PART II

MICRO PERSPECTIVE PROSPECTUS

THE

NEW

SOLUTION

If anything could be gained from the previous section of this Prospectus, Part I. (*The Problem)* it is that earth is in urgent need of a NEW toilet. It is no less critical to our survival than our need to stop burning fossil fuels.

To meet this need we have developed waterless, odorless, urine harvesting, pathogen destroying toilets and urinals. Instead of wasting precious water to transport our excreta only to ruin our water and our health, our devices transform our excreta into resources.

As we showed in the previous section, urine, more so than feces (humanure) poses multiple threats to water. However, the naturally nutrient rich urine that is harvested by our toilets and urinals is an ideal fertilizer for many crops. It is estimated that human urine could replace 9 billion pounds (or nearly 25%) of the chemical fertilizer used in the US annually.[1] (This endlessly renewable and valuable resource will be discussed at length later.)

To complete meeting this need we must also employ onsite gray-water systems that re-use household wash-water to irrigate trees, while replenishing groundwater.

I. NEW*2* – THE TOILET

Humanure can contain a plethora of pathogens. Destroying pathogens in situ is imperative. Our patent pending design is the first composting toilet that effectively eliminates fecal coliform when tested using the most probable number (MPN) method for counting coliform. [2] [3] The toilets greatly reduce the volume of humanure and render a dry, lightweight, odorless and safe compost for its eventual best use as a soil amendment.

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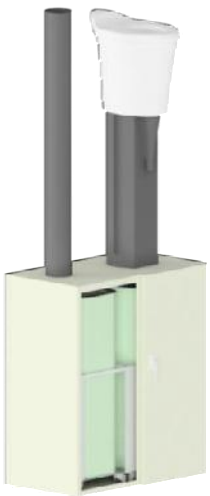
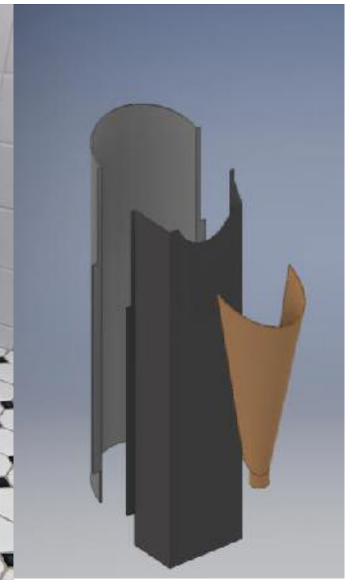
[1] Nancy Love, Principal Investigator et al. "Exploring Nutrient-Energy-Water Cycles" *Urban Collaboratory, University of Michigan,* 2019 Ann Arbor, MI

[2] MPN/g – TS, Method Reference: SM 18th Edition 9221E. Approved by Dan O'Connell, Chemistry Lab Manager and Jesse L. Portner, Microbiology Lab Manager, Minnesota Valley Testing Laboratories, Inc., 1/14/2014, New Ulm, MN

[3] 9221E. Fecal Coliform Procedure in Standard Methods for the Examination of Water and Wastewater. National Environmental Methods Index. NEMI.gov, USGS and EPA approved methods.

How does it work? – Quite well





- The thermophilic aerobic digester (**TAD**) which appears as a cabinet enclosure, above on the left, is situated directly beneath the **NEW*2.***

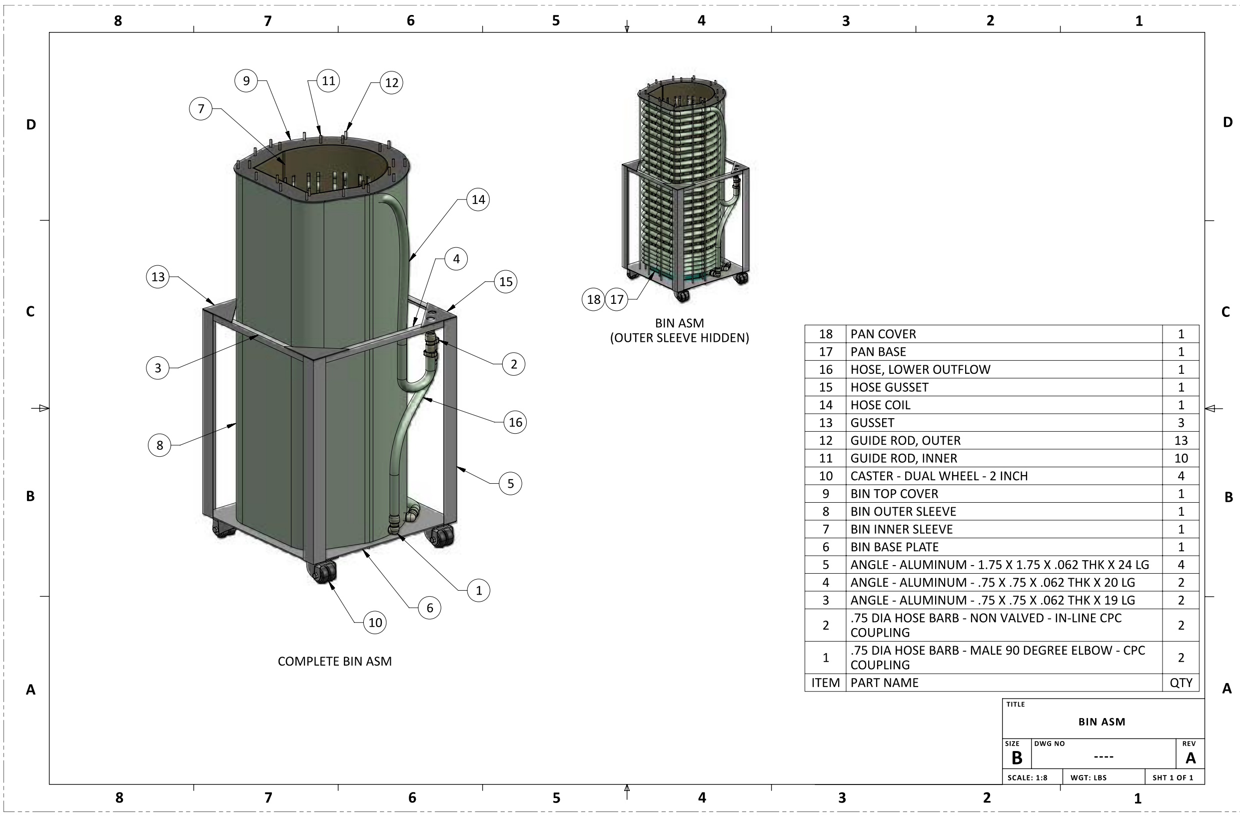
- An in-line fan situated in the exhaust vent (above on the left) assures constant air supply within the **TAD.** This also creates a continual refreshing downdraft at the seat making **NEW*2 -- absolutely odorless!*** (The left **TAD** door is removed in the model, above on the left, for the sake of illustration)

- The **NEW*2*** is connected to the **TAD** via the chute (above on the right). Humanure, toilet paper and a carbon additive drop down the chute to the bin below the **NEW*2***. Urine is diverted from the funnel in front of the chute to a buried storage tank. (The components of the chute and funnel appear separated for the sake of illustration.)

