FINAL REPORT OF

Sainte Marie Pilot Project: For the safe remediation of human waste and its transformation into an optimum fertilizer by Howard Higgins (TNR) EcoSan, thermophilic composting .

By

New Directions Foundation

LONDON – HAITI May 2010

Author: Richard Higgins, agricultural researcher and leading exponent of the science of thermophilic composting and waste management

Initial response at WASH cluster

Having been approached by the regional co ordinator, for Global Water Initiative, Central America, Catholic Relief Services, who introduced Richard to the regional director, She agreed with Richard the pressing need for averting sewage from water borne systems to a DRY method to avoid the mounting problems of: increased risk of disease, further ground water contamination from flooding and seepage and a combined solution for the hygienic disposal of all organic wastes (inc. MHM) produced in refugee camps. He was subsequently contracted by the group, who have been working in Haiti for fifty years.

Project Description

To erect five urine separator latrines for camp 1 at Sainte Marie, Canape vert, Port Au Prince for the purpose of Total Nutrient Recovery (TNR) and rendition of fecal matter and urine into an optimum fertilizer by building a dry thermophilic composting operation to digest the waste of 200 users per day. This was done in conjunction with the source separated waste from the camp and the neighbouring convent.

Specific Activities

Preparation: On arrival to initiate the project we utilized two 3 metre open pit latrines that had already been dug. They were completely open, 3 metres deep and were in use. They were exceedingly dangerous as there was no other railing or platform at the top of the pits. We capped off these dangerous latrines with a concrete block surround and a plywood floor and a plywood housing. Then the urine separator collection units, designed by NDF (Haiti), were installed using the converted standard Oxfam footplates. Five gallon buckets being placed beneath a raised wooden platform for collection of solids. Provided in the latrines housings were medium buckets and instructions to 'cover over' with a scoopful of the collected earth, dry grass, leaves and small amounts of ash etc., There were no complaints to this procedure as upon using these latrines there was found to be no smell. Also the

introduction of the ‘footplate’ system as opposed to the conventional seated toilet arrangement presented no complaints .

Richard Higgins has also a new and very economical design for a urine separator sit down toilet for the disabled and very young that were found to encounter problems with either ease of use or misunderstanding how to use the squat plate. Oxfam has since begun mass production of Urine separator squat plates.

Note: In the light of the Cholera outbreak NDF generally recommends the use of squat plates as opposed to the seated toilet arrangement as an added precaution for the prevention of spreading fecal contamination. Also processing should be carried out in the Howard Higgins Hot Box system for complete protection:

Break down of ‘Cash for Work’ presented to the project funders CRS:

We employed 2 trainee managers	at 380 HTG per day each
one plastic picker to separate from sweepings	at 180 HTG per day
one laborer	at 180 HTG per day
and one latrine cleaner	at 180 HTG per day
TOTAL COST FOR LABOUR for running this site was	9,100 HTG per 7 days

Design of latrine housing and squat plate collector

The latrine housings were built on a surround of concrete blocks joined with a mixture of cement and earth and were boarded over with 18mm plywood, which was affixed to the blocks below. The walls of the 20 Square foot latrine were 12mm plywood and were supported on 2X4 timber, the door the same. A tin roof was nailed to a similar frame. The size was determined for ease of access for mothers with children.

However we found that mothers did not accompany children to the latrines, rather the managers were oganising lines of waiting children, some as young as 3 or 4 years old, to enter the latrines in an orderly fashion, instructing them how to 'cover over' with the supplied medium.

The raised footplate collector was constructed out of 2X3 timber, sided by 12mm plywood, accommodating the Oxfam footplate as the top surface. Beneath this construction was placed the standard 5 gallon bucket, which was easily removed from the back of the footplate when replacing with an empty one.

New Directions Foundation have now sourced an appropriate 30 litre bio degradeable Bio liner that fits snugly into the 5 gallon bucket and suits perfectly the time frame for complete destruction of the liner and its contents with the first 14 days of the composting process.

