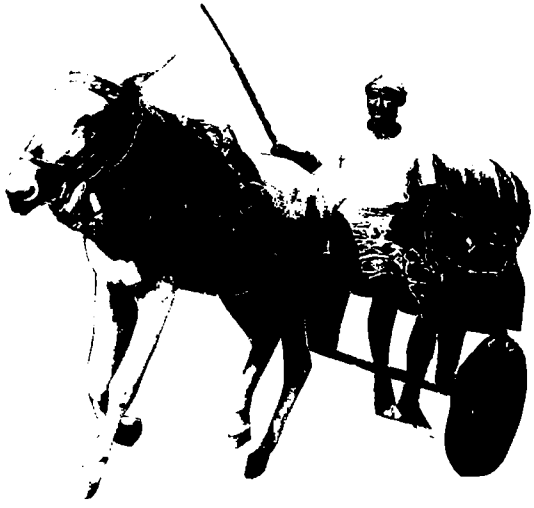
Stop the Five Gallon Flush !

A Survey of Alternative Waste Disposal Systems



70% OF THE HUMAN RACE DOES NOT HAVE PIPED WATER

✸THE PROBLEM IS NO.3

Edited by : Witold Rybczynski & Alvaro Ortega

with
Wajid Ali, Vikram Bhatt, Jon Boon, Makram Hanna,
Bernard Lefebvre and Behrooz Nournia.

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Produced with financial assistance from McGill University School of Architecture, Derek Drummond, Director.

INTRODUCTION TO THE FOURTH EDITION

This book was first published in 1973 as the result of a study funded by the Brace Research Institute. We had no idea at that time of the interest that would be aroused not only amongst technicians and students, but also in the general public. More than five thousand copies have been printed to date, and since noone has come along with a better publication, we continue to update, enlarge and reprint the book. It remains, we think, a useful access tool for the professional as well as the amateur. The Minimum Cost Housing Group continues to develop techniques for low cost sanitation and has developed designs for the Minimus, a composting toilet, which have been applied in Canada, the Middle East and in Southeast Asia. Two books have recently appeared that complement Stop the Five Gallon Flush. One is Goodbye to the Flush Toilet (Rodale Press) and the other is Septic Tank Practices (Anchor Books). They are welcome additions to this neglected field.

Witold Rybczynski
January 1978

Stop the Five Gallon Flush !

A Survey of Alternative Waste Disposal Systems

Contents

Foreword

This publication represents the third report prepared by the Minimum Cost Housing Group under the research guidance of Mr. Alvaro Ortega and Mr. Witold Rybczynski. This report has been made possible by a grant from the Brace Research Institute of McGill University and the Central Mortgage and Housing Corporation.

The Minimum Cost Housing programme commenced in September 1970 and has set as its goal, the investigation of a number of specific areas related to intermediate technology.

Shelter is an indispensible part of man's physical environment and forms the setting of man's basic social unit, the family. Unquestionably, the improvement of this physical setting with the provisions of good sanitation is commensurable with a better and healthier way of life. Although adequate sanitation is taken for granted in our urban society, optimum standards have yet to be evolved in order to eliminate the wasteful use of water and to minimize pollution. Of course, this task is even more acute in regions where inadequate sanitation is prevalent.

This report is a compendium of various systems of sanitation. Its compilation would have been impossible without the information received from industries concerned with the development of better sanitary equipment. Moreover, the Minimum Cost Housing Group worked closely with the Brace Research Institute in the development of a low cost sanitation system; the benefits derived from this interdisciplinary co-operation were invaluable and hopefully it will lead to field testing of promising systems from the ecological point of view.

Norbert Schoenauer,
Director,
School of Architecture
McGill University.
July 1973.

Part One

I. Introduction

The collection of human waste from house connections via an underground network of sewers, and the disposal of the sewage in centralised locations, first appeared in the European cities in the middle of the nineteenth century. First in Hamburg (1842) and later in London (1855) and Paris (1860), following disastrous cholera epidemics, underground sewers were begun. The first American example was in Brooklyn (1857). However the problem of disposing of large amounts of sewage in spot locations was not immediately appreciated, and it was estimated that in the fifties, in the United States, more than a quarter of the systems discharged their wastes without treatment.

This essentially Western-urban model for collection and neutralization of human wastes calls for high densities to justify the required network of water supply and sewer pipes, available capital for the large initial investment required, very large quantities of water, and facilities for waste disposal. When one or more of these factors are absent from the equation, the network system approach cannot be applied. This may be in rural areas where people live too far apart, in poor countries which cannot afford the huge (for them) investment required, in regions where water supply is a problem, and in places, such as the Canadian north, where waste disposal is difficult.

Two factors deserve special mention; the use of large quantities of water and the need to then purify this water, and the cost of the network approach.

The annual water consumption of the average North American family is 88,000 gallons (396 cubic metres), and 40% of this water is used for toilet flushing. The "standard" toilet requires 5-7 gallons (22.5-31.5 litres) for each flushing. A recent experiment at McGill showed that two people, over a one month period, consciously trying to save water, used 200 gallons (900 litres) of water for cooking and washing. In addition to this, using a conventional toilet, they would be forced to use 780 gallons (3510 litres) of water for flushing. Obviously in arid regions, or in areas with dry seasons, or where water supply is critical, the conventional water-borne system is wasteful and costly. Moreover, even where water supply is not a problem, it can be argued that the cost of purifying the water, (and sewage is 99.9% water), is the cost of purifying the transporting medium, rather than the waste, and so represents a misuse of energy and resources.

The investment in utilities infrastructures in Western cities is $500-$600 per person, whereas a country like Tanzania, in 1969, could spend only $8 per urban inhabitant. This fact is even more significant when coupled with the rapid urbanization in Africa and Latin America. The World Health Organization estimated in 1972 that only 8% of the urban families in the developing countries of Asia and Africa had access to a sanitary sewage system.

It should be clear, at this point, that water-borne waste disposal represents a (relatively recent) answer within a set of economic and physical conditions, and not clearly the least wasteful answer at that. Flush toilets should not be considered as "advanced", compared to the pit latrine. Under certain conditions the latter is ecologically sound, cheap and quite safe.

Part I of this report reviews the known methods for the disposal of household waste, noting the advantages and disadvantages. We were especially interested in self-contained systems and ones that used little or no water. Though we are concerned primarily with low cost technologies, we have included more expensive systems to show current thinking. Part II is a catalogue of data and information on some of these systems presently being manufactured in various countries.

2. Classification

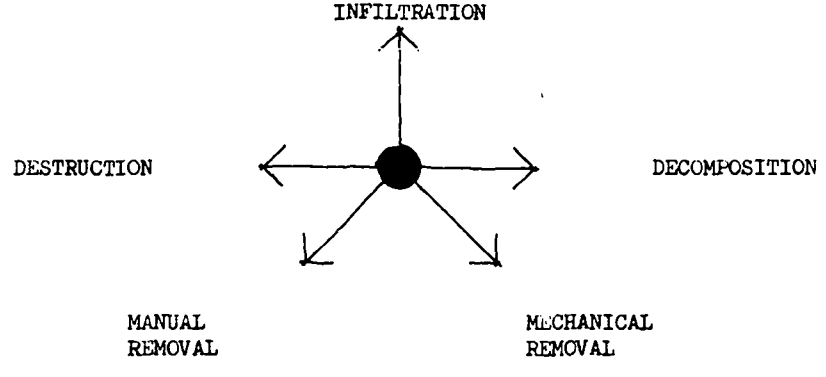
There are a number of methods of classifying waste disposal systems. The WHO publication Excreta Disposal for Rural Areas and Small Communities (1958) differentiates between water-borne methods and privy methods. The Canadian Environmental Service differentiates between fixed and portable toilets. One could distinguish between the methods of excreta disposal, aerobic (fermentation) and anaerobic (putrefaction). We have chosen to follow the system of Uno Winblad's Scan Plan Report No. 3 (1972), with modifications. This classification is by processes that occur to the human waste: removal, destruction, infiltration or decomposition.

Infiltration refers to absorption and dispersion of excreta in the soil and groundwater.

Removal refers to those methods where the excreta is transported, manually, by vehicle, or by means of pipes, to be disposed of in sewage oxidation ponds, bodies of water or to be processed further.

Destruction refers to those methods where the excreta are reduced by combustion.

Decomposition refers to those methods where microbiological action takes place.



* INFILTRATION

1. Pit Latrine
2. Aqua Privy
3. Septic Tank

* MANUAL REMOVAL

1. Bucket
2. Chemical Toilet
3. Freeze Toilet
4. Packing Toilet
5. Recirculating Chemical Toilet

* MECHANICAL REMOVAL

1. Vacuum Truck
2. Chemical Privy
3. Recirculating Fluid Toilet
4. Water-borne Network
5. Vacuum Network

* DESTRUCTION

1. Incinerating Toilet

* DECOMPOSITION

1. Compost Privy
2. Continuous Aeration
3. Algae Digester

3. Description of Types

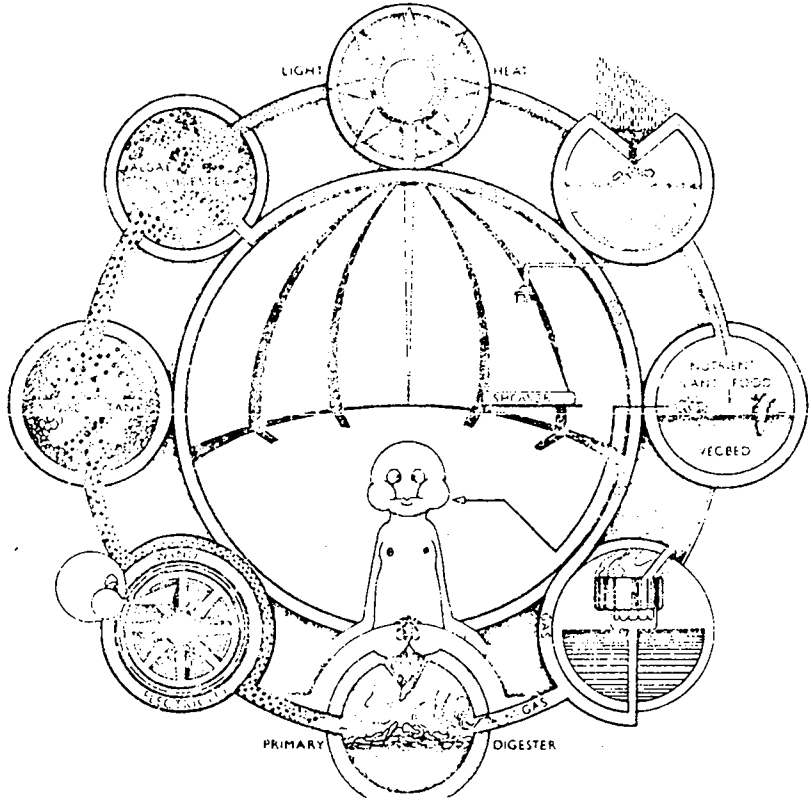
INFILTRATION This is the oldest method of waste disposal and still probably the most widespread. The waste is fermented in a pit or container, and allowed to infiltrate the soil. This process can take place with or without water, but the digestion process does slow down at lower temperatures. The capacity of the soil to absorb the sewage is critical, and sufficient area must be allowed for dispersal of the effluent.

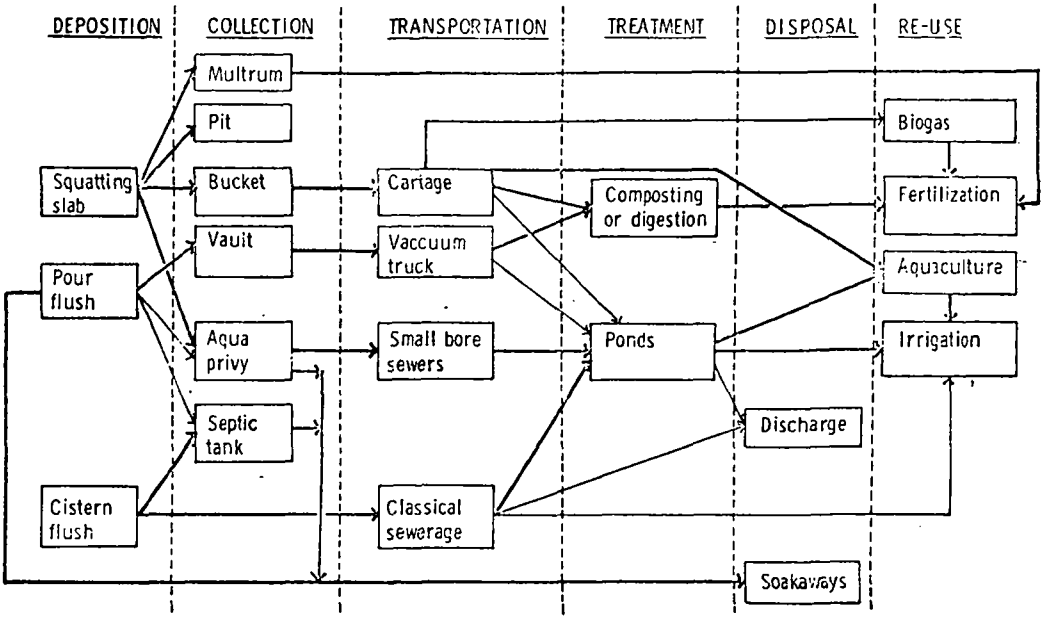
MANUAL REMOVAL There are three cases where Infiltration cannot be used; extreme cold, low-porosity soil, or too great population density. The most common method in such instances is to manually remove the waste to a distant leaching pit or sewage lagoon. Chemicals are often used to reduce smell and danger of contamination before the waste has been disposed of. Water is not usually used in these systems.

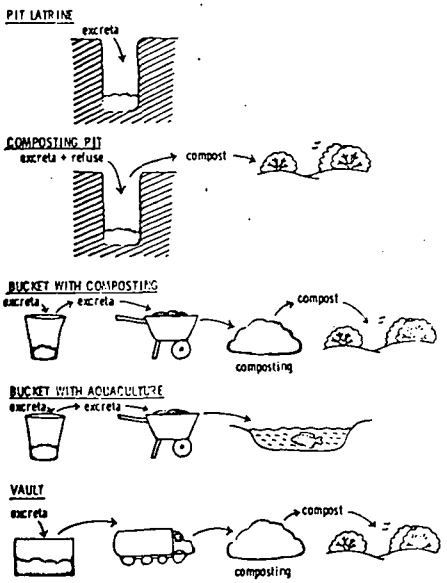
MECHANICAL REMOVAL The population density in cities and towns precludes the use of Infiltration, and also, usually, Manual Removal, as the disposal point (river, sea or treatment plant) is too far away. At the same time the concentration of people and resources permits a large capital investment in networks (roads, sewers, water supply) and so mechanical means of removing the waste from the dwelling are employed. Often large amounts of water are used.

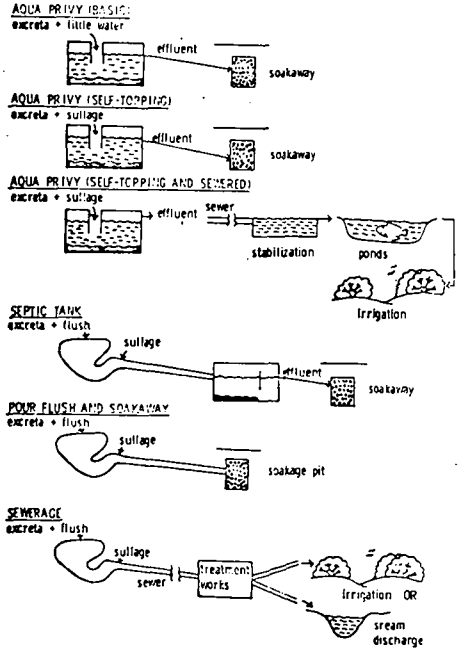
DESTRUCTION An age old use for human, as well as animal waste has been as fuel. Recently this method of disposing of waste has been applied in the form of incinerating toilets. Although this is a new development, and has not consequently seen wide use, it represents a waterless, sanitary method whose only disadvantage is possible pollution of the air.

DECOMPOSITION This represents an alternative to the anaerobic putrefaction of waste that takes place in all septic systems. The disadvantage of these systems is that there is no oxygen present, no heat build-up occurs, and pathogenic bacteria and other parasites take up to 6 months to be destroyed. In aerobic decomposition, the high temperatures generated by the oxidation, destroy the pathogens in a matter of hours. Though the processes have been understood for some time, not enough work has been done on this form of waste disposal, which has great potential, and can result not only in efficient waste disposal, but fertilizer manufacture as well.









