PAPER 1

Water-less sanitation solutions:

Why they are important?

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ABSTRACT

Water-less sanitation is a comprehensive package to treat bathroom and household waste on site and out of sight without odour.

The package includes

1. A large litter bin/incinerator for depositing waste from inside and outside the house. Normally it is placed next to the incinerator for the bathroom and toilet waste.
2. A large drying/incinerator bin for isolating, drying and burning solid toilet waste such as faeces, toilet paper, newspaper, tampons and diapers. This eradicates all pathogens and parasites. Test results from The Pollution Research Group at the University of KwaZulu Natal, Durban, confirm that the waste is not hazardous after drying and before burning. Note that the waste remains isolated, with no chance of spreading.
3. An airtight reservoir for urine derived from the toilet pedestal and/or a urinal. A layer of vegetable oil on the urine makes the urine airtight and hence there is no smell. The pH of the urine rises from 6.5 to 9 within a few days. The reservoir includes a length of copper wire. The wire and the alkalinity of the urine kill 99.99% of pathogens that may exist in the liquid. The processed urine is an excellent fertiliser which is worth about R3/litre. Test results from The Pollution Group confirm the urine is no longer hazardous.
4. Micro-drip irrigation piping takes the processed urine to gardens and fields. Unique features include low pressure and easy cleaning of blocked emitters. The same design also vaporizes the urine in high density areas where fertiliser is not appropriate.
5. A free standing and broad based pedestal with a standard toilet seat and lid. The difference is inside the pedestal. Solid waste drops into the hole at the back of a convex bib. The bib directs urine to the tank below the bib and then into the urine reservoir. The solids drop onto an auger. The auger takes the solids to the solids incinerator. Unlike other urine diversion pedestals this pedestal prevents large objects from entering the process. The auger is driven manually and/or automatically. Please Google 'The Lusec Sanitation Video" for a practical demonstration.

INTRODUCTION

Nature excels at sanitation, hygiene and sustainability. If not, the circle of life would have collapsed millions of years ago. The cycle of nutrition, ventilation, consumption, transformation, excretion, isolation, dehydration, rejuvenation and nutrition requires a team effort of many life forms that dance according to the patterns of seasons, months, hours and seconds.

For example a tree absorbs its nutrition from the air and its roots. This consumption transforms the tree on a continuous basis and excretes oxygen, fruit, and leaves. The fruit is picked or dropped. The leaves drop. Any dropped fruit and the leaves remain isolated, where they dehydrate to stop the spread of any disease and then are taken up by other life forms to be rejuvenated as fertiliser.

With us humans it is similar; we take up nutrition from the ground, the air and clean water. Our consumption transforms this into energy and excreta such as carbon dioxide, urine and faeces. The urine does not follow the same trajectory as the faeces.

This maintains isolation where the urine is absorbed by the ground to be an excellent fertiliser with soluble nitrogen, potassium and soluble phosphate. If it is not used as a fertiliser it remains a harmless potential fertiliser.

Faeces contain pathogens and parasites that require a hygienic solution which nature provides very efficiently. The pile is isolated and not moved to prevent the spread of disease. The pile is covered with mucus which is a deodorant and excellent germicide. (Gastric mucosal defence mechanisms. Turnberg LA.Scand J Gastroenterol Suppl. 1985; 110:37-40). (Alkaline mucus Wikipedia.) The fibrous content of the stool allows for drainage of moisture to the soil below. The air dries the pile from out to within.

This is important because as the surface dries, so the risk of spreading disease is reduced. Another important aspect of dehydration is maximising the difference between the relative humidity (RH) of the air and the pile itself. The pile starts at about 95 % RH.

As long as the air has a RH below that of the pile, drying will take place. So on a cloudy humid day when the RH is about 70%, dehydration will take place. If, for example, the pile is mixed with sawdust, moisture is transferred to the sawdust and the RH of the sawdust increases but the total moisture remains the same. We now have a pile with 50% relative humidity and drying will only start when the air is below 50% RH.