The urine separator device, consisting of a rectangular 5 litre juice bottle cut diagonally in half was wired to the underside of the footplate with a slight slope for drainage. This was connected to a 5 litre juice bottle, the caps for both being retained on each bottles and a small hole was drilled to accommodate the standard 12mm clear plastic pipe. The collection bottles being placed visibly outside the latrine housing. This serves as a visual indicator that when full, it is time to unscrew the cap and replace with an empty bottle. This is the original design that Richard Higgins put into use in West Bengal, India in 1997 and is detailed in his title 'The Lost Science of Organic Cultivation, (1977

Housing Construction (one, un painted, latrine for 50 persons per day)

materials needed to construct a Latrine 5ft from front to back, 4 ft wide, and sides 5ft high, roof height being 6ft 6"

14	concrete blocks	
1/2	bag of cement	
8	3X2 timber @ 6 ft	
3	3X2 timber @ 6ft 6"	
2	steel hinges and screws	(sourced in UK)
1	wood turn door bolt	
70	2" wire nails	
2	6ft X 2ft corrugated iron sheets	
1	16 oz hammer	
1	hand saw	
1	battery drill	(sourced in UK)
4	sheets 18mm plywood or tarps (walls)	
1	sheet 18mm plywood for floor	

Raised foot plate construction (for each latrine)
half inch plywood

1	Oxfam foot plate
2	discarded plastic water bottle 5 litre (urine collector)
1	flat juice bottle cut in half (urine separator)

2 10" pieces flexible wire to hold juice bottle
1 3 foot length of clear plastic pipe (sourced in UK)
4 3X2 timber X 16"
2 31"X15"
1 23"X15"
4 2.5 inch screws (sourced in UK)

2 23" X 15" sides ½ inch ply

1 31" X 15" side

3 5 gallon plastic buckets per latrine

14 Bio liners per week for use of 50 people/day (sourced in UK)

Design of composting site for 10 latrines (at 50 persons/day)

15 concrete blocks

1 bag cement

4 regular wooden pallets

1 cement trowel

Flat area required with adequate access on all sides is essential.

One of these E shaped bin will digest the effluent of 6 latrines per day

Therefore to accommodate 10 latrines two E bins are required

It is essential to have a hand washing facility outside each latrine housing with instructions

And soap.

In this situation however we were unable to obtain the CRS foot operated water pump system that dispenses minimal water for hand washing. We only had signs advising hand washing.

However there were no reports of any disease from the lack of hand washing facilities directly outside the latrines.

Design of composting site

Flat areas are required to operate this system successfully. As this derelict garden , we were allocated, was on a slope we terraced four flat areas for the installation of two double pallets on which to build the composting heaps.

It is imperative that there is a fresh water supply for minimal irrigation of compost heaps.

Protection from rainy season

The already composting fecal matter (contained in the Bio liners) is already separated by layers of the added medium in the latrine buckets, which is the key to odour prevention. The full buckets are taken from the housing to the compost area and are exchanged with newly lined buckets. The Bio liner is then simply slid out of the bucket onto the compost heap, at the rate of 8 liners per double pallet. Each layer is then covered with more composting medium, namely grass, straw or swept leaves etc., and before the next layer is added a layer of vegetable waste is prepared beforehand. The heaps are built up over 7 days thus each double pallet contains 56 Bio liners.

To protect from the falling rain we covered the heaps with tarps. This allowed the rain to run off without coming into contact with the live material on the heaps and the running surface water passes unheaded below the pallets.

Secure tool storage

A small secure shed is required for storage of the necessary tools; and for this size site they are:

2 stable manure muck forks
1 90 degree compost rake (large)
4 operation time charts, encapsulated for weather protection, on stakes in ground
1 black permanent marker pen
1 wheel barrow
2 flat spades
1 machete

Daily Operation of site

The composting materials required for the Howard Higgins operating system must include 1. Carbon and 2. Nitrogen, these items should be applied at the rate of between 70:30 – 50:50 Carbon to Nitrogen.

If straw is available, or any brown leaves, they should be mixed with 30% green leaves etc., (nitrogen) as an optimum.

These wastes can include all collected organic wastes from the camp. The cardboard/paper fraction being carbon and green leaves, grass, odd amounts of fruit and veg wastes being in the nitrogen component.