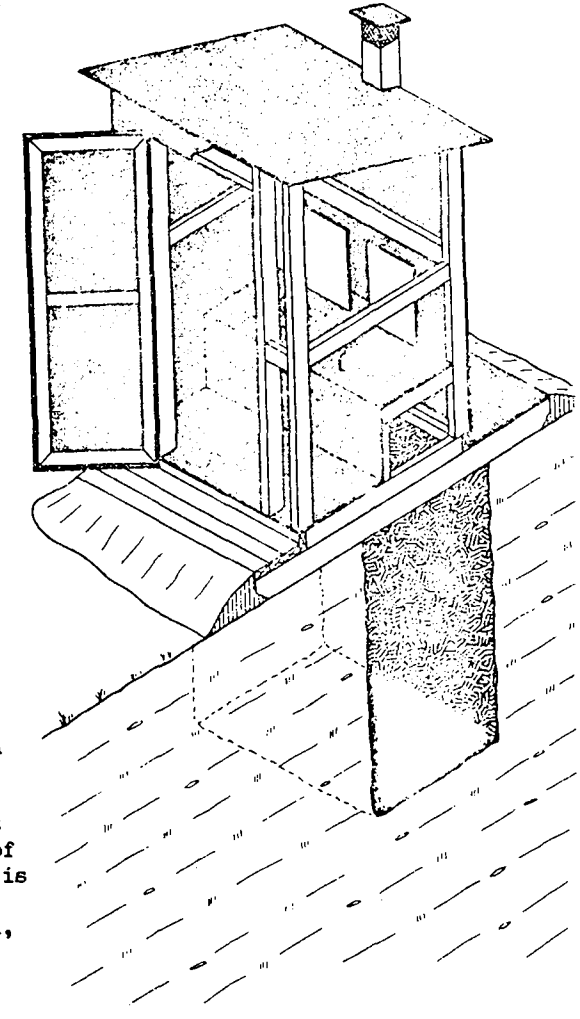
This classification system has been developed specifically to include the waste disposal/reuse systems currently used in the tropical regions by Dr.Richard Feachem of the Ross Institute of Tropical Hygiene, the London School of Hygiene and Tropical Medecine.

4. Description of Systems

* INFILTRATION

1. Pit Latrine

The pit latrine consists of a hole covered with a squatting plate, or a seat. The liquid wastes infiltrate into the ground, and the solid waste accumulate in the pit, and decompose. When the pit fills up, a new one is dug nearby. This is the cheapest system for waste disposal, and quite safe as long as it is fly-proof. It uses no water. It should be located on high ground to avoid run-off water flowing through the pit. A family of six produces about 990 gallons (4455 litres) solid and liquid waste in a year. Since much of the solid waste decomposes, it may take up to ten years before the pit is full. However it can be readily seen that the pit latrine is not suited to heavy use. This is in fact the case in many squatter settlements, where latrines are overflowing. In addition the slow process of putrefaction and pollution of surrounding soil, makes the pit latrines unsuitable, and dangerous, for high urban densities.



PIT PRIVY

* INFILTRATION

2. Aqua Privy

The aqua privy system consists of a tank with a constant water-level. The tank can be steel or concrete and is sometimes divided into 2 or 3 compartments. A vertical pipe extends from the toilet seat to below the liquid surface. A quantity of water is added to the toilet each time it is used. This displaces the waste from the first anaerobic compartment, to the second, where aerobic decomposition takes place. Gases are vented to the outside. The liquids in the tank overflow into soakage, or leaching pits, to be absorbed by the soil. The solids must be removed at infrequent intervals. Some aqua privies can function on only 1 quart (1.13 litres) of water per use. This kind of system can only function where soil absorption capacity is high and where there is no danger of groundwater pollution. Initial cost is relatively high, but operating costs are low. It should be mentioned that a variation of this system, which has been tried in a number of sites in Western Canada, with little excessive smell. This may have been the design of the tank, which had only one compartment.

* INFILTRATION

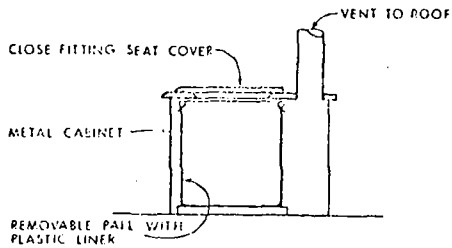
3. Septic Tank

This system is essentially an aqua privy, except that the toilet seat is not located directly on top of the tank, but some distance from it. Waste is carried to the tank by water through pipes. The advantages and disadvantages are the same as for the Aqua Privy, with a much greater use of water, about 5 gallons (22.5 litres) per use. Liquid waste is infiltrated into the soil, and solid waste settles to the bottom of the tank to be removed, usually by a vacuum truck.

* MANUAL REMOVAL

1. Bucket

This system consists of a bucket in which the waste is deposited, and which is removed and cleaned at intervals. This traditional system, known for many years and still in use, uses no water and involves little investment. However there is a health hazard when the bucket is being handled and emptied, and the waste is accessible to flies.

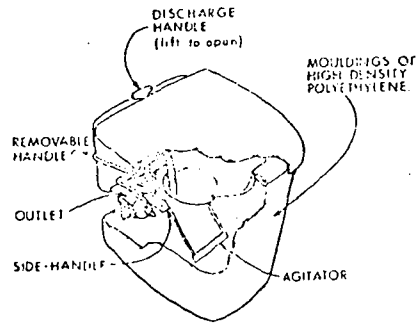


BUCKET TOILET (CHEMICAL CLOSET)

* MANUAL REMOVAL

2. Chemical Toilet

This type is essentially a bucket toilet to which are added chemicals which reduce the rate of biological decomposition and reduce odours. The bucket is sometimes in a container which is vented to the outside. Chemical toilets use none or little (1 quart, 1.13 litres) water, and must be emtied when they become full. The contents of the toilet are visible, and when the bucket is more than half full the user may get splashed. Great care must be taken with the chemicals, which usually contain lye, and should never be in the reach of children. Though the initial low cost of this type of system makes its use very widespread, the cost of chemicals is relatively high, and their use precludes composting of the waste. Experience has shown that in sparsly populated areas the chemicals will not cause pollution of rivers or groundwater, however, concentrated dumping would undoubtedly cause problems.



PORTABLE CHEMICAL TOILET

* MANUAL REMOVAL

3. Freeze Toilet

This type of toilet, developed in Sweden, is a bucket toilet where the waste falls into a plastic bag which is refrigerated. Thus the health hazards of the bucket toilet are eliminated, and the waste can be composted. Though the initial cost is high, operating costs (in Sweden) are low, US$ 0.02 - 0.03 per day. Obviously electricity or gas is required, but no water.

* MANUAL REMOVAL

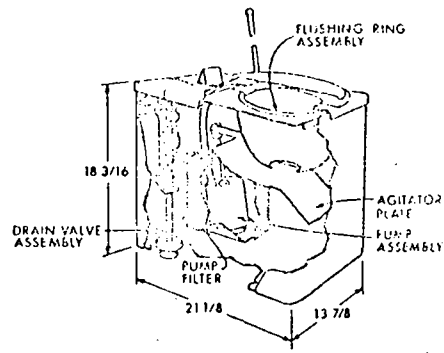
4. Packing Toilet

Another Swedish refinement of the bucket toilet. The waste is sealed in a plastic bag after each use and falls into a larger sack which has to be emptied at intervals. Once again a high initial cost, no water required, and no use of potentially dangerous chemicals.

* MANUAL REMOVAL

5. Recirculating Chemical Toilet

This is essentially a chemical toilet which has been modified by adding a pump, which recirculates the contents of the tank for flushing. The chemicals liquify the solid waste, inhibit biological decomposition, and colorize the liquid. These type of toilets are currently used in commercial passenger planes. The system uses relatively little water, requires electric power (though it could be hand-pumped), but has the same disadvantage as the chemical toilet as regards disposal of the waste. Cost is high.



RECIRCULATING CHEMICAL TOILET

* MECHANICAL REMOVAL

1. Vacuum Truck

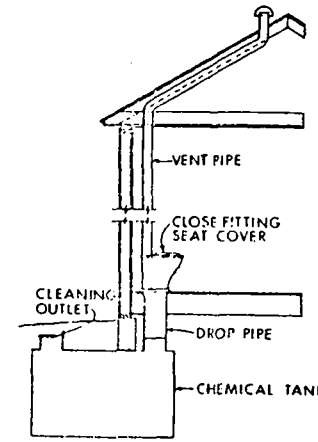
This type of system is also known as the Privy Vault. The toilet is located directly above a ventilated steel tank, or concrete vault. Waste falls directly into the tank, and is collected at frequent intervals by a vacuum truck, tank, and is collected at frequent intervals by a

and Taiwan. The system has the advantages that it uses neither water nor chemicals, but it does rely on a road network and specially designed trucks. There are odours when the tank is being emptied. Initial cost is low but operating costs are high.

* MECHANICAL REMOVAL

2. Chemical Privy

The construction of the chemical privy, or chemical toilet, is essentially the same as the privy vault, except that chemicals are used to kill bacteria, inhibit decomposition and liquify most of the solids. For example, to an empty 150 gallon (675 litres) tank, is added 25 lb. (11 kg) of lye and 12 gallons (54.5 litres) of water. The contents of the tank are virtually odourless, and being liquified and noncorrosive can be pumped out with any inexpensive pump. However they must be hauled away to be disposed of, and be hazardous to children. Same cost considerations as Vacuum truck system.



* MECHANICAL REMOVAL

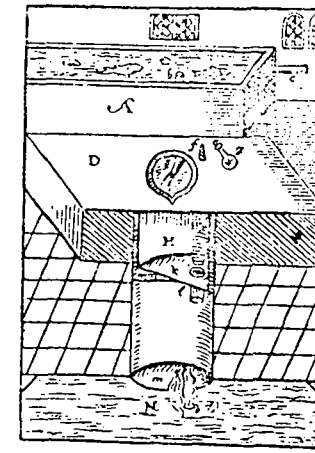
3. Recirculating Fluid Toilet

This system is currently being developed in the United States and is not yet in production . The system consists of flush toilets connected to a water-tight tank, which can be located inside or outside the house. However instead of using water for flushing, a fluid is substituted that does not mix with the waste. At the tank the waste and the fluid are separated and the fluid, odourless and colourless, is used again for flushing. The system thus uses neither water nor chemicals, while allowing several fixtures to be connected to one tank.

* MECHANICAL REMOVAL

4. Water-borne Network

The system consists of flush toilets connected to a pipe network which transfers the waste to a point of discharge (river or lake, the sea, treatment plant). Water is used to carry the waste in the pipe network. The conventional toilet uses 5 gallons (22.5 litres) each flushing, though toilets have been developed that require only 2 gallons (9 litres) per flushing. Another type of toilet, fitted with a grinder, uses 1 gallon (4.5 litres) per flushing.

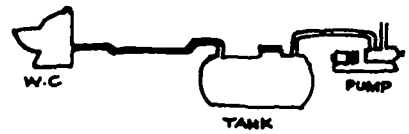


Harington's water closet, 1596

* MECHANICAL REMOVAL

5. Vacuum Network

The vacuum system has been developed in Sweden in 1957. This system consists of toilets, of a special construction, connected to a pipe network, in which a vacuum is created (negative pressure 0.5 atmospheres). About 1 quart (1.13 litres) of water is needed per flushing, and the sewage can be transported up to 640 feet (192 metres) horizontally, and 16 feet (5 metres) vertically, without the use of substations. The initial cost, as with all networks, is high.



* DESTRUCTION

1. Incinerating Toilet

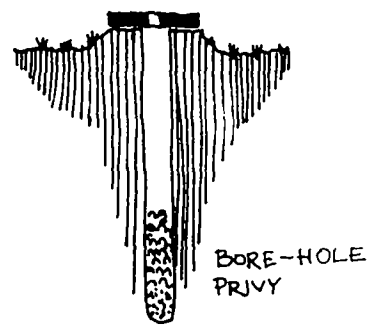
The incinerating toilet consistes of a bowl with a combustion chamber below. Most models utilize a liner that absorbs the liquid waste and is also incinerated. Fumes are vented to the outside. The source of energy may be electricity, oil or propane gas. The destruction is rapid and total, leaving only ashes, which have to be romoved periodically (and can be disposed of in the garden). Initial cost is high, as also are the operating costs (about five cents per use in Canada), however no water is used and destruction is safe and complete. Some units may overheat if used in frequent succession.

Incinerating toilets have been developed for mainly military use (in Arctic posts) in the United States. They are used in Canadian National Railway diesel cabs. In Scandinavian countries they have been developed for the consumer market, to be used mainly in summer houses.

* DECOMPOSITION

1. Compost Privy

Composting as a method for decomposition of animal and human waste to provide fertilizer has been in practice for a long time in India and China. Since the 1930's scientists have begun to study this phenomenon, and aerobic composting developed to the point where now in the Netherlands thousands of tons of compost are produced annually from municipal waste. Presently in India more than two million tons of compost are prepared annually.



The principles of composting have also been applied to smallscale conversion of human and kitchen waste. This work has been primarily in Sweden, where a prefabricated compost privy in fibreglass is currently sold.

The compost privy consists of a tank with an air intake and a ventilation duct. The toilet is located directly above the tank, as is a garbage chute. Human waste, paper and organic kitchen refuse decompose together into a fertilized humus, whose volume is about 10% of the original. At the lowest point of the tank is an access door for removing the humus. It is important that a layer of straw, sawdust or leaves be first placed in the bottom of the tank. This absorbs the liquid waste and aids decomposition. No water, fuel or chemicals are used in the process, and valuable fertilizer results, however the initial cost is high. This could be partially offset through the use of self-help, as the system is simple and contains no moving parts.

Variations of the compost privy have been developed in Sweden, using electric coils or hot air to heat the chamber and thus speed up decomposition.

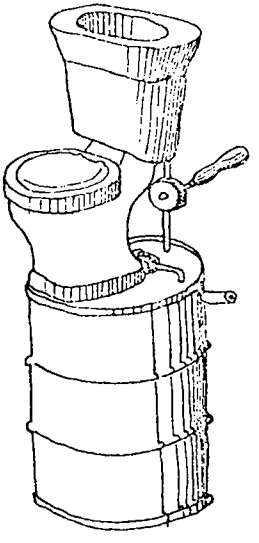
* DECOMPOSITION

2. Continuous Aeration

These types of toilets use the principle of aerobic decomposition and combine it with the flush toilet. The waste is carried to one or two tanks where it is continuously aerated by means of an air pump. The aerated liquid is used again for flushing. A variation of this system achieves aeration by circulating the water continuously in the system. The water must be changed once a year.

The units that have been developed thus far of the continuous aeration type have had certain operating problems. When overused the system tends to develop odours. If it is not used for a few days, the bacteria tend to die off, and flush water will smell for the first few days of use. Initial cost is high and operating is expensive.

A small unit of this type has been built at McGill but is only in its first year of operation; it runs on a 12 v. windmill operated aquarium pump, and utilizes an old gasoline drum, and hand-operated pump.



experimental toilet as installed in the Ecol.

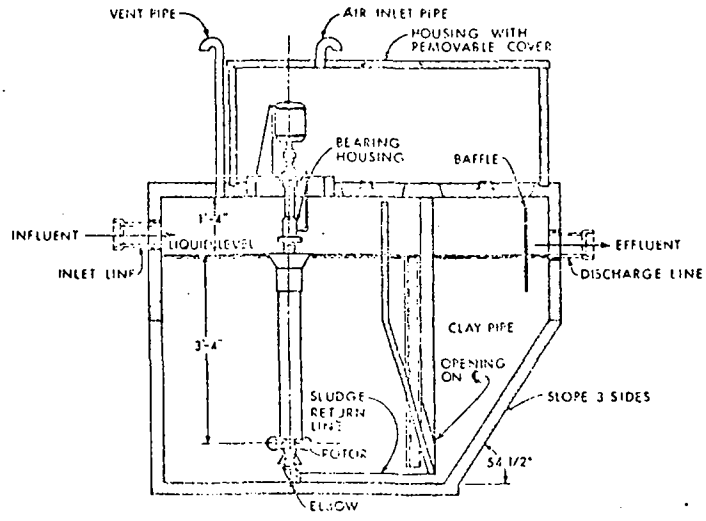
* DECOMPOSITION

3. Algae Digester

A closed system for handling waste disposal and producing gas and fertilizer is currently being built in London by Graham Caine of 'Street Farmer'. It combines a compost privy with a solar heated algae tank and digester. Pathogens are destroyed by the ultra-violet rays of the sun, and the algae break down the solids to produce gas (used for cooking) and fertilizer. This system is in it's experimental stages, and it is too early to know its cost or operating problems. However from an ecological point of view it represents an extremely good and economic use of resources, and an important area for development.

* HOUSEHOLD WASTE TREATMENT PLANTS.

A North American development in sewage treatment is the individual household plant. This plant is designed to treat waste, primarily through aerobic decomposition achieved by continuous aeration, settlement and sometimes filtration. The output from such a plant is "pure" enough to be discharged into rivers, or into the soil, without danger of pollution. It could also be re-used for flushing. These type of plants are normally used where pipe networks are not economic, and where septic tanks connot be used because of soil conditions. They require a large initial investment and continued maintenance, and are included here for the sake of completeness, and because they do represent a way of saving water by treatment and re-cycling.



Part Two

Catalogue

This catalogue of 72 waste disposal systems from 16 countries is by no means exhaustive; it represents only a cross-section of what is available, primarily in Europe and North America. Since waste disposal is not yet a science, much useful understanding can be got from studying particular products on the market.