The density of the pile has now increased and drying, if any, happens at a much slower rate. Pathogens and parasites continue to survive and the threat of disease is prolonged by months, if not years.

WATER-LESS SANITATION SOLUTIONS, WHY THEY ARE IMPORTANT

Ever since Queen Victoria lowered her haunches on a water throne in 1866 we have dropped the concepts of **isolation, dehydration, sanitation and rejuvenation**. At great expense we have chosen a path of **consolidation, hydration, dispersion, fermentation and degradation** of water, land and air. Water sanitation led to the destruction of the Egyptian, the Roman, the Greek and the Aztec empires and it is leading to our destruction as well.

Water-less Sanitation

High density living has to introduce incineration and accurate isolation and dispersion to nature's mix for better and faster hygienic results.

The rules of nature apply for kitchen waste. We all know that waste should be isolated at source. Organic waste goes to compost. If urine is added, nitrogen in urine accelerates the breakdown of fibre; the phosphate in the urine remains soluble. Anything that can be burnt should be burnt without compaction. Compaction creates slow burning and high temperatures. Other items such as tins can be added to the burn for sterilisation and sorted later. Single storey houses have enough space for these procedures. Multiple storey buildings have lifts to take the waste to the roof for processing.

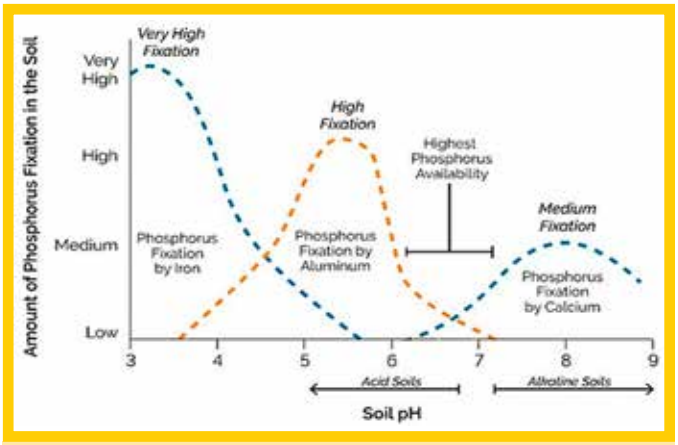

FIGURE 1: Phosphate uptake by plants

Toilet solid waste follows the same sequence of isolation, dehydration and incineration, on site out of sight for killing pathogens and parasites. Each person produces less than 200 grams of ash per year which can safely be added to the compost. The urine is isolated and stored in an airtight chamber to increase the pH to 9. This ensures that any pathogens are neutralised. Adding copper to the urine also kills pathogens. The urine is added to compost or vaporised through many micro-drip emitters.

After 3 years of testing the reliability and hygiene of the water-less toilets at Celimfundo School in the Khetani Township in Winterton, KZN, a clear line can be drawn between water-less sanitation and the flush toilets, hire toilets and composting toilets. The water-less toilets are low maintenance without a single part broken and the preference by the children is clear cut. Other types of sanitation continue to carry the risk of pathogens and parasites.

The flush toilets start a toxic journey of waste in the pedestal that accumulates other debris such as plastic, paper, plants and a host of industrial pollutants that are not sanitised and cannot be isolated. The only way the risk to health is reduced in the water is by dilution and the dumping of sludge. Modern jargon speaks of 'treated water'. However this is still toxic.