For the layer of vegetable waste, this will either come from source separated collection within the site and or supplemented with banana tree waste etc.,

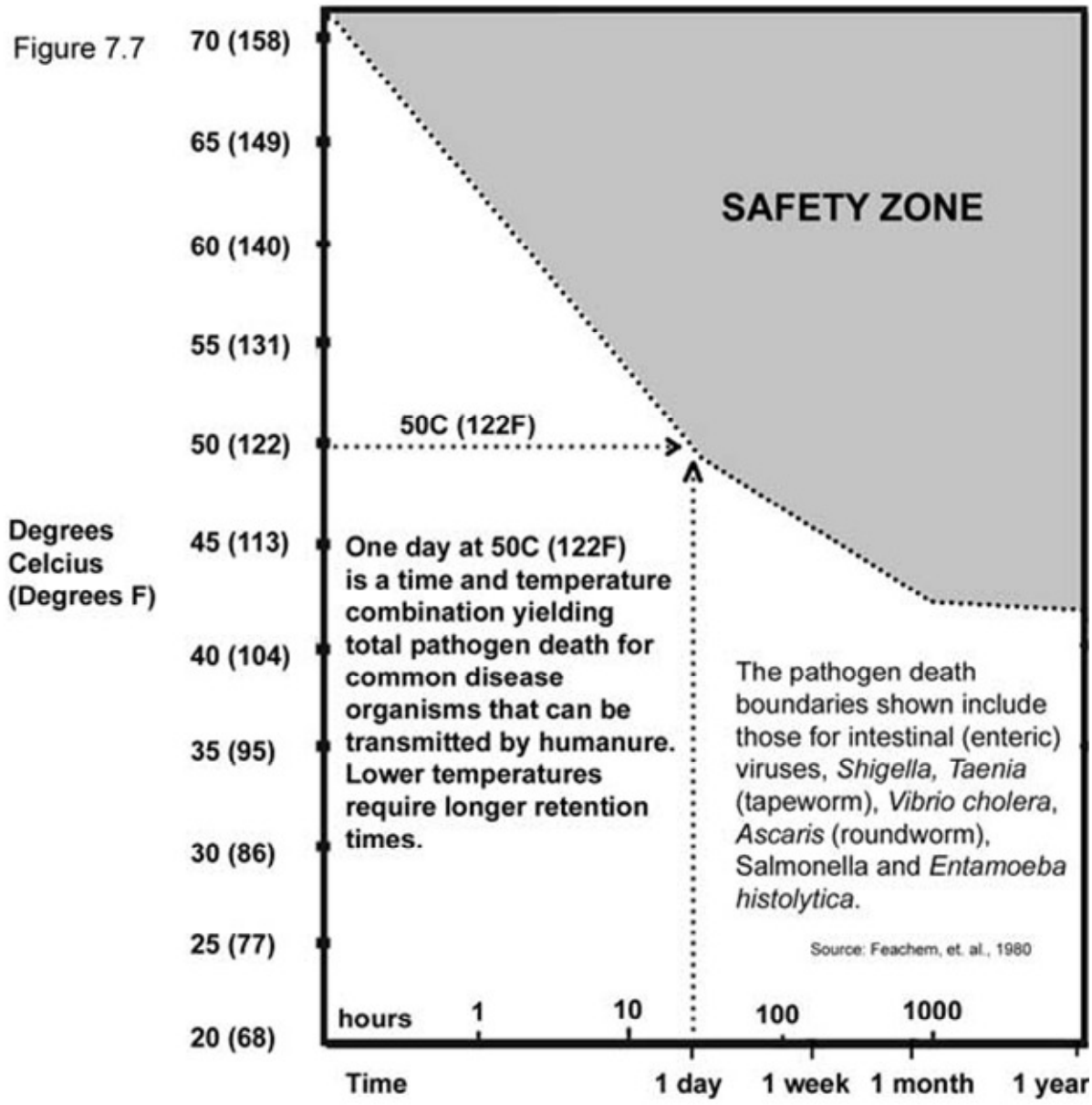
Each double pallet being built and completed over a 7 days period will now include the waste of 1,200 people as each bucket contains the waste of approx 20 people.

The temperature during the first 14 days of the process increases to 55 – 65 degrees or even up to 70 degrees centigrade, which lasts for one week, thus ensuring destruction of all harmful pathogens.
The material is then turned with the long handled forks onto the second two pallets provided alongside the first. This provides the essential aeration required to further breakdown the material. Upon building the second heap the fungus that is generated in the first heap is introduced (inoculated) into this second heap and so on, thus supplying the necessary predacious fungi and bacteria to accelerate decomposition in all subsequent heaps.