- Each bin is fitted with a natural fiber sack. When the bin below the chute (to the right-above) becomes full, usually in 2-4 months (depending on the number of people using the **NEW*2*** and the frequency of use, of course) the other bin is rolled out and the sack containing **pathogen free, dry**, **odorless, humanure** is removed. The full bin is rolled to left. The emptied bin is fitted with a new fiber sack and rolled under the chute. The **TAD** doors are closed and it's ready to go. It should be noted the contents of the sack removed are very lightweight and are < 1.5 cubic feet. This infrequent task is less onerous and far less frequent than emptying the kitchen trash.

THE SECRET TO THE SUCCESS OF NEW2

Is in the design of the bins that creates…



ITEM	PART NAME	QTY
18	PAN COVER	1
17	PAN BASE	1
16	HOSE, LOWER OUTFLOW	1
15	HOSE GUSSET	1
14	HOSE COIL	1
13	GUSSET	3
12	GUIDE ROD, OUTER	13
11	GUIDE ROD, INNER	10
10	CASTER - DUAL WHEEL - 2 INCH	4
9	BIN TOP COVER	1
8	BIN OUTER SLEEVE	1
7	BIN INNER SLEEVE	1
6	BIN BASE PLATE	1
5	ANGLE - ALUMINUM - 1.75 X 1.75 X .062 THK X 24 LG	4
4	ANGLE - ALUMINUM - .75 X .75 X .062 THK X 20 LG	2
3	ANGLE - ALUMINUM - .75 X .75 X .062 THK X 19 LG	2
2	.75 DIA HOSE BARB - NON VALVED - IN-LINE CPC COUPLING	2
1	.75 DIA HOSE BARB - MALE 90 DEGREE ELBOW - CPC COUPLING	2

PATHOGEN DESTROYING HEAT

Which distinguishes **NEW2** from any other composting toilet on earth

A temperature of 45C (113F) is maintained in the encircling hydronic coils via solar thermal collectors and spot water-heaters (as needed) and circulating pumps powered by photo-voltaic solar collectors. A base line of 45C induces thermophilic bacteria to become active, but to attain an effective die-off of heat tolerant pathogenic bacteria and viruses a temperature of 55C maintained for 5 days is optimal.[4] Certain species will become active at 50C temperature and others may not become active until the temperature rises even higher.[5]

Temperatures in the bins have been observed as high as 70C – 160F. This heat was arrived at independent of the thermostatically controlled and maintained heat in the coils, which strongly indicate thermophilic aerobic bacterial activity (TABA). The three separate MPN tests conducted by an independent lab resulted in counts of 9, 4 and 2 MPN/g – TS from samples taken from three separate bins 30, 60 and 90 days after the last use of the **NEW*2*.** (The detectable limit is considered to be 3 MPN.)

While these results appear to indicate TABA, it must be stated that no assays were made of the composted material to isolate species and determine *which* bacteria were active. It should also be noted that elevated temperatures *alone* can cause bacterial die-off and viral destruction.

This point was made by Dr. Bo Hu, Associate Professor in the Department of Bioproducts and Bioprocessing Engineering at the University of Minnesota in a recent conversation. I was seeking his advice as to the merit of pursuing an SBIR/STTR Grant from the NSF to determine if bacterial species could be isolated and cultured to promote desired TABA for **NEW*2***, as his lab has specialized equipment to identify microbial species***.*** He was polite enough not to laugh at me while explained why such a study wouldn't be necessary: within the several month period of TABA there will likely have been myriad species and myriad generations of bacteria living and dying in every bin/batch. The important thing is the results – which bacteria or even *if* bacteria rather than temperature alone caused the death is irrelevant. My quest amounted to overkill in his opinion. He noted that the EPA only requires a < 1,000 MPN count to qualify as a class A biosolid. So, why worry about it? As a point of reference Dr. Hu's work in this topic is with wastewater and anaerobic rather than aerobic bioprocessing. Physical handling of the wastes is not a concern.

Other studies of the interplay between temperature and TABA have revolved around controlling the temperature and length of exposure time to optimize preservation of nitrogen while still killing pathogens. A Chinese study found that a 14 -day period of exposure at 60C and 60% moisture content with a continuous air supply lost only 17% of the original nitrogen content while the 70% of the fecal mass was lost to TABA.[6]

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[4] A. Holmqvist, J. Moller and A. Dalsgaard, "Thermophilic composting – a hygienization method of source-separated faecal toilet waste" *The Royal Veterinary and Agricultural University, Frederiksberg, Denmark. Dalarna University, Borlange, Sweden. Linkoping University, Linkoping, Sweden*

[5] Ibid

[6] Fan Bai, Xiao-chang Wang, "Study of Microbes during the thermophilic aerobic composting for sanitary disposal of human feces" *Dept. of Environmental Engineering, Baoji University, Baoji, China / Environmental and Civil Engineering School, Xi'an University of Architecture and Technology, Xi'an, China* IPCBEE vol.17 (2011) IACSIT Press, Singapore

In 2007 the intrepid investigator, Hakan Jonsson, of Uppsala University and his compatriots (see ***1f*** and ***1m*** in *Liquid Gold later*) were back at it and tested a thermophilic digester that went beyond the question of efficacy in eliminating potential pathogenic bacteria to laying out a course for applying external heat at different temperatures at different stages of decomposition for potentially conserving nitrogen to make subsequent use of the compost as a fertilizer more efficient.[7] The Swedish study established a minimum oxygen content of 16%. In 2011 the Chinese researchers, Bai and Wang, mentioned above carried out a very similar study that not only confirmed the Swedish study (as did others) but added another loop to recover the nitrogen by capturing released ammonia.[8] Of more importance to my application, were the observations made during the studies that there was a minimum pH threshold to observe and also a minimum moisture content requirement under which TABA was significantly diminished.

In these studies, I learned of after the fact, confirm the requirements I had independently determined. **TABA Requires:** 1.) Sufficient oxygen; 2.) Conditions that are neither too dry, nor too wet, nor too basic, nor too acidic either; 3.) There is a range of temperatures in which TABA occurs, but 45C is the minimum threshold to reliably get it started.

But, these "goldilocks" conditions are not too stringent in practice as long they are relatively consistent and not disrupted all of the sudden or for a long duration. In an exhaustive study of all previously published scientific studies, Mary Belle Allen, in her 1953 compendium noted that some research isolated species of thermophiles that can be very forgiving (within the existential requirements listed above). And, Allen also noted that certain thermophiles not only adapt, but essentially shape-shift to survive new conditions facultatively between aerobic and anaerobic conditions [9]

The base line operating temperature we arrived at was set at 45C for two reasons: a.) it is well established as the minimal temperature to induce TABA; b.) because in northern climates conserving the energy required to maintain heat in the coils is a factor. However, in the summer and in warmer climates it may be advantageous to allow that temperature to rise. The Swedish, Danish/Swedish, and Chinese studies cited above all indicate that allowing the baseline temperatures to rise to 55C and even 60C would probably be beneficial.