This catalogue is not a consumer guide. Many of the systems are recent innovations and have not undergone extensive testing, in most cases the only information available is from manufacturers' brochures. In many cases prices are those that could be established in 1973; these will in any case vary from country to country, nevertheless they do facilitate comparisons between different systems.

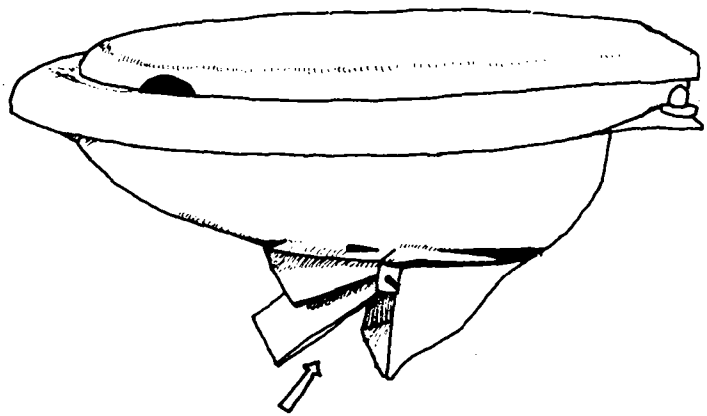
Although our interest is in low cost technologies we have found it necessary to include systems whose present status as high-cost consumer goods precludes their use in poorer economies. We feel that the basic principles of some of these systems can be adapted to lower cost solutions, as for example recent designs for owner-built composting toilets. However, all the examples do manage to conserve water, and hence the title of this book.

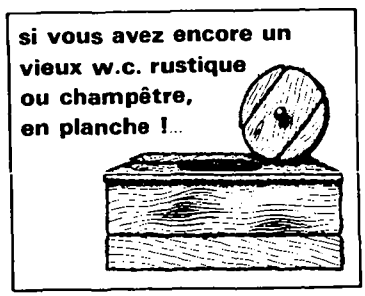
BICOQUE

Manufactured by:
Waterlo
41, Rue Censier
Paris 5e
France

Cost:

This is simply a toilet-seat for a pit latrine which imcorporates a trap-door type device for keeping odours from escaping the pit. It is made out of heat-formed plastic.





✱ CHIANG MAI SQUATTING PLATE

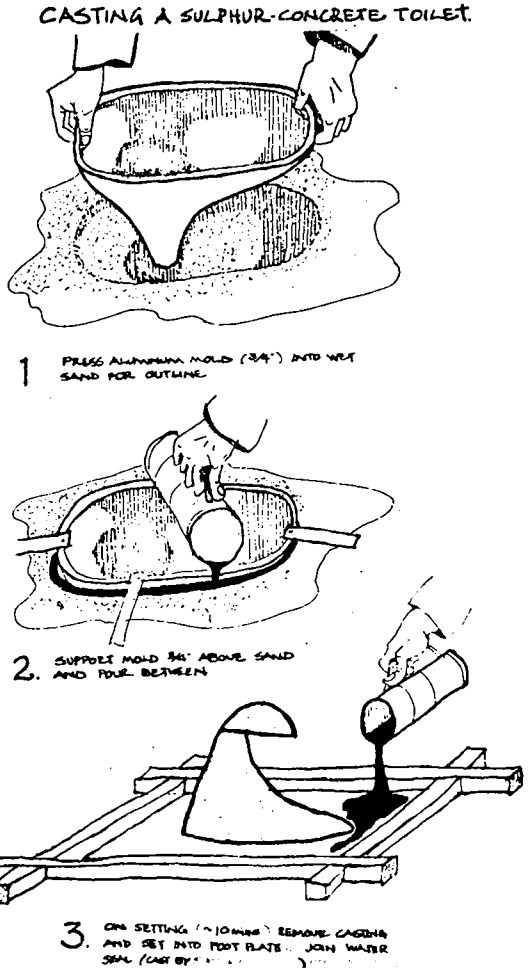
INFILTRATION
1. Pit Latrine

Mold available from:
Village Health & Sanitation Project
Ministry of Public Health
Bangkok, Thailand.

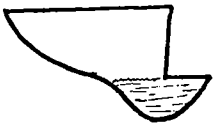
Cost: $7.50.

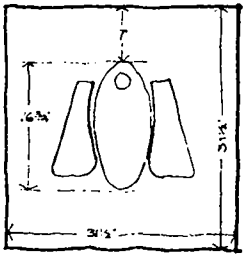
This is an aluminum master-mold used for casting a low-cost, water-sealed, sqatting-plate, which would be produced in a village situation and would be used over a pit, or aqua privy. Each time the toilet is used, a quart (1.1 litres) is poured to flush the waste and maintain the water seal.

This excellent design has been developed for use with a pasty cement/water mix. The Minimum Cost Housing Group has sucessfully cast sulphur-concrete squatting plates with this mold, thus giving a non-porous, easy to maintain toilet. Thanks to Ken Kern who lent us the mold.




BACKWARD FLUSHING TRAP


FORWARD FLUSHING TRAP



FOOT PLATE OUTLINE

WATERGATE

Developed by :
Blair Research Laboratory(P.R.Morgan)
Salisbury, Rhodesia.

Cost: Unknown

This is a pit latrine water-seal squatting plate that is self-flushing. It consists of an eccentrically hinged pan that is balanced by a counterweight. A valve maintains a constant water level in the bottom of the pan, which ensures a water-seal that prevents odours from escaping the pit or flies from coming in contact with the fresh fecal matter. When the toilet is used the weight of the faeces and urine tips the pan and the contents fall to the pit below. The pan then returns to a horizontal position and is refilled with water. The average water consumption is one liter per visit. Unlike pour-flush type water-seal latrines this model will not block if any larger objects are dropped into it.

Fig.1A **WATERGATE TOILET** - Water seal in position

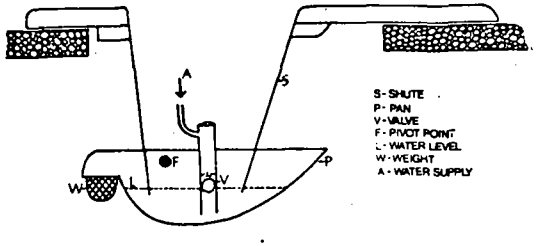
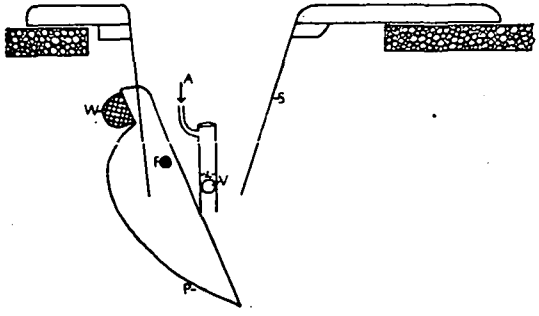


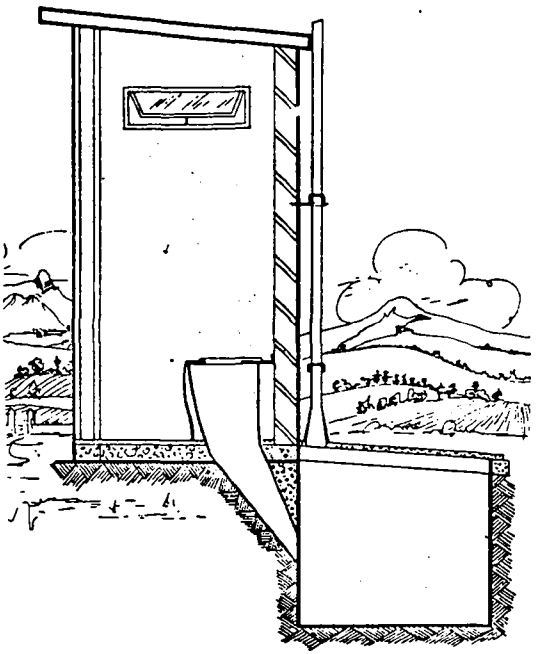
Fig.1B **WATERGATE TOILET** - Flushing

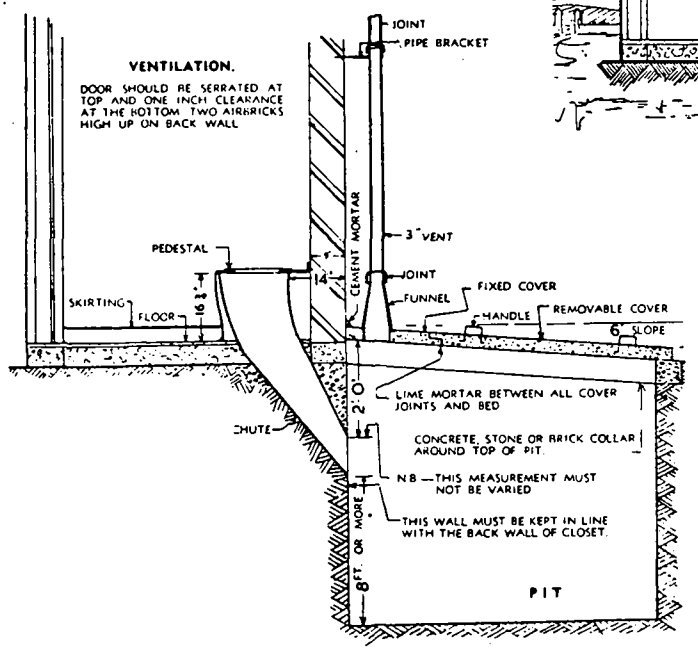


R.O.E.C.

Manufactured by;
Bell's Asbestos and Engineering (Africa) Ltd.
Johannesburg, South Africa.

The R.O.E.C (Reid's Odourless Earth Closet) Sanitary System was patented in 1944 (South African Patent No.991/1944). It consists of an offset pit and squatting plate connected by a sloping chute made out of asbestos cement. The pit is vented and can be periodically emptied via a concrete hatch. It is claimed that the configuration of the vent pipe and sloping chute prevent smells and flies from leaving the pit.



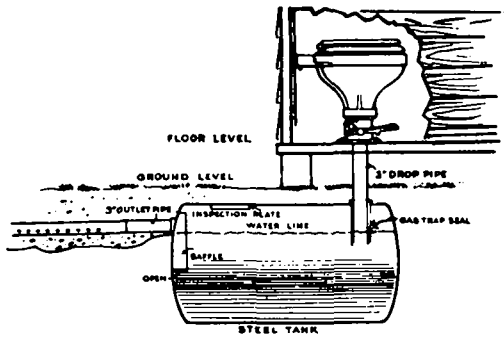


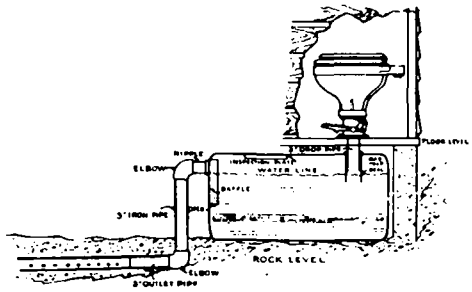
* FLUSH-O-MATIC

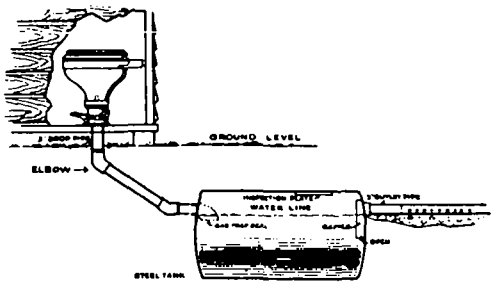
Manufactured by:
Sanitation Equipment Limited
Rexdale, Ontario,
Canada.

Cost: $79.95 (toilet alone)
$175.50 (incl. tank)

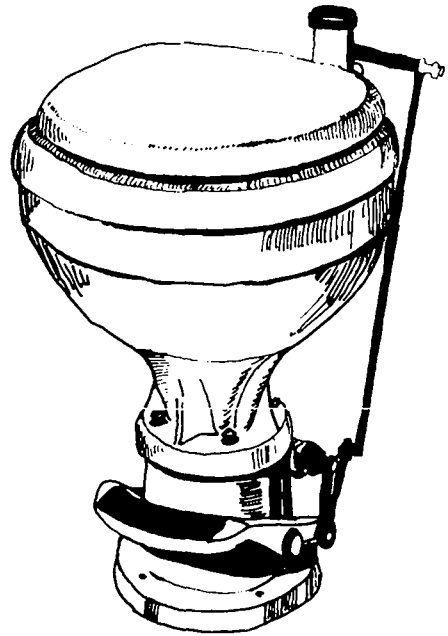
This system includes a toilet and a steel holding tank. Total weight is 175 pounds (79 kg). A foot-operated valve flushes 1 quart (1.1 litres) of water, which may be from a cistern, directly from water mains, or poured manually into the bowl. This unit uses little water, is mechanically simple and has the advantage of being able to function when there is no water in the reservoir by pouring directly into the toilet.







Il existe
3
façons d'employer
FLUSH-O-MATIC



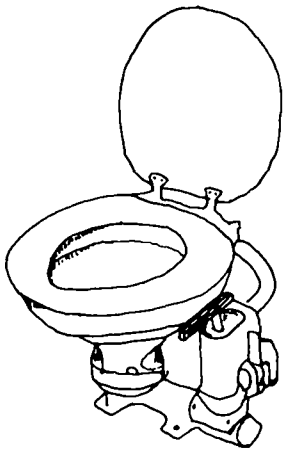
* HEAD-MATE

INFILTRATION
2. Aqua Privy

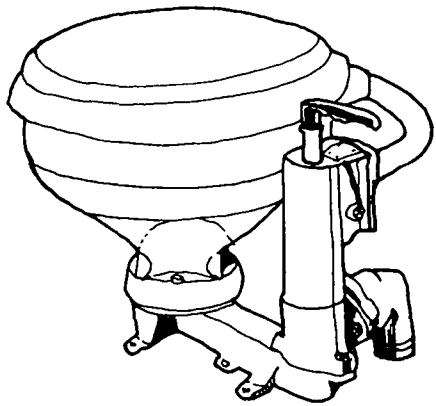
Manufactured by:
Wilcox-Crittenden Seaclos
Connecticut, USA.

Cost: $106.50

This is a marine toilet which is designed to function on small amounts of water. It would most normally be connected as an aqua privy, or in the case of a boat, to a holding tank. Water is hand pumped to clean bowl and flush toilet. About 6 strokes of the pump are necessary to pump the quart (1.1 litres) of water needed for flushing. The bowl is of vitreous china and non-corrosive metals. The unit weighs 20 pounds (9kg). The same company makes an electrically powered model for $259.00.



HEAD-MATE



MARINE HAND TOILET

* MARINE HAND TOILET

INFILTRATION
2. Aqua Privy

Manufactured by:
International Telephone & Telegraph
Rexdale, Ontario,
Canada.

Cost: $75.00

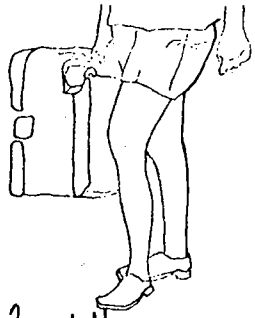
A marine toilet in which water is manually pumped to clean and flush the toilet. The unit is of vitreous china and stainless steel and bronze and weighs 23 pounds (10.4 kg). This kind of toilet might find application in areas where water is scarce and electric power not available for maintaining waterpressure. The inlet could be attached to a rain-water barrel for instance. Amount of water per flushing is 1 quart (1.1 litres).

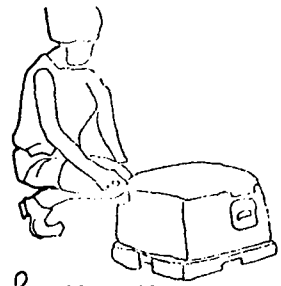
✻ PORTA POTTI

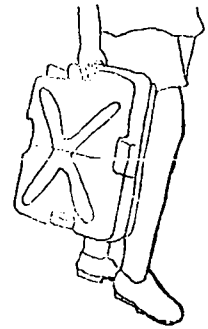
Manufactured by:
Thetford Products Ltd.
Nuneaton, Worcester,
England.

Cost: $105.00

This is a plastic portable toilet that consists of a 2.75 gallon (12.4 litre) water tank that flushes a pint (0.5 litres) of water each time into a holding tank that requires emptying after 50 uses. The holding tank detaches from the bowl. A deodorant chemical (not lye) is used in the holding tank. The flush pump is hand-operated.