This speeds up the process dramatically and ensures the rapid breakdown of all material contained within the Bio liners and the Bio liners themselves (these will not be visible at the 14 day period).

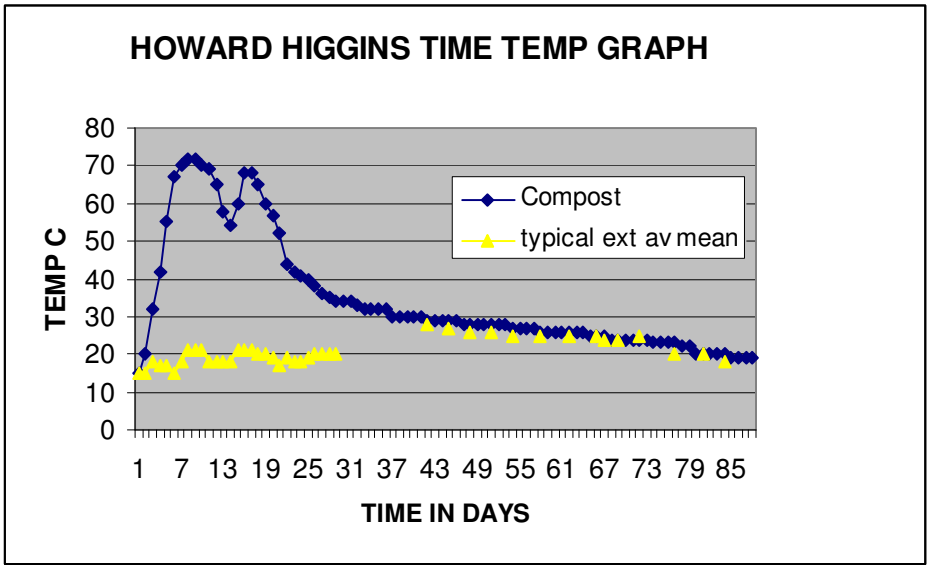
The turned material sits on the pallets for a further 14 days. At which time it can be removed for storage and maturation to the full term of 90 days. The material is then ready for use as a potent finely divided fertilizer.

Figure 7.7



From The Humanure Handbook by Joseph Jenkins, 3rd edition, page 152.
courtesy Joe Jenkins, USA

Graph showing the temperature gradients achieved through the Howard Higgins thermophilic composting system in **typical sub tropical climate.**



As the Howard Higgins system holds a high temperature for around 14 days, the product can normally be released as "safe" and turned out off the first set of pallets, however this is best done by temperature monitoring , especially at this stage. The product can then be used as a rough mulch on certain crops after 30 days. However in the face of Cholera epidemic the total product can be retained for a full year to ensure a guaranteed safe agricultural product.

We have added air holes in the tarps covering the four compost heaps in order for the carbon dioxide to escape and to allow the system to breathe. These air holes are placed at the top of the gentle curve of the finished heap so that only direct hits from rain will enter. No voluminous amounts of rain water will thus enter the heaps and affect the required moisture balance of 50%. Also we practiced the uncovering of the live heap for half a day for several days when the last application of feces in Bio liners had been added and covered with the final medium materials. This facilitates immediate aeration by unimpeded convection from the slatted pallets below. This ensures that there is no odour given off by the system.

This practice of covering with a tarpaulin, along with the high temperatures generated ensures there is no breeding of flies within the system.

Please see video footage of the system in daily operation being visited by various NGO's.

- **PeePoo bags**
  Oxfam were present on one open day and Richard offered to take their PeePoo bags at the rate of 100 per day. These were entered into, and work in perfect conjunction with the thermophilic composting system. The bag and their contents disappearing in the first 14 dyas of the process.

  These PeePoo bags are designed for refugees that have no sanitation facility whatsoever and are a safe and hygienic method of collecting feces and urine for disposal.

The amount of urine collected in these bags, if added to the compost in the right proportion ie., a flat layer covering a double pallet daily, will not affect the 50% moisture balance required for correct operation of the system. Simply less irrigation water is applied when the heap is complete.

The separated urine is added to the store of dry earth, excavated specifically for the purpose of addition, as 'urine earth', large amounts can be applied as evaporation takes much away. This creates an optimum 'base' in the manufacture of compost/fertilizer.

The surplus separated urine collected in the plastic bottles is used as an irrigation to the heaps before the first turn. Then only fresh water is applied to maintain moisture levels. The remainder can be used as a diluted fertilizer feed to fruit trees.