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[7] Hakan Jonsson et al. *Carbon Turnover and Ammonia Emissions During Composting of Biowaste at Different Temperatures* published by The Journal for Environmental Quality with the American Society of Agronomy, 2007

[8] Fan BAI and Xiao-chang WANG, *Study of Microbes During Thermophilic Composting for Sanitary Disposal of Human Feces,* Baoji University, Department of Environmental Engineering and Xi'an University, Environmental and Civil Engineering School from 2011 2nd International Conference on Environmental Engineering and Applications, and published by IACSIT Press 2011 Singapore

[9] Mary Belle Allen, *The Thermophilic Aerobic Spore-forming Bacteria,* Hopkins Marine Station, Stanford University 1953, Pacific Grove CA, USA Note: Allen's exhaustive study quoted several German studies which gave evidence of her proficiency in the German language as well as microbiology.

II. NEW*1f* (females) & NEW*1m* (males) – THE URINALS:

Design Imperatives

Human urine has considerable value as a fertilizer. We humans are a source never ending. Over time the cost of manufacturing and installing **NEW** systems could be paid for by the value of the urine harvested by our devices when utilized as an agricultural fertilizer. And, the **NEW** devices would go on producing value as long as they were in use. Infinite return on investment – now *that's* a nice value proposition (not to even consider the human and environmental health benefits derived from keeping urine out of our water by their installation and use).

Our urine is a nitrogen (N) rich fertilizer, with an abundance of phosphorus (P) and potassium (K) in an average NPK ratio of 11:2:4. There are variations based on diet. Urine also contains magnesium, calcium, sulfur and a whole host of other micro nutrients. Again, it depends on diet. All of these nutrients are also in their ionic form, so they are readily absorbed by roots.

Human urine has been widely used as a fertilizer since time immemorial and still is, where subsistence agriculture is practiced in many parts of our earth. It fell out of favor in the flushing world and was all but forgotten until the late 1990s and early 2000s when published studies emanating from the School of Agriculture at the University of Uppsala in Sweden. Hakan Jonsson was usually the lead investigator with a formidable team working alongside him. Together they fomented a sort of revival in interest and study of human urine as a crop fertilizer. The purpose of the studies was to examine the possibility of preventing the disproportionate water pollution caused by human urine and creating a "new" (to the privileged world) fertilizer at the same time. Notable European studies replicated and built upon those pioneering Swedish efforts in Finland, Germany, and Switzerland.

Interest grew and more studies have been conducted worldwide. Forays into manufacturing of urine diverting toilets and waterless urinals followed. More in **1*m*.** Here in the US, the Rich Earth Institute in Brattleboro, Vermont has been exploring the use of human urine as a fertilizer with a number of hands on experiments in the laboratory of real life. The University of Michigan at the instigation of the Rich Earth Institute and whose Abe Noe-Hays are currently collaborating as co-investigators, along with numerous other institutions, in the first major US based study. The National Science Foundation funded study is looking at various methods of processing urine into agricultural fertilizer products. The potential is enormous; according to the University of Michigan's website announcing the study: "**9 Billion Pounds – the amount of chemical fertilizer that could be replaced by urine produced by Americans each year**". With the total amount of fertilizer used in the US, as estimated by the USDA, at 40 billion pounds that is almost 25% of the total agricultural fertilizer use each year! At this writing the U of Michigan has yet to complete its study. It has published a number of its studies, which we explore later.

Our proposed method keeps it simple. Stored long enough to eliminate pathogens (more on this later) undiluted urine pumped from storage tanks and applied directly with subsurface applicators is as safe, efficient, targeted and odor free as any fertilizer application system can be.

 

Subsurface liquid fertilizer application

A study conducted by Tampere University of Applied Sciences, Tampere, Finland in conjunction with the Finnish Environment Institute, Helsinki in 2015 and 2016[10] took large undiluted human urine samples, stored the urine as per World Health Organization (WHO) guidelines and applied it directly by subsurface injection to soil where two varieties of barley crops and a hay crop were grown side by side by side.

Pharmaceuticals in stored urine used as a fertilizer not found in crops or soil at harvest.

The study reaffirmed that after the storage period, as prescribed by WHO, bacterial pathogens were not detectable but, that of the 55 pharmaceuticals and hormones tested for, 16 were indeed present in measurable amounts in the stored urine. However, at the end of the study those same pharmaceuticals were not detectable, neither in the test plot soils, nor in the plant material. This finding was similar to many previous studies worldwide. Clearly, still more studies will have to be conducted, but this Finnish study is yet another that gives further evidence that the rich microbial activity in soil readily breaks down the pharmaceuticals that are present in the urine at the time of the application. Furthermore, this same study also showed that the urine was very nearly as effective to the conventional commercial chemical fertilizer applied to the side-by-side plantings of barley, in crop yield.

Again, this study, which most closely resembles our proposed methodology needs to be repeated and, on a larger scale. If used primarily to fertilize fiber crops, as we envision, the worry that the plants might absorb compounds intact and then be ingested by humans or livestock is further

[10] Nitrogen Recovery with Source Separation of Human Urine – Preliminary Results of Its Fertilizer Potential and Use in Agriculture. Eeva Liisa Viskari, Kaisa Karimaki et al, Tampere University and Finnish Environment Institute, Helsinki. Edited by Tom Misselbrook Department of Sustainable Agriculture Services, Rothamsted Researcch, United Kingdom and published on June 28, 2018 by Frontiers Media SA, Lausanne, Switzerland.

ameliorated. Rotation of urine with other fertilizers would also be wise. Back in the earlier Swedish studies concern over the possibility of heavy metal accumulations in the soil was expressed. (That is still the drawback to applying municipal sewer sludge on ag fields.) Many studies have shown that detectable, down to trace amounts in *some* individuals' urine heavy metals is most certainly evident. But interestingly, the Swedish studies couldn't find any but trace amounts in *some* of the soil samples. As with other compounds that are present in the urine, they appear to get disassembled within a season by the myriad microbes hard at work in the soil.

There are two additional concerns which warrant further studies as well. This 2015/16 Finnish study did find several hormones present in the urine after storage. But only progesterone was detectable in the crops and in the soil, albeit in very trace amounts, at harvest. What confounded the investigators is that the very same levels were also found in the crops *not* fertilized by the urine. Progesterone has been found in certain crops and soils and surface waters for decades. It was long thought that it was conveyed in animal excreta as well as in human urine. It has also been conjectured that progesterone may also naturally occur in certain crops. It is certain that progesterone and other related hormones and chemicals reside in measurable amounts in all surface waters and thought to cause infertility from fish to men and breast cancer in women. Further studies are needed here too.

The other as yet not thoroughly studied [enough] topic is possible soil salinization. Humans ingest salts, so urine contains salts. One of the bad side effects of using groundwater for irrigation is soil salinization. Another culprit is roadway ice-melt products. Is there enough salt in urine that it would add to that list if its use became widespread? No, except when overused. Then yes, it is possible to induce salinization with overuse especially in certain soils. Direct fertilization in arid regions and dry periods requires caution as well. A German study analyzed soils where fertilization with human urine is common practice and also, observed induced salinization in a controlled greenhouse. The takeaway? Urine fertilizer management should start with consideration of the soil dynamics. Roughly put, salinization and the even more likely, *sodicity* (sodium build-up), particularly in clay soils, could be worsened by too much urine fertilizer.[11] But, the German study concluded, the possibility of soil salinization and sodicity does not preclude the use of urine fertilizer, even in sensitive conditions. As always, careful application is key.