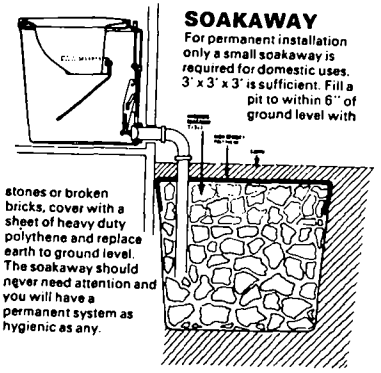


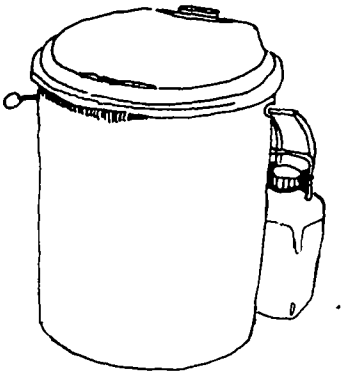
* PERDISAN STANDARD MINOR

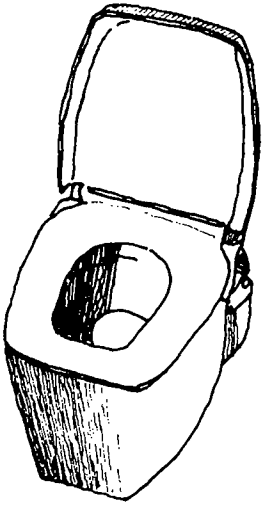
Manufactured by:
Racasan Limited
Cromwell Road
Ellesmere Port
Wirral
Cheshire L65 4DP
England.

Cost: $75.24

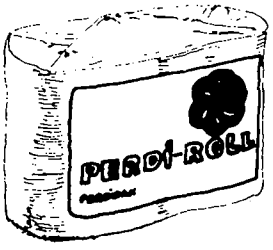
This portable bucket-style chemical toilet is of high-density polyethylene and weighs 17 pounds (7.7 kg). It is charged with a small amount of water and chemical. No water is used for flushing and the capacity is about 120 uses. After use the handle is depressed, which opens a spring loaded flop and lets the waste fall into the chemical solution. Special paper must be used. The unit can be permanently installed.







PERDI-ROLL
A 2 ply-toilet paper especially made to liquefy in Perdisan toilets and for use with all chemical toilets and W.C.'s.



X80 POWDER
Perfected after years of research, this perfumed powder liquefies, sterilizes and deodorizes all waste matter including suitable toilet paper. For use only with Perdisan toilets it is highly concentrated, and is activated by the addition of water.

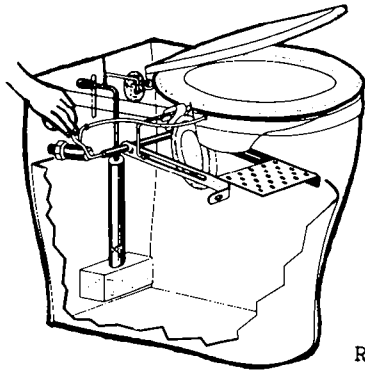
* RANCH

MANUAL REMOVAL
2. Chemical Toilet

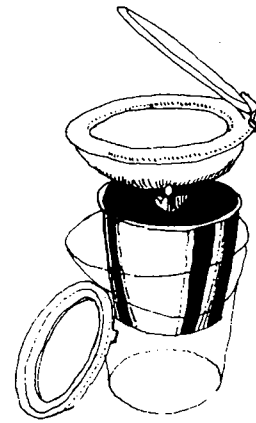
Manufactured by:
Waterlo
41, Rue Censier
Paris 5e
France.

Cost:

This is a portable chemical toilet which is carried to the point of discharge and emptied. It can also be connected to a drain pipe for permanent fixing. A performed, chemical is added once a month to inhibit decomposition. No water is added. A handle opens the splash pan and moves a paddle within the reservoir. The unit is out of polyester plastic and stainless steel parts.



RANCH



IGLOO

* IGLOO

MANUAL REMOVAL
2. Chemical Toilet

Manufactured by:
Waterlo
41, Rue Censier
Paris 5e
France.

Cost:

This is a portable bucket toilet to which chemicals are added, but no water. The removable bucket is inside a container. The bowl has a trap-door device for keeping odours in.

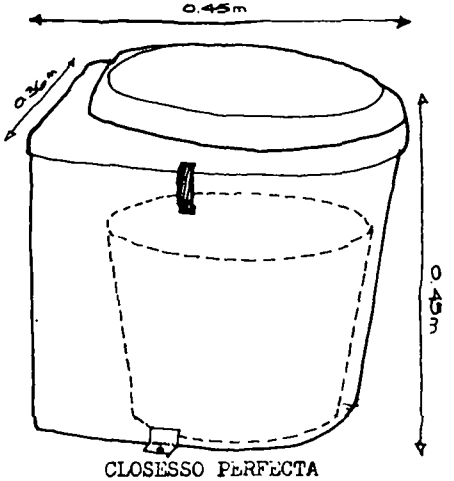
* CLOSESSO PERFECTA

MANUAL REMOVAL
2. Chemical Toilet.

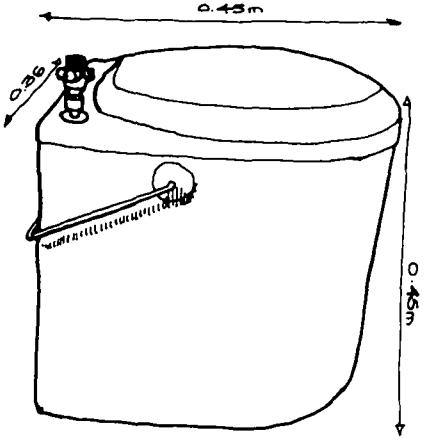
Manufactured by:
Etablissements Goby
18 Rue Bascout
94600 Choisy-le-Roi,
France.

Cost: $72.00

This is an essentially fixed toilet which consists of an outer container with a removable bucket inside, all out of plastic. The bucket of 3 gallons (13.5 litres) capacity is removed to be emptied. A splash-pan protects the user.



CLOSESSO PERFECTA



MOBILCLOSET

* MOBILCLOSET

MANUAL REMOVAL
2. Chemical Toilet.

Manufactured by:
Etablissements Goby
18 Rue Bascout
94600 Choisy-le-Roi,
France.

Cost: $72.00

This is a portable toilet with a capacity of 6 gallons (27 litres). The entire unit, weighing 11 pounds (5 kg) and is carried to the disposal area. One valve opens the outlet at the bottom of the unit. The other value operates the splash-pan. The unit is of plastic.

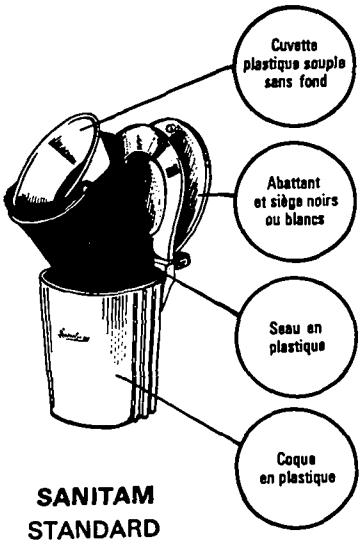
✱ SANITAM STANDARD

MANUAL REMOVAL
2. Chemical Toilet.

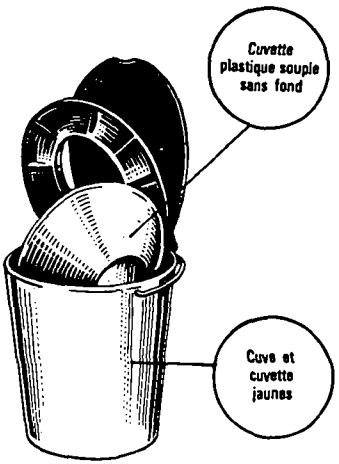
Manufactured by:
Techniques Agricoles Modernes
1, Rue du Bac
Paris - 7, France.

Cost: $48.60

This toilet consists of an outer container and an inner removeable bucket, weighing 11 pounds (5kg), all out of plastic. An initial charge consists of 2 quarts (2 litres) of water and chemicals. The capacity of the bucket is 6 gallons (27 litres), though in practice it would be emptied when half-full, that is, for three people, once a week.



SANITAM
STANDARD



SANITAM SALUBRIS

✱ SANITAM SALUBRIS

MANUAL REMOVAL
2. Chemical Toilet.

Manufactured by:
Techniques Agricoles Modernes
1, Rue du Bac
Paris - 7, France.

Cost: $32.60

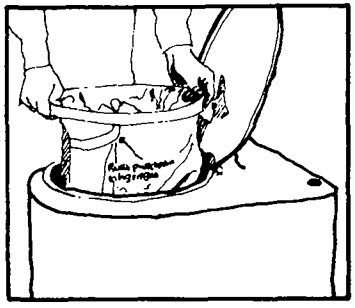
This is really a bucket toilet to which chemicals are added. When full the toilet is simply dumped out. The unit is of plastic and weighs 4.4 pounds (2 kg). It requires an initial change of 2 quarts (2 liters) and has a capacity of 6 gallons (30 litres).

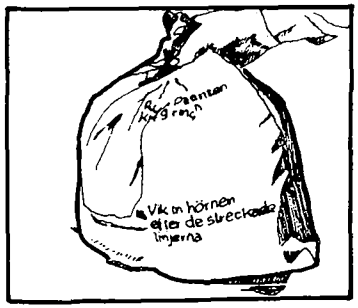
MARKT

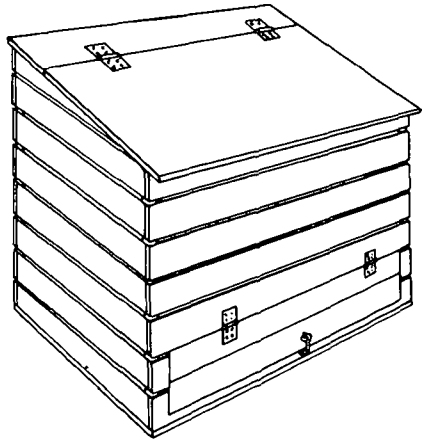
Manufactured by:
Markt & Co. A/S
Kirkegt. 6B
Oslo 1, Norway.

Cost:

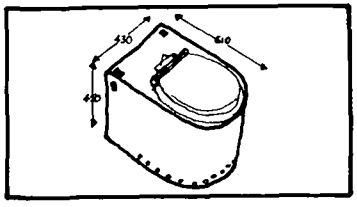
This toilet function on the principle of a deep freeze. The waste falls into disposable paper bags (capacity 5 gallons,22.5 litres)that are located beneath the seat. The disposable bag is located within a plastic bag for convenience. A 120 watt compressor (current 220 volt, 10 amps) maintains the contents of the sack at +5°F (-15°C). Temperature is controlled by a thermostat. The waste is frozen solid, like a block of ice, so there is no smell, and bacterial action stops. No water is used. When the bag is 2/3 full it is removed and sealed. Since the bags are biodegradable and no chemicals are used, they can be composted to give garden fertilizer. The body of the unit is of fibreglass, and the inner refrigerator-container is aluminum. Weight is 77 pounds (35 kg). A practical note: warm air, from the compressor, is streamed over the seat to keep it warm.

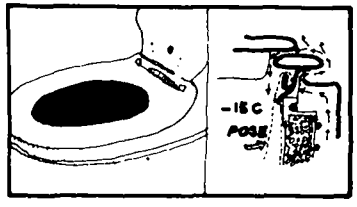






COMPOSTING BIN

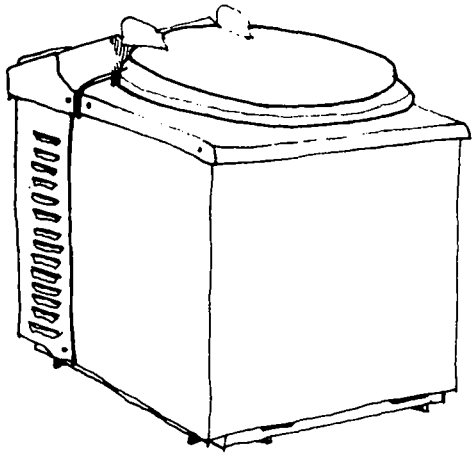


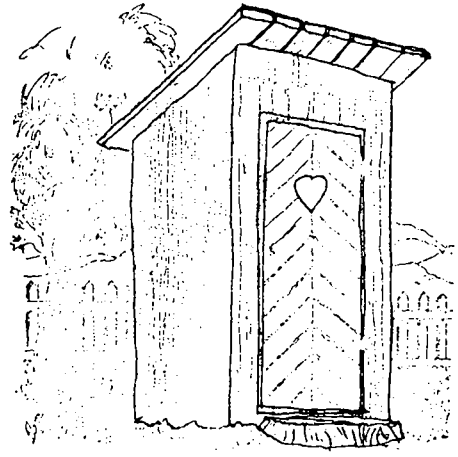


Manufactured by:
A.S. Elektrokjøp
Økernsentret,
Oslo 5, Norway.

Cost:

This toilet uses a 130 watt electrically-powered compressor which freezes the waste to +5°F (-15°C). The 5 gallon 22.5 litres disposable bag will accomodate an average family for 10-14 days. The toilet requires a space 16" x 24" (40 x 60 cm), and is made of stainless steel. The seat is warmed by hot air. The manufacturer suggests three methods of disposal: (1) Bury bag, in which case everything decomposes, (2) Composting and (3) Removal to treatment plant.





ELSTAR FRYSEKLOSETT

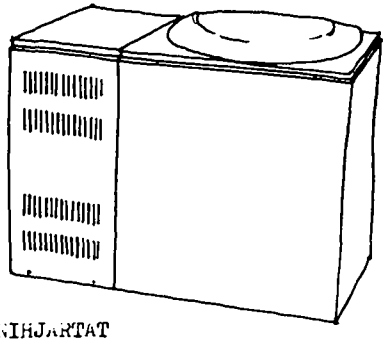
* MINIHJÄRTAT

MANUAL REMOVAL
3. Freeze Toilet

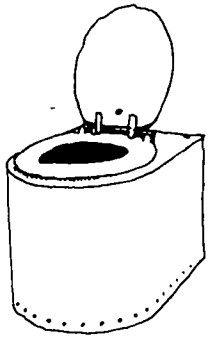
Manufactured by:
Osby-Pannan AB
283 00 Osby,
Sweden.

Cost: $383.00 (incl. sales tax).

This toilet operates on 220 v, and is rated at 150 watts. The capacity of the plastic bag is 9 gallons (40.5 litres). In case of a power-failure the contents will begin to smell after 24 hours and would have to be removed. Electrical cost is 3 cents per day (Sweden).



MINIHJÄRTAT



TE-BE

* TE-BE T-1970

MANUAL REMOVAL
3. Freeze Toilet

Manufactured by:
Te-Be Elprodukter
Fack 34
561 01 Huskvarna,
Sweden.

Cost: $336.00 (incl. sales tax)

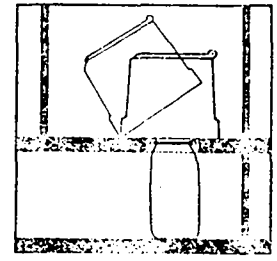
This toilet operates on 220 v, and is rated at 120 watts. The capacity of the plastic bag is 6.6 gallons (29.7 litres). Electrical cost is 3 cents per day (Sweden).

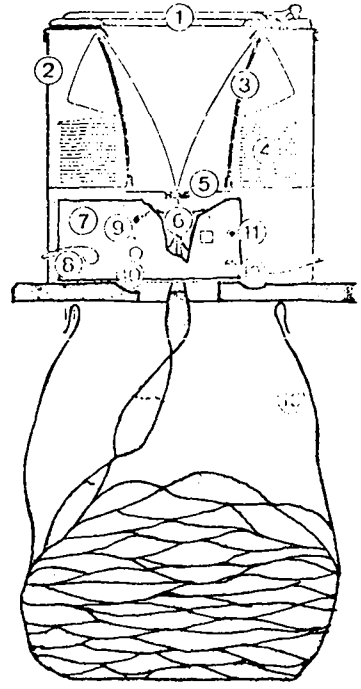
PACTO 101

Manufactured by:
Pactosan A/B
Box 100
71300 Nora Stad,
Sweden.

Cost: $621.00 (incl. sales tax)

This is really a sophisticated bucket toilet. The waste is collected in a plastic tube and is sealed after each use. The "sausages" fall into a removable plastic bag. The sealing of the plastic is by heat (200 v. simple phase) and the movement of the plastic is accomplished by a foot-operated pedal. A meter clocks the number of uses, and a warning light prevents use of toilet if plastic runs out. The unit, of polystyrene and metal, is portable and of particularly rugged design, as it is sold for building construction sites.