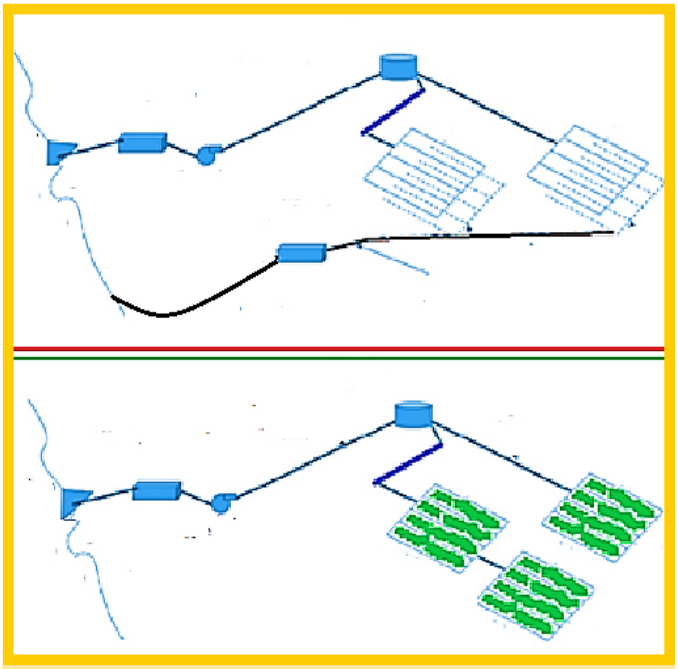

FIGURE 2: Using water in urban areas

Sludge deserves special mention. It is the product of the water treatment process. Chemical reactions in the sludge create a product that has a pH of 10. To reduce the toxicity of the sludge Ferrous Chloride and/or Aluminium Chloride is added to bring the pH down to 8. By this stage the waste of thousands of people has been consolidated into a poison that includes heavy metals and phosphates that cannot be regarded as fertiliser. Every farmer and horticulturalist is challenged daily to get the soil right for best plant growth. It starts with soluble phosphate. There is plenty of phosphate in the soil, but it takes skill and time to make it soluble.

Only when the pH of the soil is between 4.8 and 6.2 is phosphate available to the plant in large quantities (https://www.pioneer.com/home/site/us/agronomy/phosphorus-behavior-in-soil/).

Figure 1 shows this relationship. Treated sludge has an average pH of 8, made up of Calcium Phosphate with a pH of 10 and Ferrous Phosphate and/or Aluminium Phosphate which is very acidic. All these compounds are unavailable to the plants. In an attempt to get rid of sludge in KZN, sludge has been applied to cane lands where the health of the citizens is not jeopardised.

The application rate is 50 tons per hectare; this is beyond financial benefit, but it does get rid of sludge. Farmers tell me tomatoes grow prolifically; the seed comes from the sludge.

Figure 2 shows how water-less sanitation compares to flush toilets on a macro scale. In the top picture, water is taken from the river, treated and sent to homes and industry. Flush toilets send the toxic water to a sewage plant where the sludge is stored and the toxic water is returned at a rate dependant on the flow of the river. In other words, the solution is dilution. The toxins remain but at a diluted proportion.

The second picture shows the possibility of water-less toilets where there is no return flow and the river remains pristine. For the same amount of treated water from the dam 50% more homes and industries can be supplied with water. Storm water can be better managed for recycling within the urbanised areas.

Urine as a fertiliser has many benefits; it is free and it contains Nitrogen, Potassium and Phosphates that are soluble and available for uptake by plants. Plants grow for only a few months of the year but urine benefits the soil throughout the year by adding nutrition to the microbes in the soil and by breaking down vegetation into excellent compost, just as nature intended for maximum yields.

FIGURE 3: Pecan nut tree treated with urine

FIGURE 4: Flowers grown with urine as the fertiliser

Figure 3 is a comparison between a pecan nut tree with 20 litres of concentrated urine in one application, last year in October, and the other is left untreated. The late rains in January meant a growth spurt. Notice how the treated tree grew new leaves whilst the other did not.

Two (2) years ago I grew 250 buckets of flowers, the fertiliser was urine. Figure 4 shows some of the results.