If it turns out that the direction of the current Rich Earth Institute/University of Michigan study to process harvested urine to further reduce the volume as a liquid fertilizer and/or potentially to a dry powder proves workable the urine will still have to be collected efficiently. **NEW** toilets and urinals provide the most convenient, practical, low cost and pleasant way to harvest the urine regardless of subsequent processing or end application methodology.

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[11] Michael Jongha Boh and Joachim Sauerborn *Effect of NaCL -- Induced Salinity and Human Urine Fertilization on Substrate Chemical Properties,* Institute of Plant Production and Agroecology in The Tropics and Subtropics, University of Hohenheim, 2014, Stuttgart

Recent University of Michigan study shows that undiluted stored urine disassembles plasmids responsible for horizontal gene transfer resulting in ARB.[12]

This is a very consequential study. The headline of the Guardian story covering the story read, "Yes wee can: study gives green light to use urine as crop 9ertilizer – Researchers say stored urine from humans is not likely to spread antibiotic resistance"[13]

Most antibiotics are not fully metabolized. Some studies show as much as 90% of all of the antibiotics manufactured are excreted in urine. A small percentage are excreted in feces. A recent study conducted in China tracked 18 antibiotics, ARB and antibiotic resistant genes (ARG) in fresh urine stored from 1 to 30 days, "during **30 days of storage**, aging urine showed significant elimination of antibiotics and antibiotic resistant bacteria but only a slight reduction in antibiotic resistant genes."[14]

The University of Michigan team used urine that had been stored after it had been, 1) heated (pasteurized), 2) filtered or 3) just stored, unpasteurized and undiluted (like we do) **for 12 to 16 months**. They then introduced extracellular DNA (plasmids) that contained genes for resistance to tetracycline and ampicillin into the 3 forms of stored urine.

What they found was that the plasmid dropped into the unfiltered, unheated stored urine basically fell apart and lost their ability to transfer the ARG to *Acinetobacter Bayli (AB)* (a common bacterium found in most soil). Stored urine that had been pasteurized or filtered didn't perform so well at all in altering the ability of the plasmids to transfer ARG to *(AB).* The plasmids are shaped like tight coils or rings of DNA. Very interestingly the rings get clipped, severed or cut up in the cold aged urine within 24 hours.

Why? How? Team U of M speculate there may be an enzyme(s) (yet to be identified) at work that get(s) inactivated when the urine is pasteurized or filtered. It sounds like the basis for the next study project. At any rate, that was some excellent work ladies, Bravo!

This means installation of two storage tanks are necessary at each site because urine must be stored for a year to be sure the plasmids are inactivated, bacteria are killed and antibiotics are eliminated.

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[12] Heather Goetsch, Nancy Love, Krista Wigginton, "Fate of Extracellular DNA in the Production of Fertilizers from Source-Separated Urine" *Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, MI*
Environ. Sci. Technol. 2020, 54, 1808 - 1815

[13] Nicola Davis, Drug resistance reporter, "Yes wee can: study gives greenlight to use urine as crop fertilizer – Researchers say stored urine from humans is not likely to spread antibiotic resistance" theguardian.com Wed. Jan 2020 08:00 EST

[14] Xiaoqin Zhou, yapping Lv, "Occurrence of typical antibiotics, representative antibiotic bacteria, and genes in fresh and stored source-separated human urine" *Environmental International Volume 146, January 2021, 106280*
https://doi.org/10.1016/j.envint.2020.106280

Typical Tank Installation

This is the capital expense of urine harvesting. You can see from the picture excavation is necessary because of gravity and the need for storage. Spherical shapes are required as tanks may sit empty for a period and the spherical shape deflects soil pressure even when empty. In cold climates the tanks must be buried at a depth safely below the frost-line to prevent freezing, not because the urine couldn't be frozen (that's exactly what the team of investigators at the University of Michigan are doing to intentionally; all the nutrients have a lower freezing point than water (which can be removed when frozen) but to prevent damage to the tank caused by freezing and thawing cycles, especially in clay soils. Not to belabor the point, but the most efficient urine diverting flushing toilets use a third of a liter of water with each flush which unnecessarily increases the water volume by 100%, that must be subsequently be removed.

Why are two tanks necessary? Every collection tank is itself a natural processing plant. The stored urine becomes very basic, reaching stasis at a pH of 8.5-9.5. This means that the stored urine is essentially self-sterilizing. Not much life is possible at such a high pH, pathogens included.

At the risk of redundancy, to be on the safe side a minimum of 1 year will definitely assure pathogen and plasmid free contents. For that reason, at least two tanks must serve every collection point. While on subject: Tanks telemetrically connected to an inventory board where collection could be coordinated would be another logical infrastructure expense to ensure the most efficient fertilizer application possible.

After more than a year in subterranean stasis the urine first collected was pumped (harvested). A sample was sent to the same MN Valley Testing Lab that did the **TAD** testing discussed earlier. The urine was collected from the first **NEW *2*** and the first **1*f*** over 10 months after the year-long storage period. It was crucial to learn if the nitrogen (**N**) had been preserved, primarily, but also to see if the results were in line with those of the many tests have been conducted worldwide. Great care was taken in the design but real-life experience is essential.

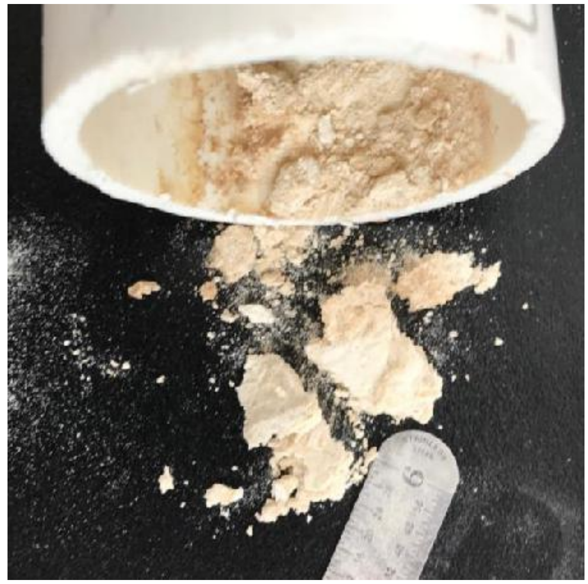
A 6-foot length of PVC pipe was attached at the end of the hose connected to the pump, so that the end of the suction line could be firmly secured on the bottom of the tank, to see if the phosphorous (**P)** ions had settled on the bottom of the tank. Since sedimentation in the drain-pipes was observed, it was logical to assume that **P** would settle to the bottom of the collection tank(s) as well. Indeed, the lab results showed precisely that: **P (**as **P** 205) was 810mg/liter. That is over twice the expected average taken from many previous tests. For future reference and guide for future practice: The pumping process will to some degree distribute the settled ions. As an added assurance, fertilizer applicators should make sure the harvested urine is well agitated in the fertilizer application tank prior to and, even during the actual soil injection. The test also showed that there was apparently no **N** lost during the lengthy storage period. In fact, total **N** was on the high side at 6400mg/liter. **K** (as **K**2O) was 1700mg/liter. Finally, the pH was 8.93[15]. Both of which were typical of previous findings in other tests the world over.