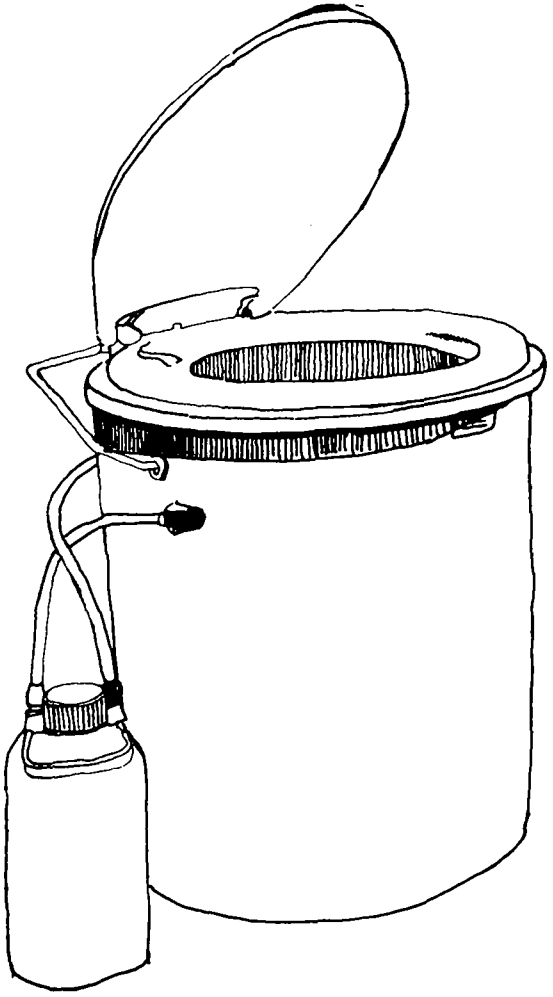
1. Lid and Toilet seat of plastic.
2. Outer container.
3. Removable bowl.
4. Endless plastic film.
5. Bottom plate with valve.
6. Rollers.
7. Electrical components.
8. Foot-pedal for feeding down.
9. Meter for number of uses.
10. Warning lamp.
11. Outlet for extra warning lamp.
12. Electrical cord 220 volts.
13. Garbage Bag.

* JETFLUSH MINOR

Manufactured by:
Racasan Limited
Cromwell Road
Ellesmere Port
Wirral
Cheshire L65 4DP
England.

Cost:

This is a portable toilet which weighs 18 pounds (8.2 kg) and is carried like a bucket. The waste falls into a chemical solution when a handle-operated flap is opened. Then the toilet bowl is cleaned by a perfumed sterilant, which is drawn back into the flushing bottle for re-use. The water pump operates from a 12 volt dry cell or car battery. The capacity is 100-120 average uses.



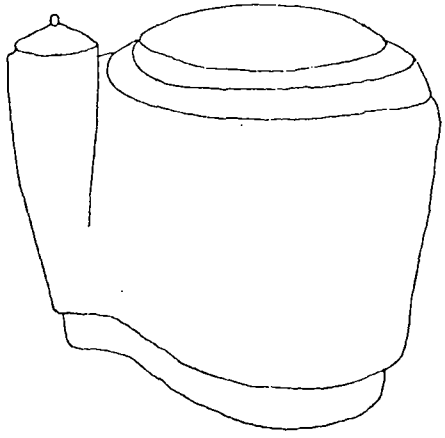
PERDI-SANFRESH
A perfumed sterilant for use with the Jetflush toilets.

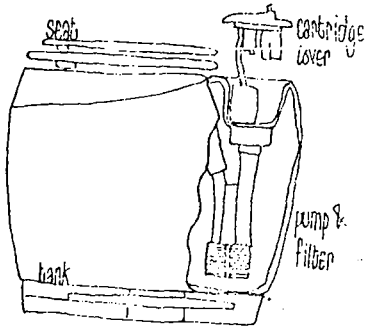
* MONOMATIC

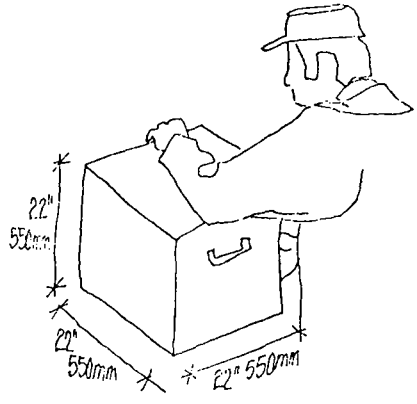
Manufactured by:
Monogram Industries Inc.
10131 National Blvd.
Los Angeles
California 90034, USA

Cost: about $195.00

This toilet is charged with 4 gallons (18 litres) of water and a chemical, which accomodates 100 uses before being replaced. The unit, originally developed for passenger airlines, uses a 12 v. electric motor to recirculate the fluid. It is mainly used in recreational vehicles. The unit is made out of plastic and weighs 35 pounds (15.75 kg) empty, and about 85 pounds (38.25 kg) when full.







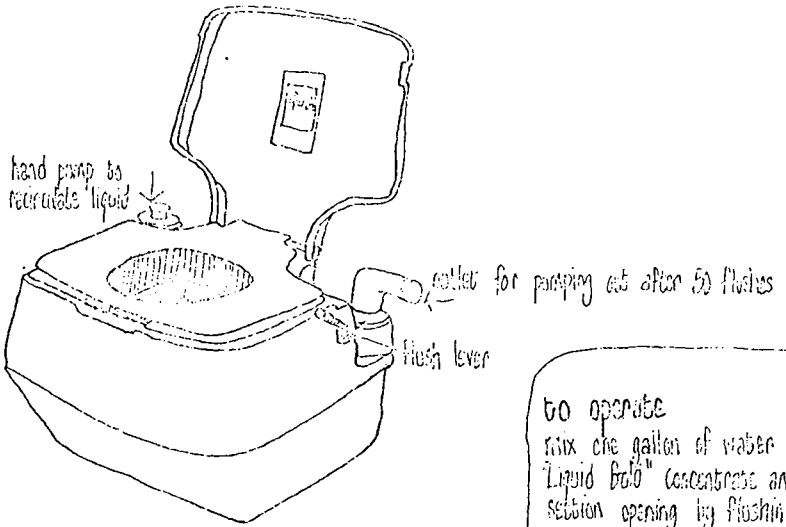
✱ POTPOURRI

MANUAL REMOVAL
5. Recirculating Chemical Toilet.

Manufactured by:
Sanitation Equipment Limited
Rexdale, Ontario,
Canada.

Cost: about $69.95

This portable chemical toilet is made out of polyethylene and weighs 11 pounds (4.95 kg). The initial charge of water allows, with added chemicals to inhibit decomposition and smell, up to fifty re-uses before the reservoir (6 gallons, 27 litres) must be emptied. Each flushing uses 1 quart (1.13 litres) of water. A manually operated handle opens the sealing trap and at the same time pumps water from the reservoir into the bowl. The pump contains a filter cartridge. The unit may be connected to a permanent water supply and used as a fixed toilet.



"POTPOURRI"

to operate
mix one gallon of water with 3 ounces of "Liquid Gold" concentrate and pour through bowl section opening by flushing the side handle. pump liquid into the bowl and flush. Repeat, to mix thoroughly. Before using, always pump liquid into the bowl. Flush dry when travelling.
NOTE: Use white toilet tissue only.

Cleaning
use only mild cleaners, detergents or soaps —avoid using abrasive cleaners. Clean the toilet bowl periodically as you would your household toilet.

instructions fixed to lid of unit.

✱ CRAFT TOILET

MANUAL REMOVAL
5. Recirculating Chemical Toilet

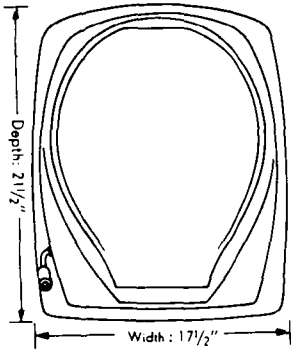
Manufactured by:
Craft
New York City
N.Y. USA.

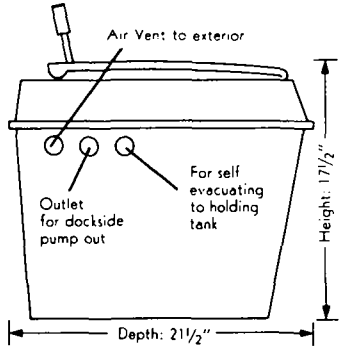
Cost: $215.00

This essentially fixed toilet is made out of fibreglas and weighs 40 pounds (18 kg). The 7 gallon (31.5 litres) capacity tank is initially changed with 3 gallons (13.5 litres) of water together with chemicals. An electric - motor powers a pump that re-circulates this fluid for flushing; an electrically powered macerator breaks down all solids into liquids. The unit can be used about 200 times before it needs to be emptied. Electricity is 12 v.

MARINE "HEADS"

craft
chemical recirculating automatic flush toilet





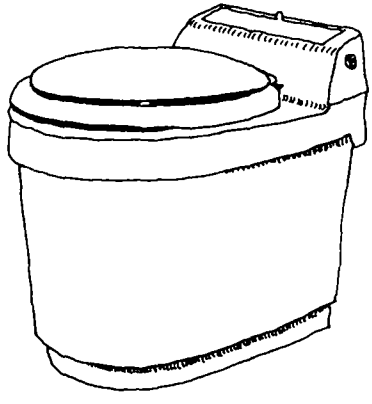
* OJO 7000

MECHANICAL REMOVAL
1. Vacuum Truck

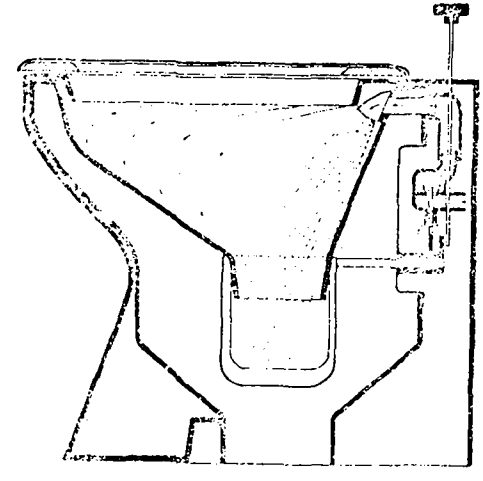
Manufactured by:
PLAST AB CIPAX
Bredaryd,
Sweden.

Cost: $546.00 (not included tank) (incl. sales tax)

The toilet is charged with 3 gallons(13.5 litres)of water, poured manually into a reservoir behind the seat. Waste falls directly into the tank. The bowl is cleaned with water which is recirculated for future use. A small amount of water, 3 ounces (0.1 litres), is left to form a water seal. Once a week the reservoir is emptied into the tank and refilled. Following each use, an electrically driven fan (35 watts) vents the tank. Water is sprayed into the bowl by an electric pump (40 watts). Both pump and fan are 24 v, from 220 v by a 100 watts transformer. The tank is emptied at intervals by a vacuum truck, or could drain to a tile-field. The unit is of polyethylene plastic.



OJO 7000



OJO 7100

* OJO 7100

MECHANICAL REMOVAL
1. Vacuum Truck

Manufactured by:
PLAST AB CIPAX
Bredaryd,
Sweden.

Cost: $364.00. (incl. sales tax)

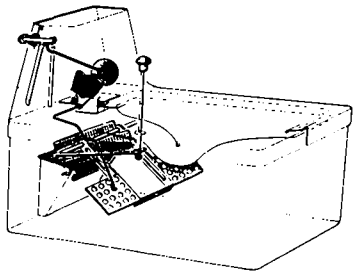
This unit is connected to a water-supply line and uses 1,5 pints (0.8 litres) each time the toilet is used, to clean the bowl. A small amount of this water forms a water-seal in the bottom of the bowl. Flushing is accomplished by lifting handle. No electricity or chemicals are used. The tank is vented, and must be emptied at intervals.

* TURQUO

Manufactured by:
Waterlo
41, Rue Censier
Paris 5e,
France.

Cost:

This is a "luxury" model designed in the so-called Turkish manner, probably the only healthful defacating position known to man. The unit is connected to a water-main and drained via a 1½"(38.1 mm)diameter pipe to the tank, vault or leaching, pit. The bowl is flushed by syphonic action of 2.5 gallons (12 litres) of water. Chemicals are added once a month. Overflow to the drain-pipe is automatic. The unit is of polyester plasitc and designed to be installed flush in the floor. It requires about 16" (40 cm) below the floor to accomodate the reservoir. There is no vent.



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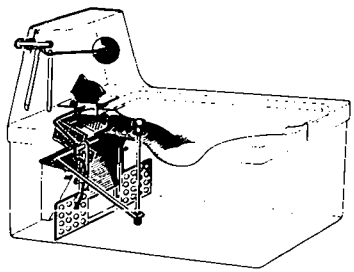

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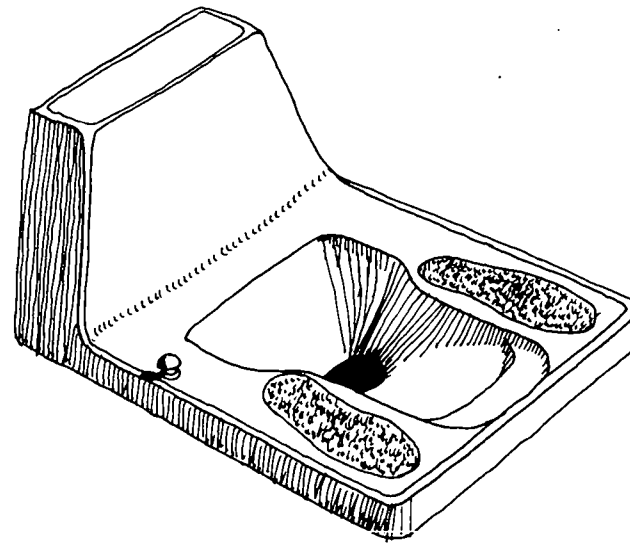


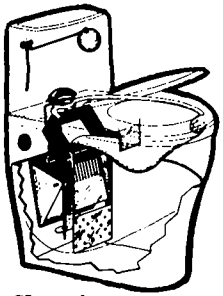
waterlo chimique

* MANOIR

Manufactured by:
Waterlo
41, Rue Censier
Paris 5e
France.

Cost: $272.00.

This is a "luxury" model designed to look, and function, somewhat like a flushing toilet. The unit is connected to a water main, and is drained via a 1½"(38.1 mm)diameter pipe, to a tank, vault or leaching pit. The bowl is flushed by syphonic action, unlike most chemical toilets, which requires more 2,5 gallons (12 litres) water for each use. Chemicals are added. When not in use a water-seal is effected in the bowl. The unit is of polyester plastic.



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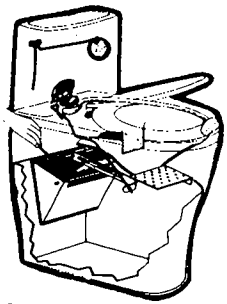

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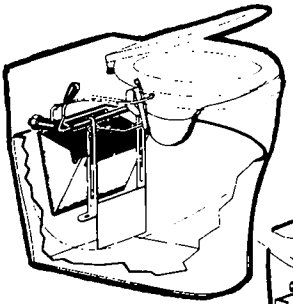
MANOIR



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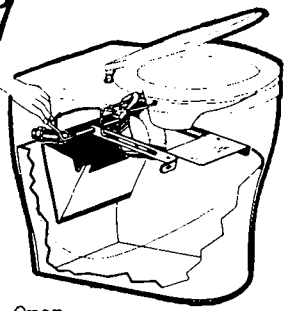


Open

CASTEL

* CASTEL

MECHANICAL REMOVAL
2. Chemical Privy

Manufactured by:
Waterlo
41, Rue Censier
Paris 5e
France.

Cost: $182.00

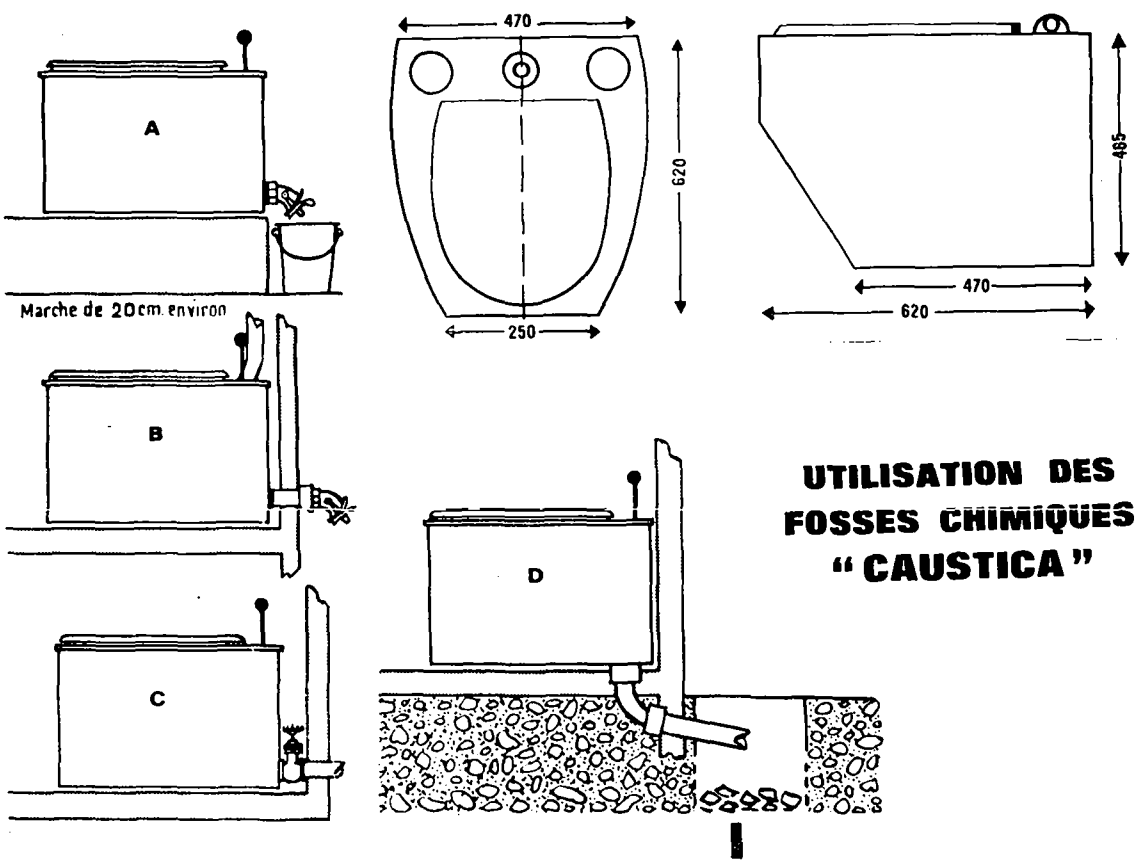
This is a fixed toilet that would be connected to a leaching-pit, tank or vault via a pipe network. It is connected to a water supply pipe by a 1½"(38.1 mm)diameter pipe, and uses 1 quart (1.1 litres) of water for each use, to rinse the bowl. An over-flow mechanism empties the reservoir as water is added. Chemicals are added to inhibit decomposition and thereby, smell. There is no vent. A water-seal is effected when the toilet is not in use. The unit is of polyester plastic.