Where there is suspected worm infestations in the population urine, the material can be heat treated for sterilization.

Developments
Richard has sourced 30 litre Bio degradable liners in the UK, that will fit into the 5 gallon buckets. He has tested them at his training centre and they, like the PeePoo bags completely vanish, with their contents, in the first 14 days of the process.

All in all methods of DRY sanitation should be addressed as a far more comprehensive solution to the sanitation problem anywhere in the world. With the rapidly declining mineral phosphorus reserves, our world agriculture and food prices will increasingly suffer.

Results

- **Acceptability**
  There were no complaints during the pilot project, only comments of satisfaction from the camp residents. A few ACF porta cabin latrines had appeared on the other side of the site but people preferred to use our latrines even though they were further away and we did not have the option of sit down toilets. These were kindly removed by ACF at our request so as not to detract from our pilot project.
- Scientific – apart from the early work of Howard in the title 'The Lost Science of Organic Cultivation' Higgins set up a trial for full analysis at the Waltham pet center in the UK. This is a research centre owned by the MARS group where dogs are bred solely for nutritional purposes. 200 dog wastes were added daily in paper bags and the resident scientists analysed the '30 day' old product, at four different time intervals. All samples were found to be free of pathogens and 'chemically equal to earth',.
  We did not have the facility to have the end product tested in Haiti, nor were we equipped with the basic long probe thermometer but by following the strict time pattern of the operating system (and with simple temperature monitoring) the safe remediation of human effluent is easily effected to this same level.

- **Accesibility**
  Our five latrines were all on one side of Camp 1, at Sainte Marie but for the 200 people camp, it was not too far to walk to one of our latrines.
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- **Processing to fertilizer**
  Time period of processing from charging heaps to time of first turn and complete visual destruction of PeePoo bags and other fecal matter - 14 days.
  Time from charging heaps to full pasteurization - 30 days.
  The total time for processing human feces and urine to a finely divided, saleable fertilizer - 90 days.
- **Viral disease elimination**
  One year. (see previous graph).

ECONOMY

if the compost is normally stored in heaps, as suggested, for the full 90 days. A rate of reduction of 4:1 is achieved in the process from the beginning to the end. Thus the space required is considerably small for the amount of waste being digested and fertilizer produced.

For every 4 cubic meters of material entered onto the pallets one cubic meter of finished compost is achieved, which equals one ton. The fact that this potent fertilizer can completely replace the need for artificials of any kind and that the only running cost in its manufacture is labour, means that it is an economically viable option to the chemical system of farming.

As the sources of commercial mineral fertilizers decrease so the prices will increase. (ref. Dr. Rosemarrin on Phosphorus, NDF web site)

NGO's visiting site

A large number of visitors attended the demonstration site over the open days. These were people from the NGO's listed in the credits at the end of the Film II that is included with this report. They all found it extremely informative and interesting. They had all been invited to a celebration lunch before the talk and were seated 20 feet from the compost heaps that contained approximately 7,200 human wastes. They were un aware that they had been sitting in front of such an operation. (no smell, no flies)

Further recommendations

Due to the outbreak of Cholera in Haiti and due to the large amounts of conventional latrines we recommend that the sludge tankers be diverted far from the habitable areas and taken to flat open fields . We can then process safely the liquid effluent into a safe material without causing any fear to the city inhabitants. (consult for further details)

Simply pumping sewage from one hole in the ground to another is not solving any more than an immediate removal problem and is indeed the reason that the entire water table in Port Au Prince was polluted before the earthquake.