DRAIN PIPING

All the way to the tank from the **NEW*2*, NEW*1f*** and ***1m*** it is imperative to avoid less than a 1 to 12 slope because urine comprises up to 5% solids, some of which does accumulate/settle on the lower surface of the pipe as the urine flows to the tank. The drain-pipe in our initial experimental installation was fully removed after just 2 years of use and it was observed that solids had indeed accumulated/settled on the lower surface of the 2" pvc drain-pipe. But, less than would be expected in any standard sewer drain of the usual suspects: fat and other residue from soaps to nuts on top of all the excreta – sewer pipe sludge. What's more, the single-purpose urine drain-pipe deposits appeared to remain flowable. (One more pertinent observation: These first "fully removed pipes" were stored under a roof to dry for further observation. Once dried, the drain-pipe deposits shrank at least by half, to a mere flaky, soft, talc-like substance, rich in phosphorous and potassium ions. (See the picture below.)

[15] Minnesota Valley Testing Laboratories, Inc., Lab # 15-N10273 W.O.# 12-14951 Lab Managers D. O'Connell & J. Portner, Oct 7, 2015, New Ulm MN, USA

DRIED RESIDUE IN DRAIN PIPE AFTER TWO YEARS OF USE



Then, after 5 years of use the drain pipes were “fully removed” again. As you can see in the photo below there was almost no increase in the accumulation despite having been in use for over twice as long. As was the case 5 years earlier, the residue was viscous but flowable. The photos below were taken a few days after removal to let the flowable residue dry enough to set up so the photos could be taken.

WHY FLUSH URINE?

The earlier Swedish studies and the latest at the University of Michigan made the same mistake of needlessly flushing the eminently flowable urine, by use of a urine diverting flush toilet thus creating the following problems:

1.) It increased the volume making more trips for pumping and field application than was necessary. Why was that choice made? Could it be that was the only appliance available at the time? It really makes no sense when the objective is to reduce the urine to its elements (as in the later U of M study) that also on the face of it, seems to be counterproductive.

2.) When the volume of water used to flush urine drops below 1.5 parts water to 1-part urine, scale builds up and hardens even faster than with the large volume wasteful urinals (where it still causes drain plugging migraines with hardened deposits). When water meets urine elements in both precipitate and bond into solids. "It's like epoxy-resin glue", said one plumber based on his experience with urine diverting low flush toilets and waterless urinals, "Urine flows and so does water. But as soon as the two come together it's like mixing tubes A and B of epoxy- resin glue. And, that is what plagues all of the waterless urinals that drain to a conventional sewer." (Among other deficiencies discussed in **1*m***)***.***

Hakan Jonsson was interviewed about his studies some years later. He spoke of [hardened] lessons learned; singling out the urine diverting toilets lack of popularity among the studies' participants due to hardened deposits in drain pipes. The research team (out of exasperation?) recommended frequent cleaning of the urine drain pipe with a roto-rooter like device.

3.) Use of the flushing urine separating toilet with its urine mini-bowl in the front of the toilet concentrates the urine ***and the odor*** which is sure to flow up past your nose to the universally senselessly positioned ceiling exhaust fan in bathrooms. It is another one of those ancillary annoyances that follows along with the overall senseless and harmful way of transporting our excreta in precious water.

Conversely, you can always tell when something you have built rewards you with pleasing bonuses – that's the sign of good design – did someone say odorless? All three **NEW** appliances breeze by the "smell-less" test.

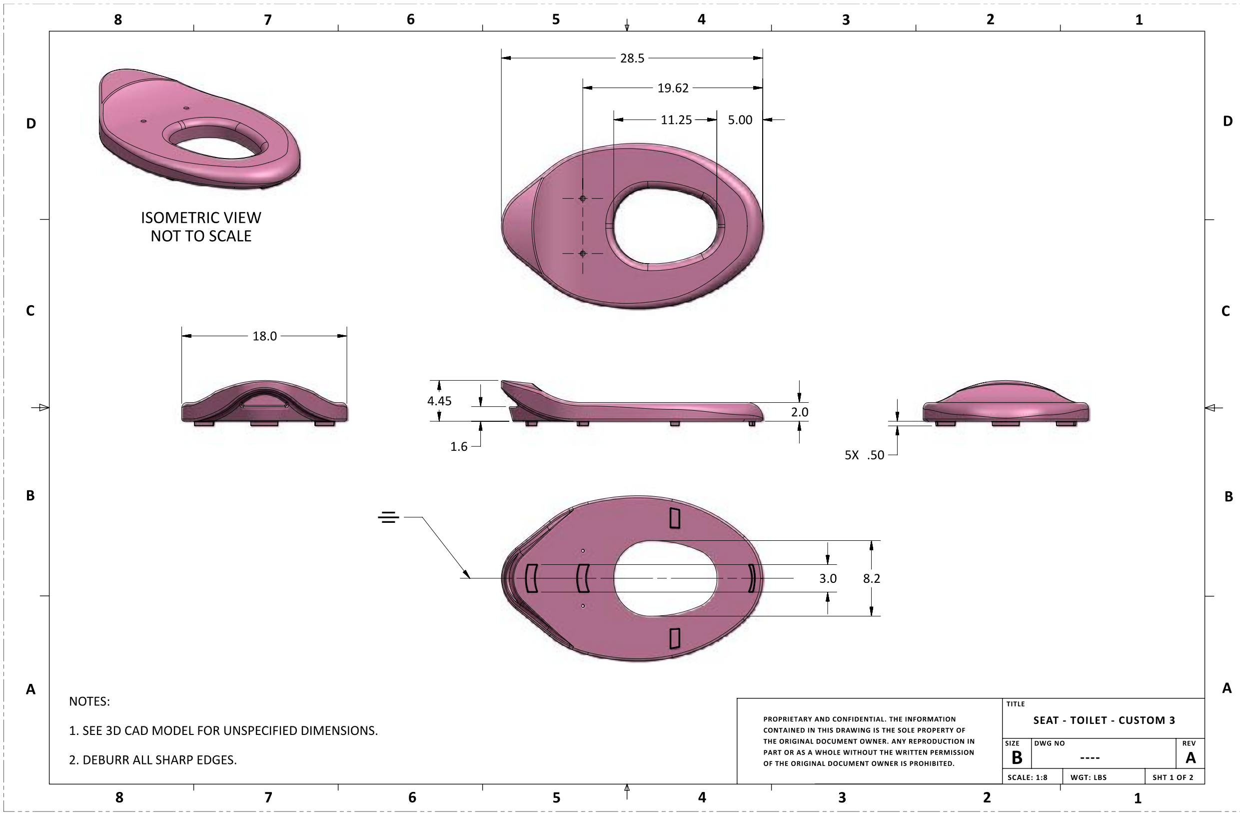
III. NEW*1f*

EARTH'S FIRST WATERLESS URINAL FOR FEMALES

A *JOY* TO USE

1*f* is the very first waterless urinal on earth designed specifically for women. Women everywhere agree it's about time. It is *positively* evolutionary. A refreshing down-draft at the seat makes it totally odorless. Functionally, ergonomically, biologically, aerodynamically and aesthetically designed throughout. Form sculpted by function. Durable. Beautiful.