✱ CAUSTICA 128

Manufactured by:
Etablissements P. Mimault
45, Rue du Fort
94400 Vitry Sur-Seine
France

Cost: $98.00

This is a vented chemical privy designed for fixed use, for 34 people. It is made out of enamalled steel and weighs 66 pounds (30 kg). The unit can be emptied manually into a bucket, or can be connected to a drainage pipe. A splash pan protects the user and is manually opened. This also moves a paddle in the bottom of the tank. The toilet is sealed when not in use. Water and chemical are added after each emptying. A smaller portable and lighter (44 pounds, 20 kg) model without any vent and for use by 1-2 persons, Caustica 65, is also made by this company for $63.00.

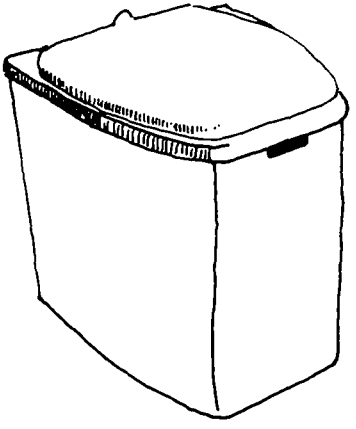


* CLOSENET STANDARD

Manufactured by:
Etablissements R.Derouineau
Moulin de Pelissey
33-Gradignan
France

Cost: about $50.00

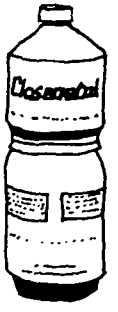
This is a fixed toilet which functions without any water and is connected to a holding-tank or leaching-pit. A constant level of water is maintained in the toilet. Chemicals are added at frequent intervals. Each time the seat is lifted it activates a pump, and 1-2 quarts (1-2 litres)of fluid are automatically pumped out. An equal amount of water is added after each use, to clean the bowl. The outlet pipe is small-diameter and can be connected to any drain. All parts are of plastic, and the toilet weighs 18 pounds (8.1 kg).



Désinfectant super concentré liquide assurant :
— Désodorisation absolue ;
— Destruction totale des germes microbiens ;
— Eloignement des mouches et autres insectes.

Utilisable dans les modèles portatifs BABY, PRATIC et JUNIOR.

Compte tenu des quantités infimes à utiliser, c'est le moins cher de tous les désinfectants connus.



Produit chimique composé, extrêmement puissant, assurant la dilution totale et la désodorisation absolue des matières.

Utilisable dans les modèles STANDARD et UNIVERSEL.

Conditionné en seau plastique étanche de 40 doses, contenant une pelle spéciale doseuse.

Après utilisation du produit, le seau plastique, de très bonne qualité, est récupérable et utilisable dans le ménage.

*BIO-FLO 512

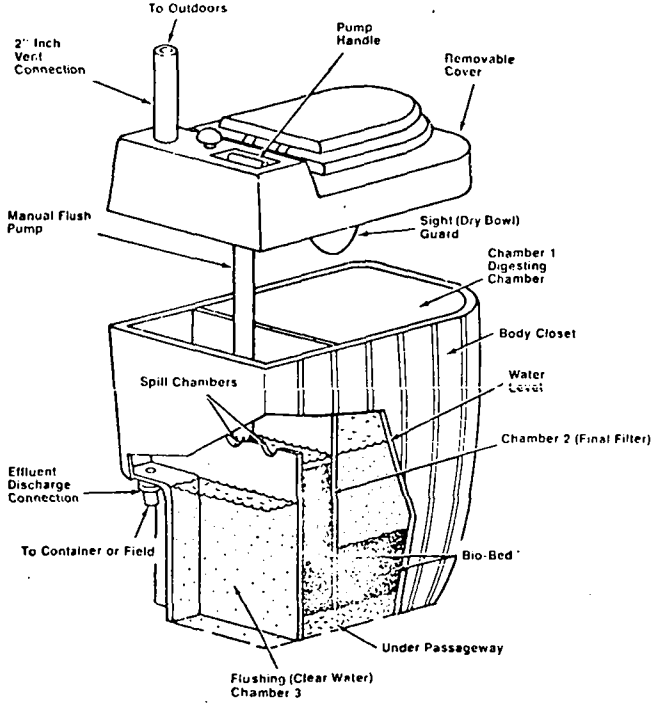
MECHANICAL REMOVAL
3. Recirculating Fluid Toilet

Manufactured by:
Pure Way Corp.
301-42nd Avenue
East Moline
Illinois 61244, USA

Cost: $329.00

Recent test installations in Maryland and Virginia have been failures due to problems with clogging and odours. The reasons for this are not yet clear

The toilet is manufactured from fibreglass and plastic.. The design of the unit provides a large compartment for the deposit of the body waste plus paper. Alternating layers of gravel and activated charcoal are placed in the bottom of this compartment. The liquid percolates to the second chamber which is similar, though smaller. The overflow from the second chamber flows through a weir to the third pump chamber, where it is manually pumped to flush the toilet bowl. The discharge flows via a fourth chamber to a tile field.
Once a week a packet is added to the first chamber of the unit, which consists of freeze dried aerobic and anaerobic bacteria and enzymes, which are intended to increase the bacterial and chemical action taking place.
The amount of effluent is very small, averaging 0.2 liters/person/day.
The operating cost is less than 4 cents per day; the activated charcoal and gravel ought to be replaced about every two years, at which time the unit is primed with 15 gallons of water. The unit has been tested with as many as 13 people using it at one time.

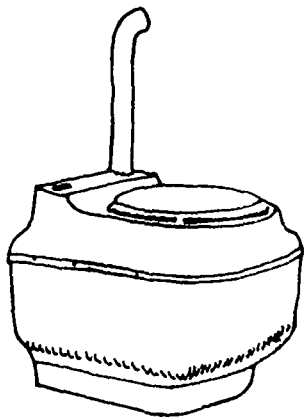


PURE WAY BIO-FLO

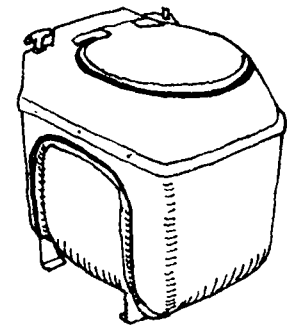
✻ BIOCYCLE MK 1

Manufactured by:
Biodynamics Ltd.
Camac Buildings
Ballymount Road
Clondalkin,Co.Dublin
Ireland

Cost: $230.00



MK 1



MK 2 (Portable)

This toilet is manufactured out of ABS plastic and contains four compartments which make up the filtration and recycling process. The same fluid is used for flushing the bowl. Digestant compound is added periodically to the first compartment. The manufacturer's brochure describes this as follows:

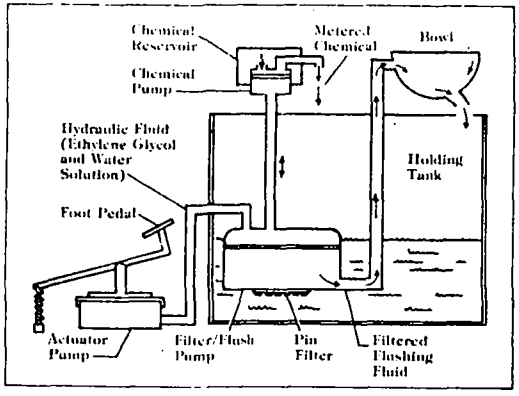
> "... selected micro-organisms, active enzymes, buffers, bacteria and activating agents effectively decomposes all organic waste-entirely within the unit itself. It completely neutralizes and liquifies human waste and the resulting effluent becomes clean, clear water."

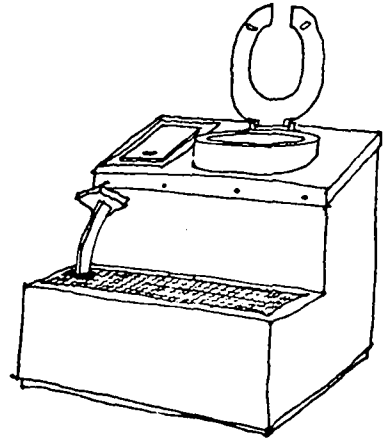
It is not made clear how this is achieved.

Manufactured by:
Monogram Industries Inc.
1945 E.223rd Street
Long Beach, Ca. 90810, USA.

Cost: NA

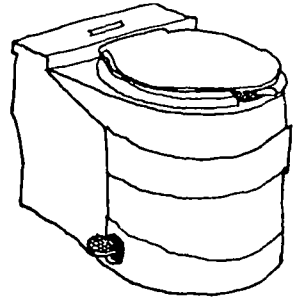
This recirculating system was developed from aircraft sanitation and is now used in commercial, industrial and recreational applications. When the flush pump (which can be manual or electric) is activated, fluid from the holding tank is combined with a measured amount of chemical from the reservoir, and is pumped to the bowl to flush the contents back to the holding tank. The treated waste accumulates in the holding tank, from which it is periodically removed. Depending on the model the system may be used from 160 to 1000 times before discharge. Fifteen gallons of water are used for 1000 uses, or about a tenth of a pint (0.07 liters) per use. The treated waste is removed, usually to a septic tank. The holding tank chemicals are claimed to be bio-degradable.





Model 601

Jet-O-matic



Model 621

✻ MAGIC FLUSH

Manufactured by:
Monogram Industries, Inc.
1165 East 230th Street
Carson, California 90745
USA.

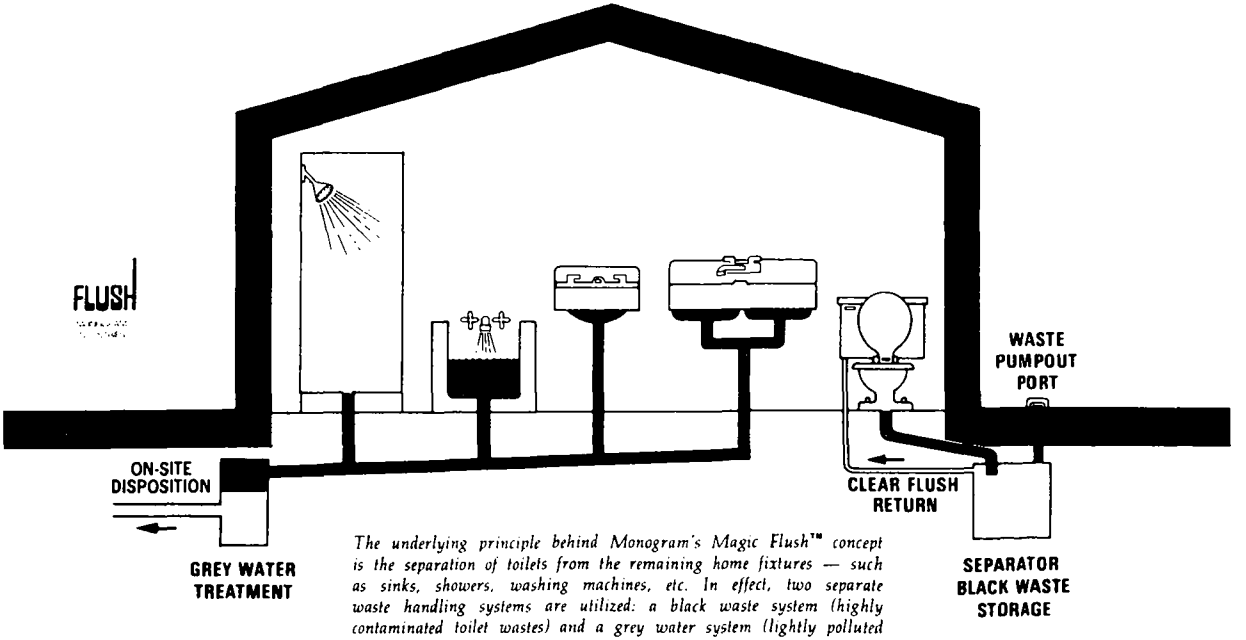
Cost : Not available.

MECHANICAL REMOVAL
3. Recirculating Fluid Toilet

This system is now in production in Canada by :
Monogram Sanitation Products of Canada Ltd.
3332 Mainway
Burlington, Ontario.

This system is currently being developed and is not yet on the market. An inert, water-white fluid is used with conventional flush toilets. It is absolutely immiscible to human waste, and is readily seperated from the waste and used over and over again for flushing. The seperated wastes are stored in a small tank for periodic collection by vacuum truck. It is estimated that a 320 gallon (1440 litres) will contain the waste of a family of four with semiannual service.

Magic Flush™ black waste system... sewerless house.



The underlying principle behind Monogram's Magic Flush™ concept is the separation of toilets from the remaining home fixtures — such as sinks, showers, washing machines, etc. In effect, two separate waste handling systems are utilized: a black waste system (highly contaminated toilet wastes) and a grey water system (lightly polluted bathing and wash water).

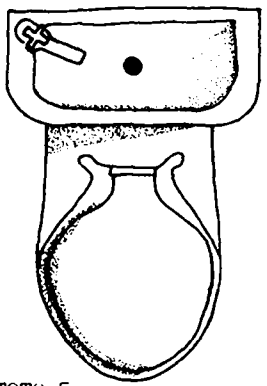
* TOTO 5

MECHANICAL REMOVAL
4. Water-Borne Network

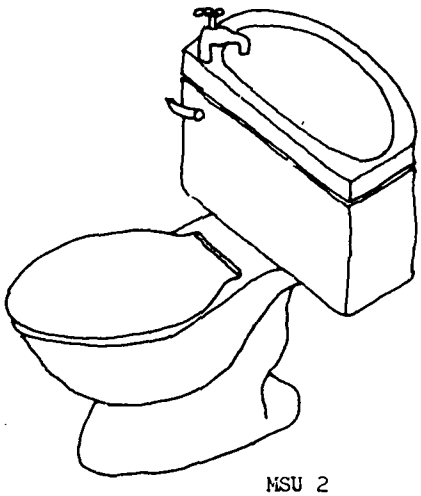
Manufactured by:
Toto Ltd.
458 Shinozaki, Kokura-Ku
Kitakyushu, 802 Japan.

Cost:

This is a conventional flushing toilet, except that the tank-cover is a wash-basin. That is, the dirty wash-water (grey-water) is used for flushing waste (black-water). The saving in water would be in the order of 25%, as well as there being a saving in cost and space, since two bathroom fixtures occupy the space of one.



TOTO 5



MSU 2

* M S U 2

MECHANICAL REMOVAL
4. Water-Borne Network

Designed by:
Minimum Cost Housing Group
McGill University
Montreal (1971)
Canada.

Cost: $50.30.