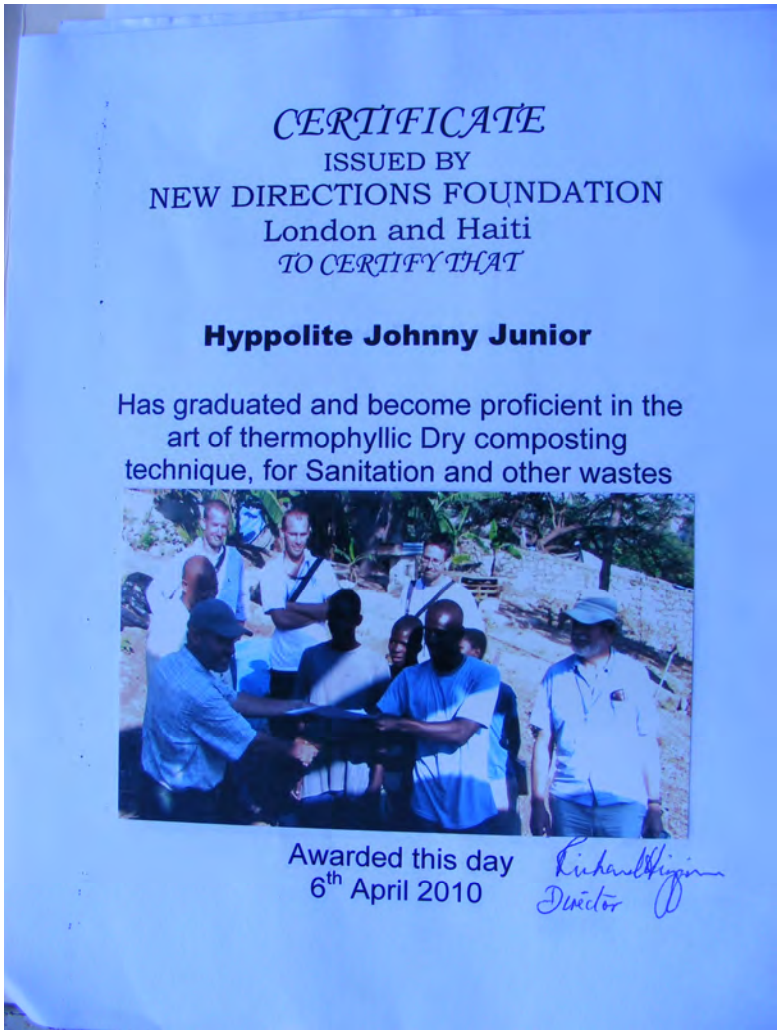
Further technology

In the UK The Howard Higgins system has been designed for rural communities with an enclosed twin Hot Box system, and for a "Cholera safe" system a four Hot Box system. Each Box is one metre cubed and operates a, self regulating, convection aeration system. They safely contain all live waste for the critical period. Thus it passes all the Environmental Health regulations of the west and it is proposed with the World Health Organisation guidelines. The pair worked alternately can digest the sanitation waste, in the new Bio liners, of upbetween 36-42 houses, continuously**. Thus this system is the most compact and efficient sanitation system. (consult for further details) . We also instruct the method of application of the potent fertilizers produced. (consult for further details).**

New Directions Foundation has different models (with automatic data recording) for Hot Chamber composting according to the capacity required.

As consultants we can offer consultancy for setting up a large scale low tech composting operation along the same lines as those herein for the immediate disposal of human feces and urine from Port Au Prince, as this is where the main problem is concentrated.

Typical scene in Port Au Prince



Red Flags

It is essential that any site is set up and run by a qualified consultant at the outset. IE., as supplied or trained by New Directions Foundation. In light of the outbreak of Cholera later in the year. We can only hence recommend a closed composting system IE., the Hot Box System designed and supplied by Richard Higgins, UK. This ensures a Cholera safe operating system which prevents rats and other vermin from entering the processing compost.

Conclusion

This pilot project at Sainte Marie has proved a 100% success. There have been no problems reported and we have only had comments of praise for the lack of smell at the latrines.

Reports of cleanest refugee camp in Haiti

It is hereby concluded that DRY sanitation via composting provides the least less risk for the spread of disease and the highest benefit to agriculture, and that the passing of human waste into any water borne system, increases risk of disease, ground water contamination and is less beneficial or completely removed from agriculture. As supported by the statement made by the World Health Organisation.' Contamination of drinking water from human sewage causes more deaths on this planet than from any other cause.'

Richard Higgins
Lead sanitation engineer/ Consultant
New Directions Foundation

www.newdirectionsfoundation.org

Enclosed with this report is a VIDEO LINK for Open days at Sainte Marie, featuring the comments of Professor Bob Reid, WEDEC (Water Engineering Development Committee). This group recommends appropriate technology for NGO's.

Haiti Film II http://www.vimeo.com/15274638 using the password ynos

Haiti Film III http://www.vimeo.com/15284086 using the password ynos

Professor Bob Reed (WEDC) and Richard Higgins , New Directions Foundation.