A SOLID, COMFORTABLE SEAT



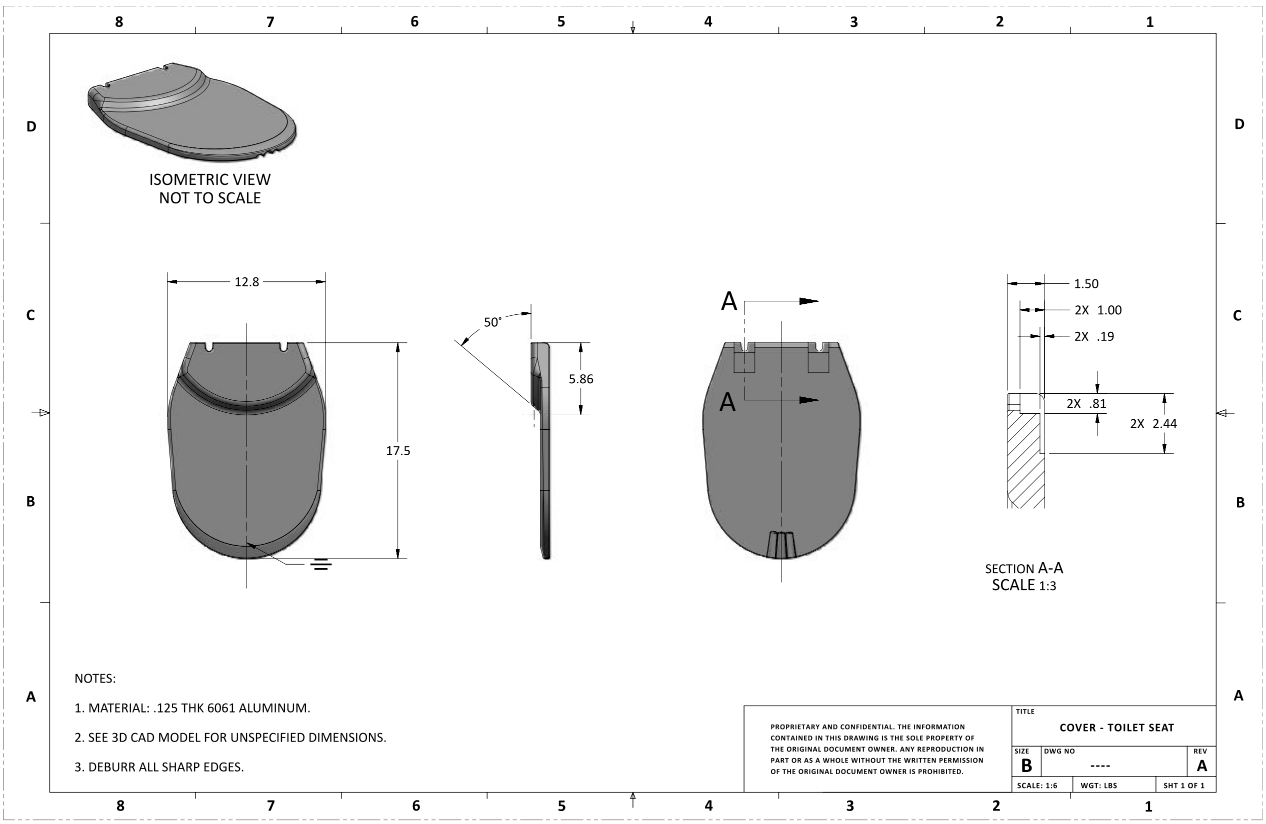
The sculpted form lends its comfort to the warmth, solidity, stability and sturdiness of wood. No wobbly seat perched on hard cold porcelain with hard to clean inadequate hinges that invariably loosen and/or break to contend with ever again.

BUILT FOR *Life*

They can be easily installed anywhere. No need for water supply lines. Yes, men can use them too. But they will have to sit to use them. Besides, they'll have their very own urinals, the ***1m*** to use.

Think of it, you will never have to endure the toilet seat left up again!