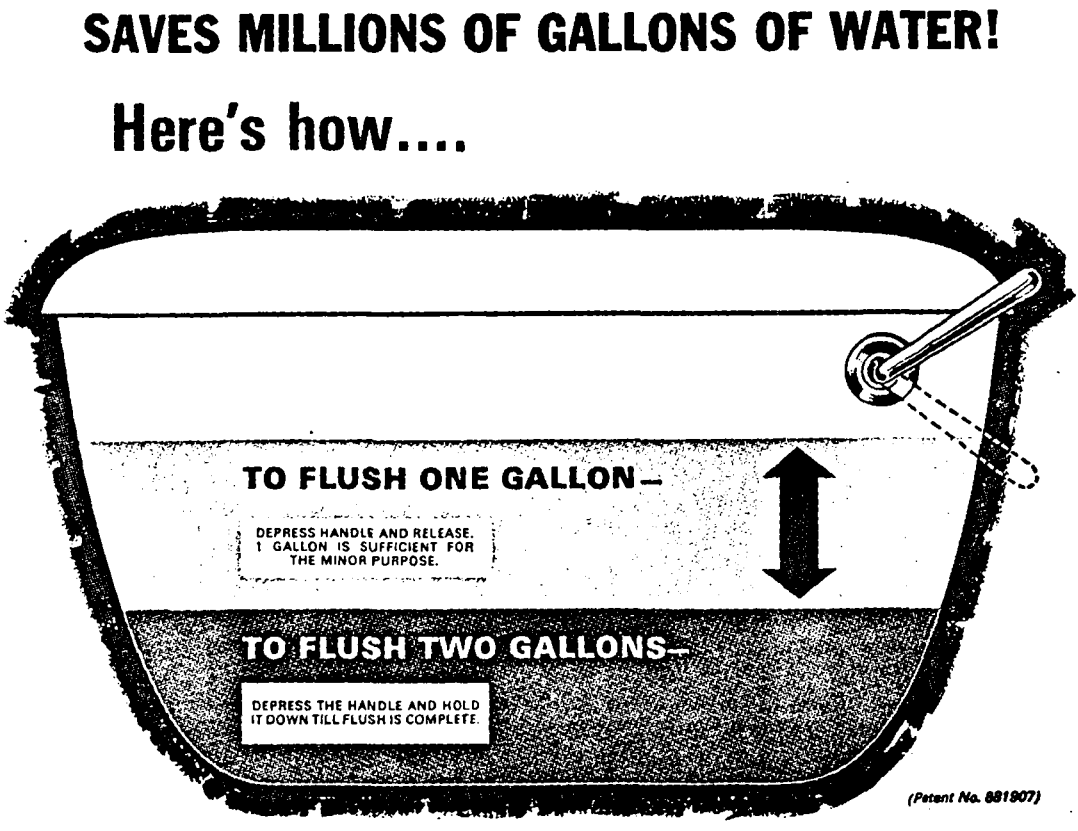
The Minimum Sanitary Unit 2 uses a wash-basin as a cistern cover. An experimental model was made out of sulphur concrete, but could also be in porcelain or fibreglass.

* DUAL FLUSH CISTERN

Manufactured by:
Ideal-Standard Limited
Ideal Works
Hull
England

Cost: about $17

The Dual Flush Cistern for water-borne networks is designed to save water while maintaining the advantages of flushing toilets. The cistern releases either one or two gallons of water according to requirements. One gallon is flushed if the cistern handle is released immediately after pressing down, two gallons if the handle is held down until the flush is completed.

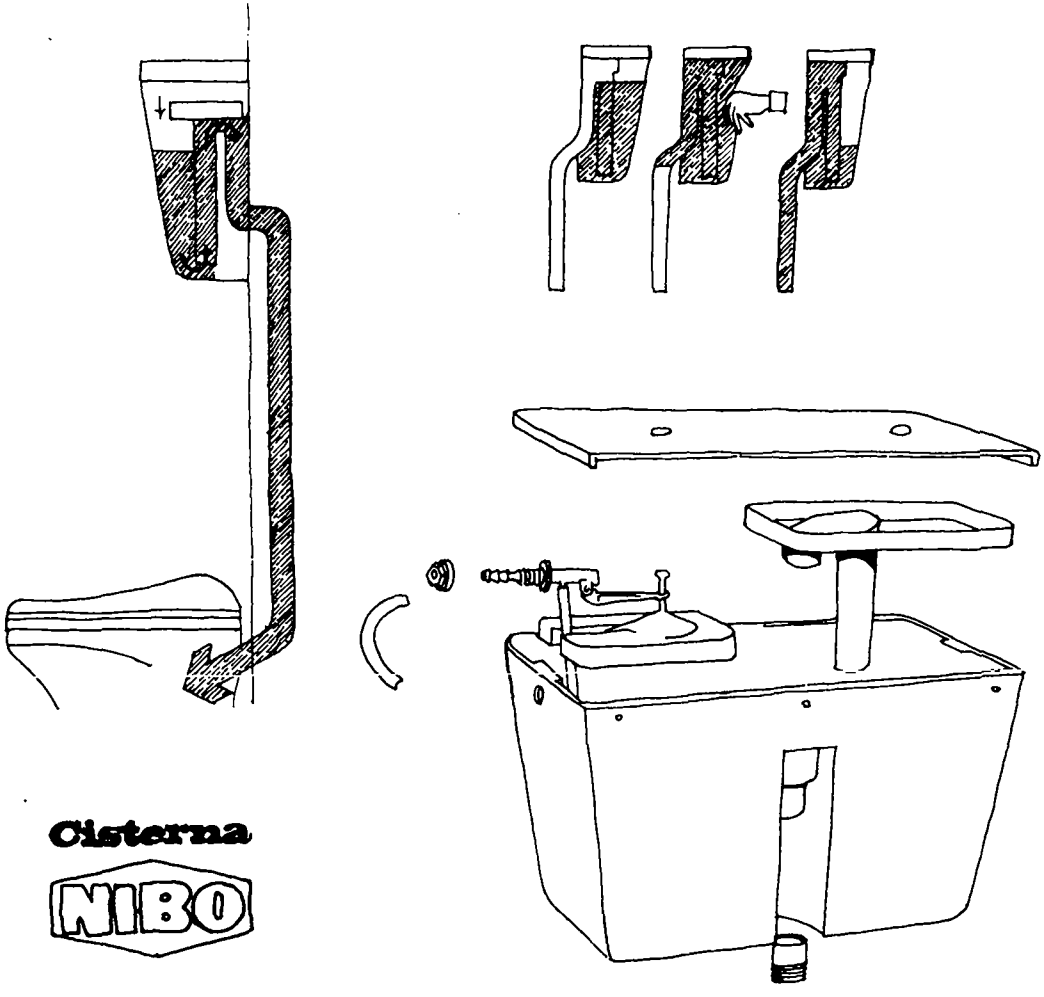


NIBO

Manufactured by:
Nibo Plast
Montevideo
Uruguay

Cost:

This cistern is made out of a flexible thermo-plastic and is designed to reduce the number of moving parts. To flush the toilet one presses against the body of the cistern by hand, and water flows into the down-pipe following the principle of physics of "connected vessels". This gives the user control over the amount of water flushed, whether for solid or liquid waste. In addition, this type of cistern will not waste water through slow leaking, or if the handle is kept down, as conventional models sometimes do.

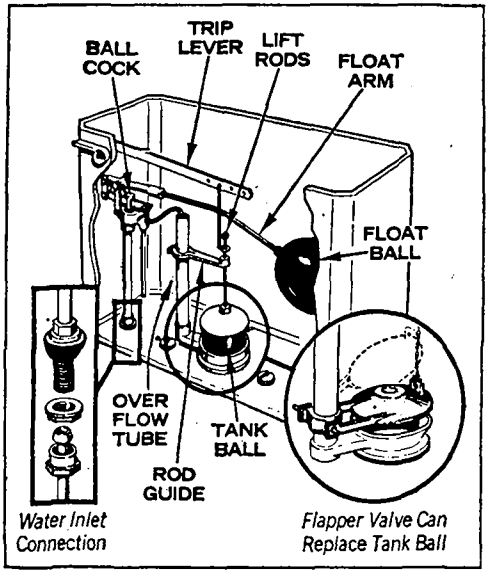


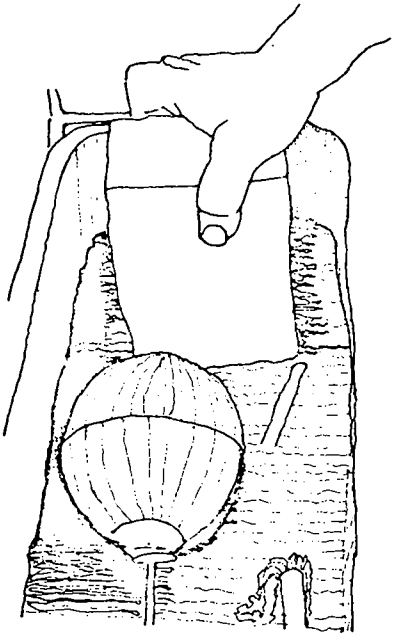
✱ BRICK-IN-THE-TANK

Do-it-yourself method
for saving water.

Cost: $0.06.

CHERRY HILL, N.J. (Associated Press). -
Six months ago, Tilly Spetgong, a serious gal with a goofy idea, walked into city council carrying a brick. Councilman Steve Morgan ducked under his desk.
"He must have thought I was going to throw it," she said, "but all I wanted was to put one into every toilet tank in town." The unusual proposal to save water stunned the council, but it was approved. And it so convulsed this residential community of 65,000 across the Delaware River from Philadelphia that it swiftly assisted the scheme - to become probably the first with a brick in nearly every toilet.
The idea is that the brick will take up space in the toilet tank, displacing a small amount of water that is not necessarily needed for flushing.
"It was wacky idea that got people laughing, and also made them aware that people pollute and people can conserve," said Mrs. Spetgong, a 44-year-old mother of two who used to raise chickens and now, admittedly, "raises the dickens" as a member of the conservation advisory board.
The council anteed up 32,000 to by 34,000 hardened bricks, the kind that won't break up in any kind of water and enough for every toilet in the town's 17,000 homes.
Last weekend, about 175 persons distributed 27,000 bricks, two to a house. They will finish this Saturday.
Mrs. Spetgong said: "If the average family of four flushes a total of 20 times a day we would save 34 million gallons of water every year in Cherry Hill."

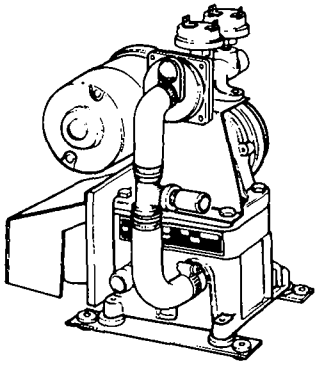


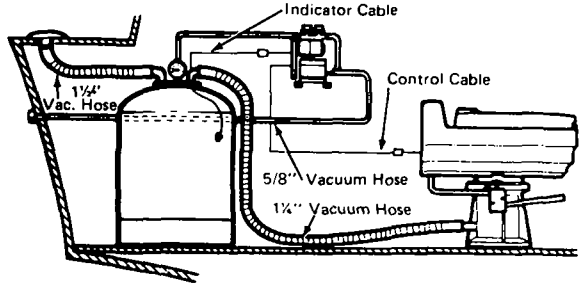


Manufactured by:
Mansfield Sanitary, Inc.
Perrysville
Ohio 44864, USA

Cost: $710.00

This is a marine sanitation system that operates on small quantities of water (1 liter) for flushing by using a vacuum to move the waste through small diameter pipes, irrespective of gravity.

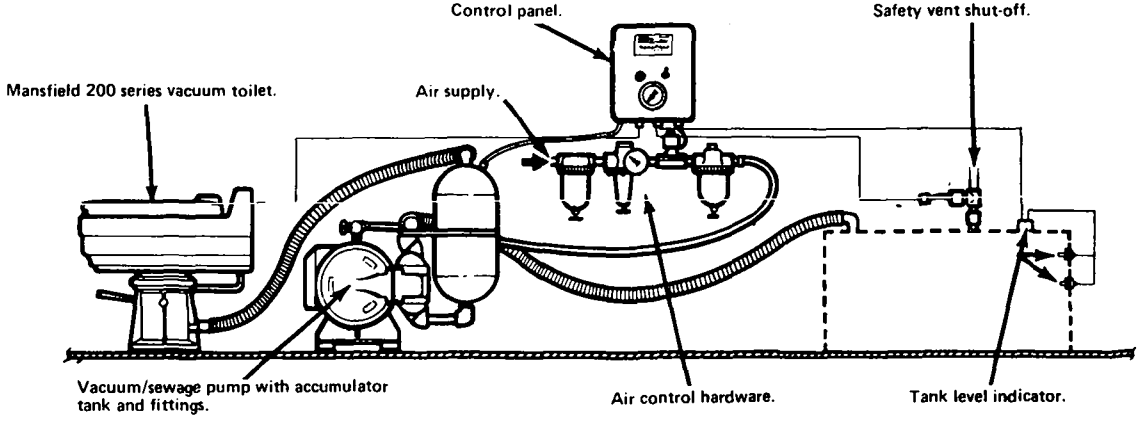




SINGLE PUMP
MODEL 5862

DELUX VACU-FLUSH COMMERCIAL SANITATION SYSTEM.

The standard commercial system includes three toilets and the below control hardware.



ELECTROLUX VACUUM SEWAGE SYSTEM

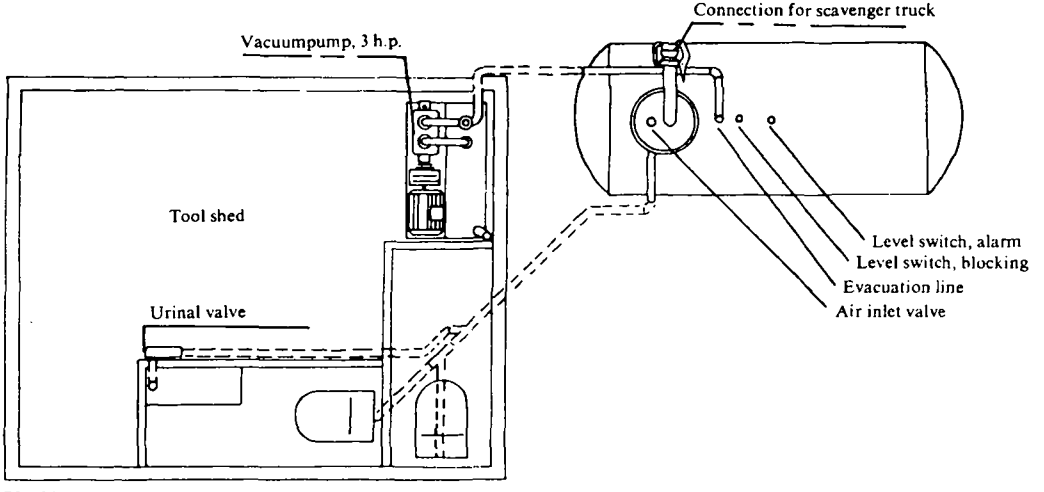
Manufactured by:
Electrolux
Environmental Systems Division
S-105 45
Stockholm
Sweden

Cost: 1 toilet - $1177 (incl. sales tax) 5 hseholds - $4190 (incl. sales tax)
2 toilet - $1738 (ditto) 10 hseholds - $6579 (ditto)

The Electrolux Company in Sweden has developed a Vacuum system in the early 1950's, which is a method of transporting sewage by vacuum, thus eliminating a large volume of the normal flush water found in flush toilets.
The system has been applied at several different scales: in passenger railway cars of the Swedish State Railways, in a camping site with 83 toilets, and a small community of 273 houses.
The greatest advantages of this system are - the small amount of water used and consequently less waste to remove from holding tanks; less excavation, smaller diameter piping required; smaller holding tank required. It is estimated that a vacuum system is 25%-40% cheaper than a gravity system.

The Kvarnviken installation consists of two vacuum toilets and a vacuum urinal which are connected to a 3 m³ tank. The plastic pipes are 63 mm in diameter.

The installation is operated by a 3 hp vacuum pump. The 13 m² building provides additional storage space.



PLAN

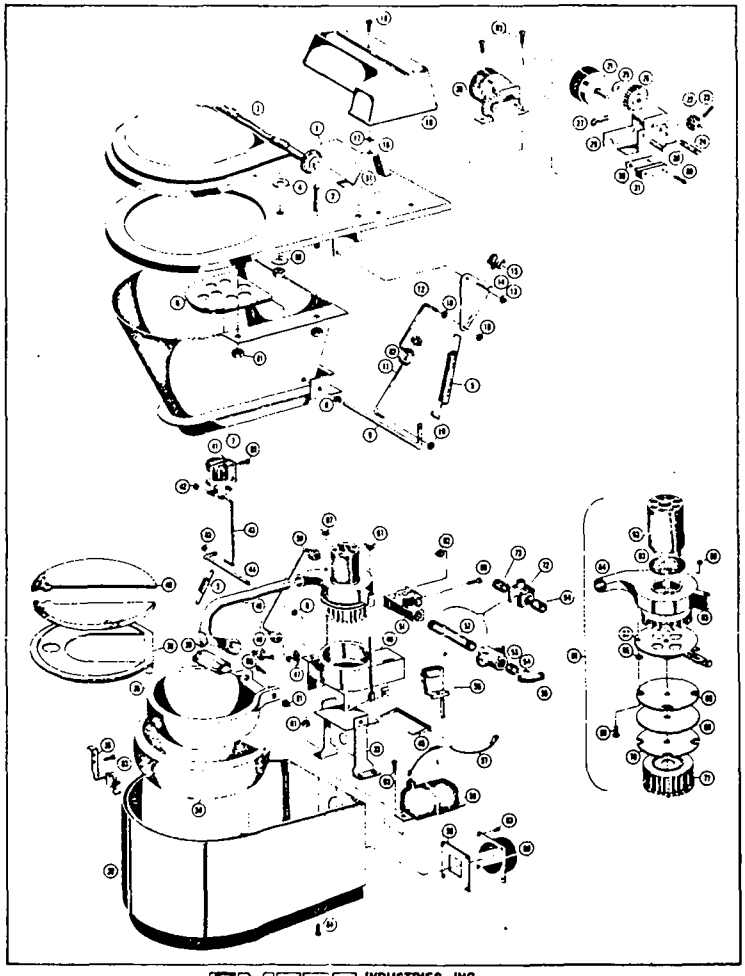
* DESTROILET

Manufactured by:
La Mere Industries Inc.
Walworth, Wisconsin 53184, USA.