Imagine a world with control over these 4 elements of pathogens, parasites, soluble/insoluble phosphate and waterless sanitation:-

1. Existing water storage would be sufficient.
2. The cost of community health would drop by 20%.
3. High urbanisation rates could be easily accommodated and the backlog reduced within years.
4. Mining of phosphate would drop 30%.
5. Plastics for food would drop by 30%.
6. The distance travelled to bring food to cities would drop by 30%.
7. Everyone can do something do green up and feed up their families, especially the poor.
8. The collection of household waste and industrial waste would drop by 90%.
9. Social tension caused by the fear of survival would be alleviated in urban and rural areas.
10. Billions of hectares would be restored to health, by improving soil quality.

I can think of another 20 reasons but that would be boring.

Water-less Sanitation Solutions go way beyond any standards set anywhere in the world. ISO and SABS standards are set for items such as toilet seats and cisterns and processes; there are no standards for pollution output such as pathogens, parasites and black water. Water-less sanitation should be regarded as a rational design rather than a SABS or ISO standard.

FIGURE 5: Examples of water-less toilets

Figure 5 is an example of water-less toilets in an outside cubicle and in a bathroom. The outside cubicle has inner walls of corrugated galvanised iron for maximum light reflection and visibility. On the outside, galvanised wire is riveted to the corrugated iron and mortar is applied for strength, insulation and stability. The pedestals are free standing; they can be fixed to the floor and/or the walls.

CONCLUSIONS

1. Water-less sanitation is efficient, economical, hygienic and sustainable.
2. Dumpsites and flush sanitation is short sighted and always destined to fail.
3. There is no methane production with waterless sanitation.
4. Flush toilets stop dead, the circle of life.
5. The joys and jobs of urban horticulture far outweigh the drudge of sludge.

RECOMMENDATIONS

1. Start with those without flush sanitation.
2. Replace existing flushing systems.
3. Insist all new buildings include water-less sanitation, and incinerators for toilet and household waste.
4. Horticulture should be encouraged at every building. It is very easy because urine and other fertilisers are applied without disturbing the soil. Digging the soil releases carbon into the atmosphere and the delicate microbes in the soil are destroyed. Every adult human produces enough urine as a fertiliser to grow the equivalent of about 300 kilograms of tomatoes per year.
5. All households should be encouraged to keep a bottle of 30% hydrogen peroxide. This, mixed with ordinary hand cream is an excellent germicide for skin conditions such as rashes, wounds and other viral/bacterial irritations anywhere on the body. These include athlete's foot, eczema, urinary tract infection, painful haemorrhoids, and cold-sores around the mouth and/or nostrils. Sinuses are cleared by 2 drops in the nostril. In all circumstances, when it is applied, if there is pain it means there is infection. There is no pain when the infection clears. This results in minimal tissue waste and better pathogen control before pathogens can enter the waste stream. Diarrhoea can be controlled by mixing 1 teaspoon of hydrogen peroxide with a litre of clean water and sipped over 6 hours. Add sugar for taste.
6. Newspapers can be read, and then used for toilet and anal cleansing, saving paper and waste. The newspaper improves dehydration and combustion of the waste. The newspaper is also very good at degreasing plates and pots before washing.
7. Many residential areas of South Africa have a home with a single sewer outlet but many shacks on the same premises without adequate sanitation. Water-less sanitation can plug the gap.
8. Capacity of water-less toilets can be increased with forced ventilation and/or heat. The recommended rate of burning toilet waste in a bin of 900mm x 450mm x 450mm is as follows (this is based on current research and predictions):-

40 girls, per school toilet, aged 14 to 16	Once every year
40 boys, per school toilet, ages 14 to 16	Once every 3 years
1 household of 6 adults	Once every year
1 office block toilet for ladies	Once every 4 years
1 office block toilet for men	Once every 6 years
Taxi rank toilet for men or women	Once a month

REFERENCES

Turnberg LA, Scand J. Gastroenterol (1985), Gastric mucosal defence mechanisms.
Alkaline mucus. Wikipedia. https://www.pioneer.com/home/site/us/agronomy/phosphorus-behavior-in-soil/