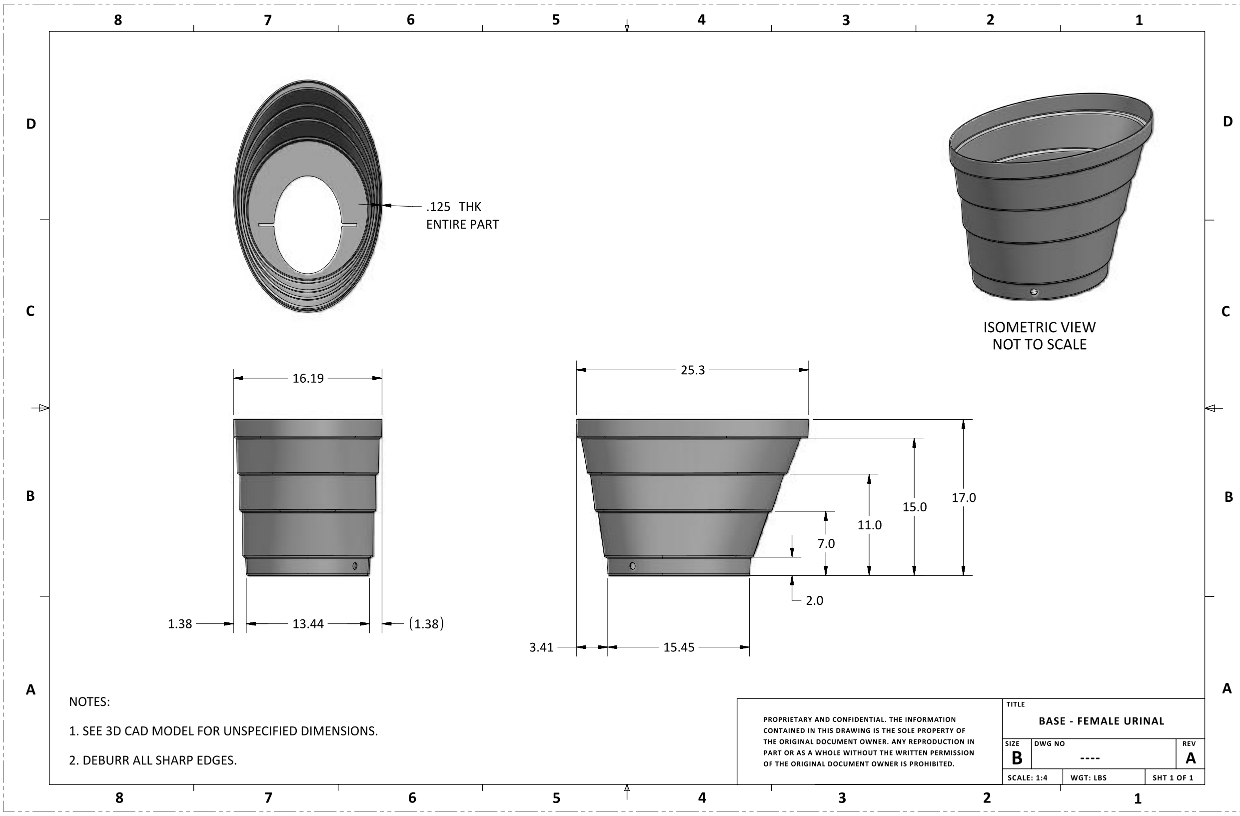
TOUCHLESS LID



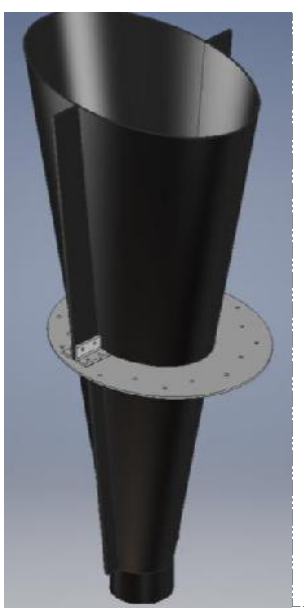
The touchless lid, identical to **NEW *2***, opens with a tap of your foot to the switch located on the lower right base of the **1*f*** to open the lid and, another tap of the foot to close it. The DC motor driven lid lifting apparatus, housed within the lid itself, is easily overridden by simply lifting the lid manually. As a bonus, you can also easily lift the whole lid off -- free from the seat below for easier cleaning. No bolts or nuts. Just lift.

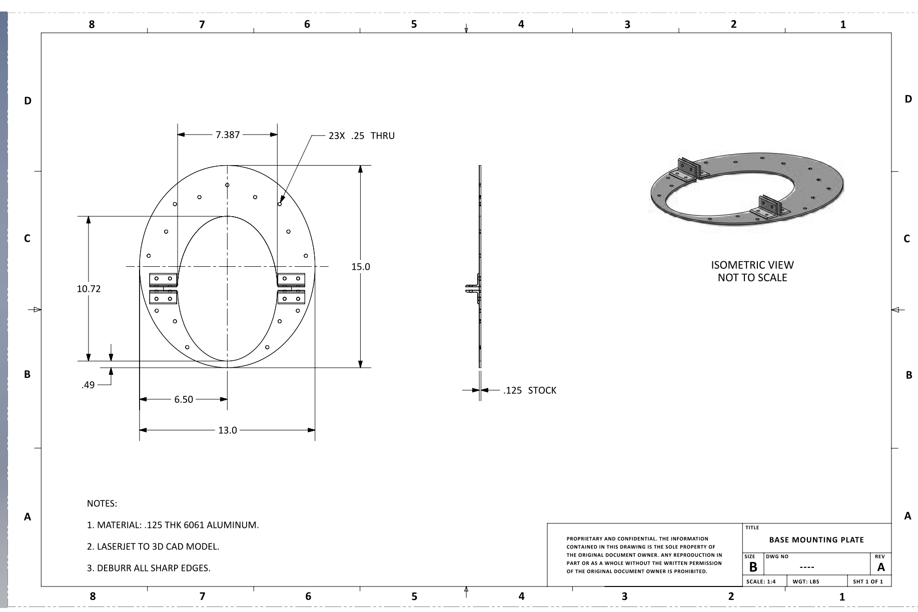
Though not as hygienically necessary as the same apparatus for the **NEW *2*** model the touchless lid is still preferable, especially in public buildings. Employing the same foot tap switch in both the ***1f*** and ***2*** models makes them uniformly predictable for all users. After years on the market, motion and proximity switches still have their glitches. (***The foot tap operated switches should be adopted across the board for all plumbing fixtures, for their reliability and out of hygienic necessity, especially in public restrooms.)***

FLUTED BASE



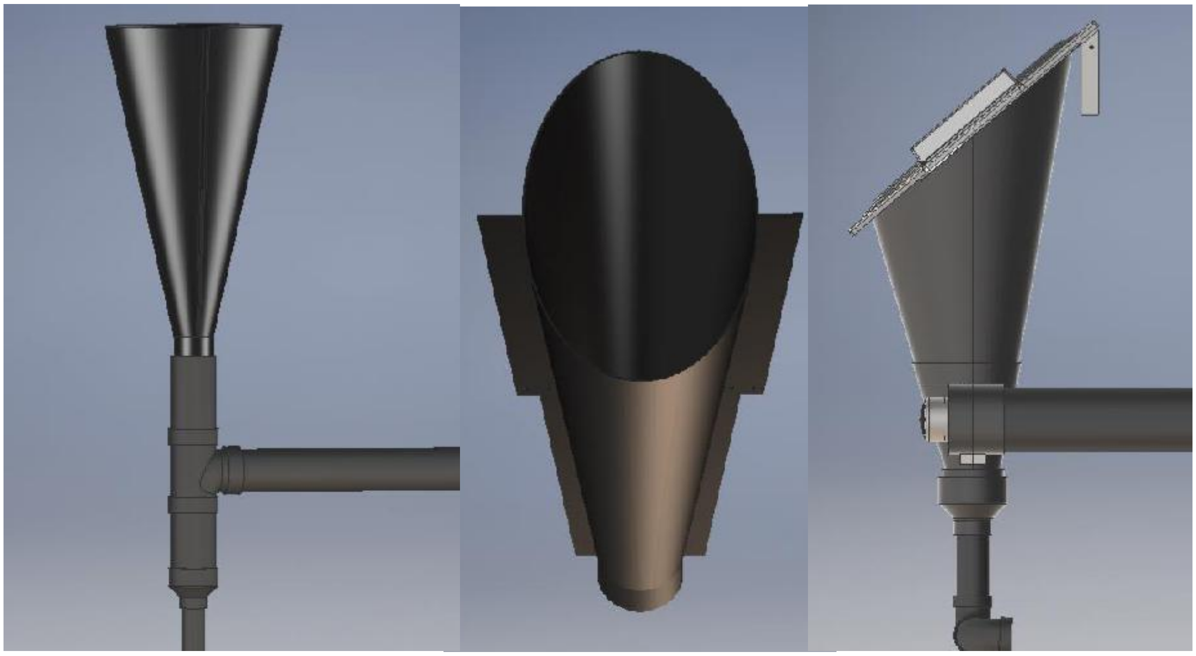
The fluted base is similar but slimmer than the **NEW*2***, not only using less material, but giving it a trimmer, more aesthetically pleasing profile. It’s lightweight and stackable for easy shipping.



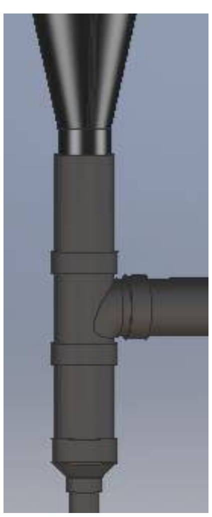


The base, funnel, and base (to floor) mounting plate fit together making assembly a snap, and result in a rock-solid permanent installation.

