on the toilet by himself. He is used to open defecation, therefore she placed him a newspaper on the ground, let him defecate and disposed it into the toilet afterwards.

Thadius' youngest daughter (2 years old) uses a child's potty and he emptied it into the toilet.

How many times did you use the MoSan toilet?
Peter "I use it the whole day"
(He has a clothing shop close to his house and now goes home during the day to use the toilet)

Did the separation work properly? If not, why?
Thadius explained that urine and feces separate completely, but when the newspaper liner inside the feces bucket goes over the lip it can cover the urine container and lead urine inside of the MoSan toilet.

Thadius explained, when the urine container was full and he carried the toilet, urine floods over and enters the toilet. More smell can occur.

Did you carry the toilet? How was your experience?
Isabel said, she moved and carried it to the door when Stephen came, but the toilet can become very heavy when completely full.

Did the toilet have any bad smell? When? Which smell?
Hannah "Yes, when (feces) not covered it smells, but when covered there is no smell."

Dorcas "I like the smell when Stephen left" (he used air freshener spray)

Peter said, that Stephen seemed confused during his first collection. He needed a lot of time and did not do the steps in a smooth order.

How was the collection?
Hannah explained she prefers the collection at the door instead of inside the house. "Not good to come in bedroom" (toilet placed next to her bed)

Peter Peter explained he preferred the collection inside his one-room-apartment. He doesn't want neighbors to know that he is attending a pilot.

Hannah's sons didn't feel comfortable to use the toilet inside her sleeping room. (sons live across the street but bring their children to Hannah when they go to work)

The collection happened regarding on user preferences

People like a toilet at home, but would prefer it in a separate room

For safety and comfort all people used the toilet inside their home at night. During the day some placed it outside to decrease smell and make it accessible for the whole family.

How did you check the filling rate of the urine container?
Hannah "I can hear it from the sound of the urine."
Other people mentioned they just open the seat and look at the semi-transparent canister.

Dorkcas used the toilet in her bedroom, but her husband offered to build a small extra room for everyone accessible. During the day she placed the toilet outside the house, at night inside.

How did you cover feces? Did the toilet get dirty from it?
Peter: "No, I used a cutted PET bottle as a shovel. I just do it carefully and no ash gets on the seat."

How do you feel putting paper into a separate bin?
Dorkas: "Its ok, but it's different."

At night people like to have a toilet lose to where they sleep. One reason is the darkness and the lack of electricity and light to find the way.

CONTINUATION

Currently two users are continuing to use their MoSan toilet after the official end of the 4-week pilot. The Sanivation team requires waste samples for testing and experimenting with treatment and reuses. The team collects the waste themselves once a week. Each household now has one additional urine container for replacement if the urine container in the toilet fills before the weekly collection. One household is applying the urine with water on their private garden. At the other household the user, or the Sanivation team member empties the urine into an existing pit latrine on the property since there is no garden. The users continue to be please with their MoSan toilets and do not mind the bit of extra involvement in the toilet's upkeep.

REFERENCES

1. Foote, A., E. Woods, et al. (2012). Inactivation of helminth in a solar concentrator. Am J Trop Med Hyg (supplement), 87 (5): 293.

APPENDICES

1. Collection Log Form
2. Survey After week 1
3. Group Discussion Questions After 3 weeks