THE FUNNEL IS KEY



One of the key elements that makes the **1*f*** and **1*m*** so effective is the funnel, and its shape relative to its function, manufacture and assembly. The deep oval funnel shape is essential to its dual-purpose function. It begins the air exhaust/vacuum that allows odorless use while preventing the nitrogen rich ammonia from escaping the sealed storage tanks below. In its other function, the funnel is also the start of the drain. The steep walls shed the urine which dries even quicker due to the constant downdraft. It is unnecessary to ever clean the funnel.   The black surface of the abs plastic, and again, the depth of the funnel, creates a visual vanishing point to punctuate the point that it is practically maintenance-free.



There are other examples of certain design imperatives throughout that can't be overlooked to assure proper function, for instance, the dual function of the inverted sanitary tee (4" ABS) employed in the exhaust venting of the ***1f.*** Since there is a constant and uninterrupted exhaust airflow up and out the exhaust vent-pipe, intentionally inverting the sanitary tee (tee) creates turbulence as the exhaust air is pulled into the vent stack while simultaneously creating a veritable air-flow curtain that in turn results in a vacuum downstream which prevents volatilization of the valuable nitrogenic ammonia from escaping up through the drain pipe from the tank. As the urine flows down the drain-pipe the urea begins to convert to ammonia in which this ionic form of nitrogen is ready to be absorbed by root hairs when it is applied as a fertilizer.   The inverted positioning of the tee this way also assures that the urine flowing down past the tee exhaust opening will shed more readily.

1.) Urinating into a **porcelain flush toilet** from a standing position and aiming at the bowl below is nothing short of absurd. Admit it gentlemen -- from that distance there sometimes is a little side spray that misses the intended target. Urine does not fall in a perfectly confined stream, under the best of conditions. Even perfectly aimed forceful streams splash back when they hit the surface of the water in the toilet bowl. Everyone has seen urine spray droplets on the rim of the porcelain toilet-bowl. The truth: it happens just about every time a male urinates. Sometimes urine spray droplets land on the floor beside the toilet too. It's particularly irritating when we encounter a toilet seat that a previous male user had apparently forgotten to lift before he urinated, leaving spray on the seat. Then there is the toilet seat left up by forgetful males syndrome; this to the great consternation of females.

2**.) Flush Urinals** are universally deficient. They are smelly and messy. Flush urinals are prone to splashing flush water back out of the confines of the urinal itself. During and after urination droplets of urine land on the floor under and in front of wall mounted urinals. The same somehow holds true for urinals that are floor mounted. Urinal drain pipes are prone to blockages from hardened precipitates as we discussed earlier. Removing these blockages are difficult and costly. In some cases the only solution is to remove and replace the blocked drain pipe at even greater cost.

3.) At least the **waterless urinals** currently available don't spray flush-water back at you. They also save a large volume of flush water. But that is where the advantages end. Waterless urinals drain to a wasted water treatment plant (WWTP) or private septic system (SS). That means contaminants in the urine will return to surface and groundwater just as with all flushing toilets and urinals. Waterless urinals are not immune from drain pipe blockage either. The same phenomenon of hardened precipitates occurs at the point where the drain pipe from the waterless urinal first connects to the general sewer drain pipe carrying wasted water. Removing these blockages from drain pipes is even more difficult and costly than is usually the case with flush urinals. So too is removal and replacement of these pipes, because the blockages at the intersection of the waterless urinal drain pipes and the general sewer drain pipes usually meet further downstream. In addition, because waterless urinals are all wall mounted and have generally the same shape and dimension of their flushing cousins, the problems of urine spray residue is every bit as annoying and odiferous. There are two more drawbacks unique to waterless urinals that are on the market today.

Since there is no sewer-trap, a proprietary cartridge in waterless urinals is fitted into the drain that allows the urine to flow through the usually oil-based substance in the cartridge. It blocks sewer gas and odors from escaping out the drain and into the room. The substance in the cartridge must be replaced periodically and/or, (depending on the manufacturer), the whole cartridge must be replaced. This requires labor and replacement expenses. Because no flush water removes the urine from the surface of waterless urinals, they must be sprayed with a disinfectant/deodorant and wiped clean manually very often, otherwise dried urine odors waft into the room.

IV. NEW*1m*

M for "*Missless*"

THE BIG OVAL

You will understand when you are standing in position at the ***1m*** what, “missless” means. The large elongated oval opening below you is positioned to make “missing impossible”. Hopefully you will chuckle (not to the opening 4 notes ascending and 4 notes descending bar of the *Mission Impossible* theme music) but with appreciation of the ergonomic/geometric/aero- and fluid dynamic considerations, cost analyses and time for building and testing that preceded the manufacture and installation of the urinal which you are not missing pissing in. The careful ergonomic considerations assure that all of the spray/splash-out/splash-back and odiferous residues discussed above are eliminated.

It is the same deep funnel shape and dimension as the **1*f*** so as to optimize the fluid dynamics for shedding and drying the urine, which, in conjunction with the constant downdraft allows for the quickest drying. In addition, because there is a constant down draft the same funnel shape also optimizes the aerodynamics of the exhaust air to pull room air down to the bottom of the funnel which gets pulled up and out the vertical stack. **This makes it: 1.) completely odorless**, 2.) creates a vacuum and air curtain to prevent the loss of the Nitrogen (**N**) residing in the ammonia in the sealed collection tank. As discussed earlier where it was germane and depending how you arrived at these words you may already know: There is a solar powered in-line fan to boost the chimney effect optimized exhaust design.

If the fan stops, it will have to be replaced. Don’t be alarmed, the chimney effect is sufficient to keep the vacuum and air curtain functioning. Urine won’t dry as quickly, so you will *probably* be able to smell your urine *while* you are urinating, but not otherwise. The lid will prevent any air in the funnel from not going up and out through the stack until the fan is replaced.

NEW*1m*, like the **NEW*1f*** and **NEW*2*,** has a touchless lid. Except to activate the 12V DC motor, also in the lid, you bump the switch mounted on the air filter change-out cover to the exhaust air duct with your right shin. Bump again when done. (manually overridable too, just like the others.) Questions or comments?

V. FERTILIZERS

There are a number of ways this could play out. We could integrate vertically and produce a special brand of **NEW** fertilizers. Part of that could be a service contract with homeowners and others who install our units. We could grow specific N loving crops. The possibilities are many. This has always been part of my vision but first things first. Developing **NEW*2U*** has taken a lot of effort.

VI. GRAYWATER SYSTEMS – NOWUS

Natural onsite water use systems (NOWUS) is another of many spin-off enterprises that will be created. There can be no “one-size-fits-all” system for a number of reasons.

The designs will be site specific much on the order of SS. Soil types, demand i.e. household or business size, and local regulations will all come into play. The species of trees, either growing onsite, or planted will depend upon the region and what is appropriate. Native species will be encouraged.

Reusing graywater to grow and irrigate trees is intrinsically beneficial on many levels – removing carbon dioxide, while providing oxygen, shade and naturally regenerating groundwater are all very purposefully intended consequences.

VII. OTHER INTENDED CONSEQUENCES

We want to be sure we aren’t using products that would harm the trees we are nurturing or the groundwater beneath them. This could lead to producing any number of **NEW** gentle soaps, toilet paper, cleaning products and ways. Many possibilities for New Earth Ways lie before us.

Questions or comments?

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