Cost: $465.00

A number of models are available, differing only in the power source-propane or natural gas, and 115 v. A.C. or 12 v. D.C. Electricity is used to power a blower that evacuates smoke and cools down the unit. Gas is used as fuel to burn the waste. The unit is built of porcelain enamel and steel and weighs 100 pounds (45 kg). With 4-6 people, the ashes will have to be cleaned out weekly. Each cycle uses one quarter pound of gas, and the capacity of the system is about 60 uses a day.

EXPLODED VIEW



LAMERE INDUSTRIES, INC., WALWORTH, WISCONSIN 53184

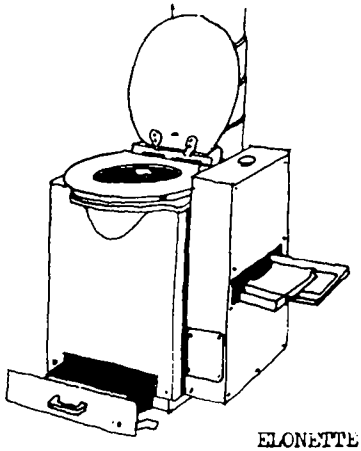
DESTRUCTION
1. Incinerating Toilet

* ELONETTE

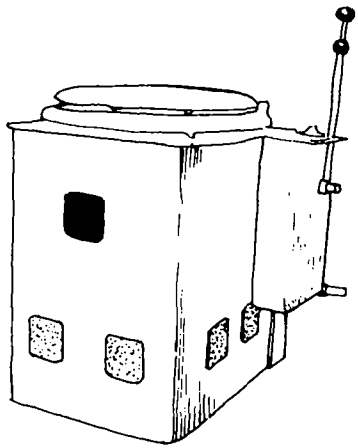
Manufactured by:
AB Elonette
Grevgatan 50
114 58 Stockholm,
Sweden.

Cost: $364.00 (incl. sales tax)

This unit (2200 watts, 220 v. 1-phase) has a 30 minute burning cycle, and no cooling cycle. Special paper bags, with small amount of sawdust, are used to protect the bowl and facilitate burning. Operation cost is about 4 cents per visit (Sweden).



ELONETTE



TOARETT

* TOARETT

Manufactured by:
Ageno Produktions AB
Knistallvagen 56
126 41 Hagersten,
Sweden.

Cost: $325.00 (incl. sales tax).

This incinerating toilet operates on gas. The burning time is only 8 minutes, and produces little odour. Operating cost is 8 cents per visit (Sweden).

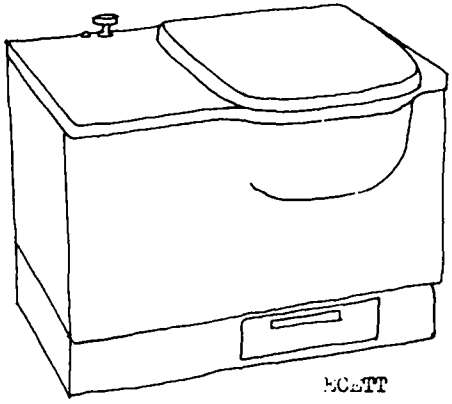
* SCOTT

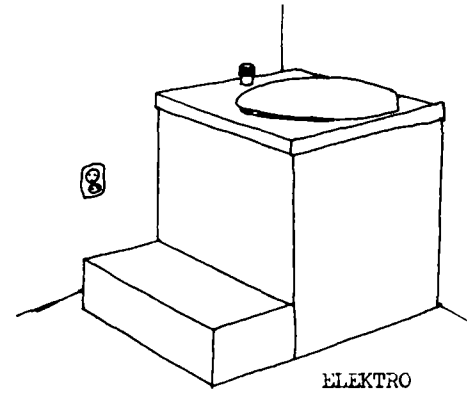
DESTRUCTION
1. Incinerating Toilet

Manufactured by:
AB Eskilssons Industrier
Box [illegible]
[illegible] 00 Amal,
Sweden.

Cost: $781.00 (incl. sales tax)

This combustion toilet is electrically powered (3-phase 380 v. or 3-phase 220 v.) and has a 40 minute burning time plus 30 minute cooling period, (fan). One burning cycle can accomodate up to 4 visits. A special bag is used to protect the bowl, and is incinerated together with the waste. Some nuisance is caused by the odour of the smoke. Swedish authorities do not allow incinerating toilets where the house is less than 640 feet (195 m) from the nearest neighbour. Operating cost is about 6 cents per visit (Sweden).





* ELEKTRO STANDARD

DESTRUCTION
1. Incinerating Toilet

Manufactured by:
Elektro Standard AB
Box 26
641 00 Katrineholm,
Sweden.

Cost: $847.00 (incl. sales tax)

The burning time of this unit is 30 minutes plus 45 minutes cooling-off (fan). Burning is repeated from the start for visits made during the burning period. Special paper inserts are used. Electrical cost is about 5 cents per visit (Sweden). Burner - 2700 watts, fan - 70 watts 3-phase 380 v.

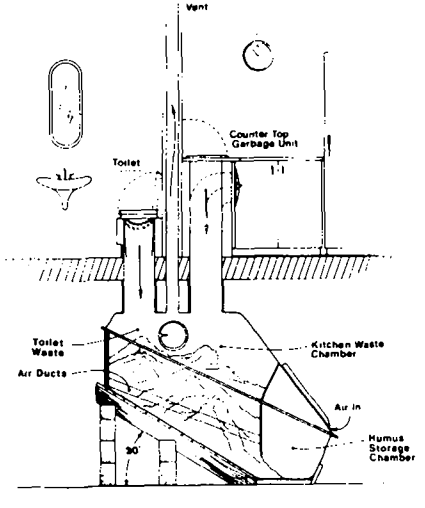
Manufactured by:
Clivus AB
Tohstigen 6
S-13500, Tyresoe, Sweden.

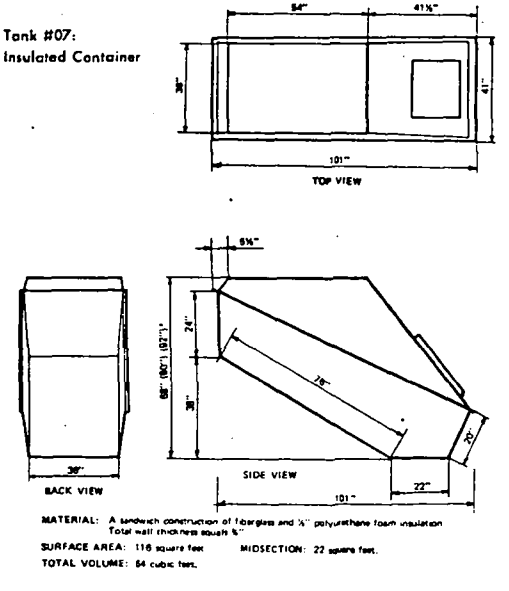
In Canada:
Crowdis Conservers
MacMillan Mountain Road
RR 3, Baddeck, Cape Breton
Nova Scotia, B0E 1B0, Canada.

In USA:
Clivus Multrum USA, Inc.
14A Eliot Street
Cambridge, Mass. 02138, USA.

Cost: $1600-$1800.

This is a system for the biological decomposition of organic waste, with a buil-in garbage chute and toilet. It consists of chutes from the kitchen and toilet, an exhaust ventilating stack and a decomposition chamber. It will handle all solid and liquid human wastes (though not the greywater) as well as kitchen garbage. The output is called humus, and can be used as a soil conditioner. The entire unit is of fibreglass and was originally developed for remote Scandinavian holiday houses.The chamber is large enough to store waste from 4-6 people for several years before humus is removed.The addition of a mid-section that enlarges the container increases the capacity to 10-12 people.





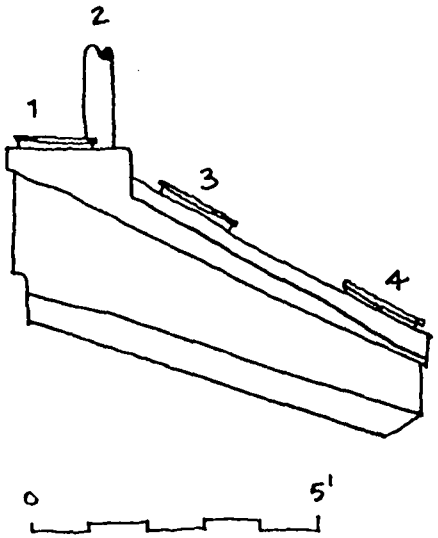
* MULLTRUMMAN

Manufactured by:
Polypur AB, Stockholm, Sweden.

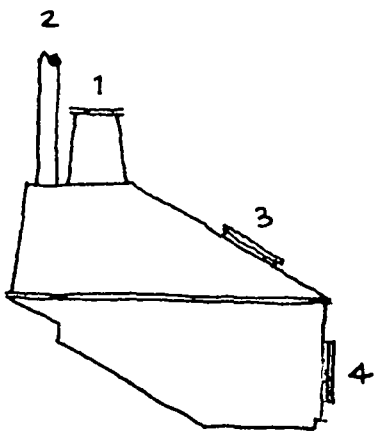
Cost:Unknown

This fibreglass composting toilet follows the principles established by the Clivus, but with a significant reduction in size. It is designed to sit half-in and half-out of the house, and does not require a toilet stool.

MULLTRUMMAN



TOA-THRONE



legend

1 toilet
2 vent
3 organic waste
4 compost hatch

* TOA-THRONE

Manufactured by:
Adeceka, Goteborg, Sweden.

Cost: Unknown

The smallest of the Clivus inspired fibreglass composting toilets, it is only four feet (1.6 m.) long. Air intake is from the bottom.

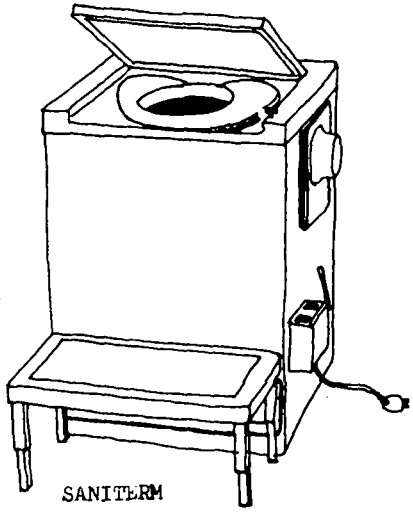
* SANITERM

DECOMPOSITION
1. Compost Privy

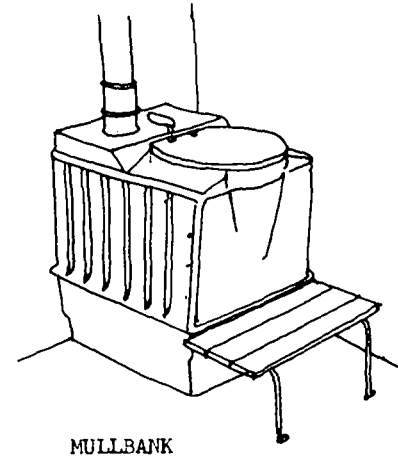
Manufactured by:
AB Electrolux
Luxbacken 1
112 62 Stockholm,
Sweden.

Cost: $742.00 (incl. sales tax).

This toilet dries and decomposes the waste by recirculating heated air. After 4 - 8 weeks the "ash" is moved to the rear of the decomposing by means of a hand-operated mill. When the dried material is re-moistened (by urine) there is some smell, but no pathogenic growth. In any event, no odours enter the bathroom, and the vented air is first passed through a charcoal filter. Electricity cost for average use is 24 cents per day (Sweden).



SANITERM



MULLBANK

* MULLBANK

DECOMPOSITION
1. Compost Privy

Manufactured by:
Inventor AB
Prastgatan 42
831 00 Ostersund,
Sweden.

Cost: $308.00 (incl. sales tax).

The decomposition of waste is accelerated by electrical heating coils in the bin. Decomposition is not total, and the ash, which should be removed twice a year, should be composted or mixed in garden-soil, to complete the process. Electricity cost for average use is 6 cents per day (Sweden).

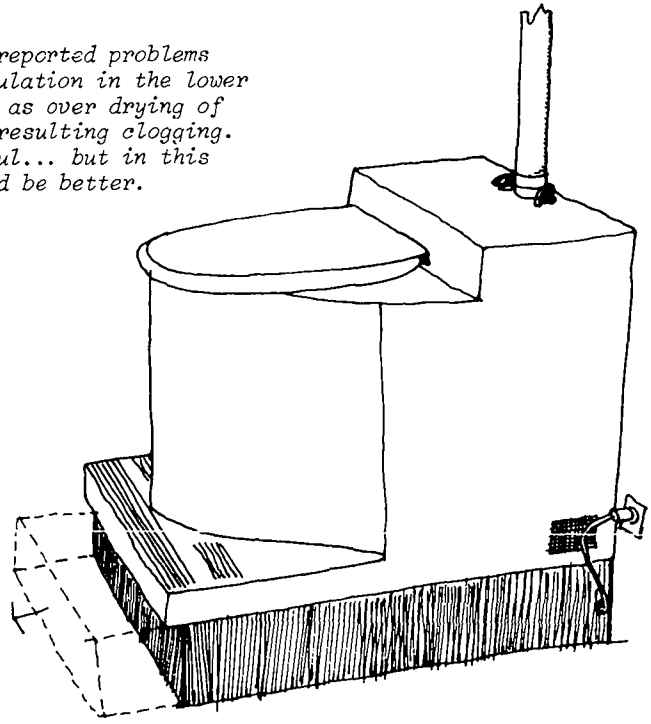
* MULL-TOA

Available from:
Hans Kr. Nielsen
Sørkedalsveien 22
Oslo 3, Norway.

Cost: about $350.00. (incl. sales tax)

This is a composting toilet that uses a stream of warm air to effect the aerobic decomposition of the waste. A 180 watt motor (running at 42 v. via a transformer from 220 v) re-circulates warm air though the waste up to 250 times. As the air becomes saturated it is automatically discharged through a ventilation stack. The system moves 42 c.f.m. (1200 litres/minute) at 86°F (30°C), ideal for microbiological growth. All liquid waste is vented with the saturated air. For a family of 3-4 persons, the drawer would have to be emptied once a year. The resultant mould is suitable for fertilizer. No water or chemicals are added. Kitchen waste may be put in the toilet to encourage microbes. At least 28" (71 cm) clearance is required in front of the toilet for the pull-out drawer. The body is of polyethylene plastic.

There have been reported problems with urine accumulation in the lower chamber, as well as over drying of solid waste and resulting clogging. Small is beautiful... but in this case bigger would be better.



MULL-TOA

✻BIO-SYSTEMS

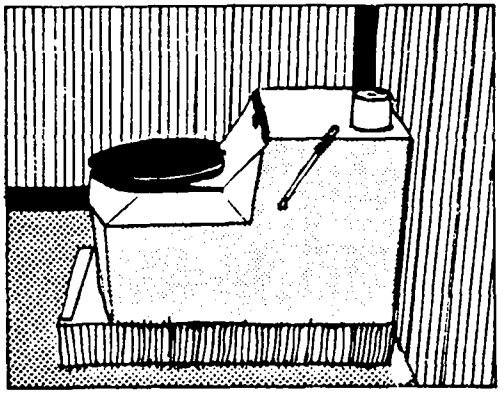
DECOMPOSITION
1. Compost Privy

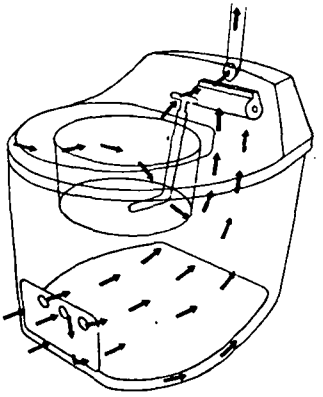
Manufactured by:
Bio-Systems Toilets Corp.Ltd.
255 Gladstone Street
Hawkesbury, Ontario, K6A 2G8, Canada.

Cost: Model A - $949.00; Model M - $749.00.

This small composting toilet contains a heating element and an electric motor which drives a fan. There is a rotator that serves as a stirrer, and is either manual (Model M) or motor-driven (Model A).The rotator is actually a drum that makes one complete revolution each time the toilet is used, and ensures even distribution of the excrement.The capacity of this toilet is three persons for long-term use.One pound of humus-soil "starter" is added to the unit each year. The manufacturer recommends burying the product from the toilet one foot below ground in the garden. The unit weighs approximately 110 lbs(51 kg), is 22" (56 cm) wide, 42" (108 cm) long and 32"(81 cm) high.

MODEL M





✻TROPIC

DECOMPOSITION
1. Compost Privy

Manufactured by:
Monogram Sanitation Products of Canada Ltd.
441 Wyecroft Rd.
Oakville, Ontario, Canada.

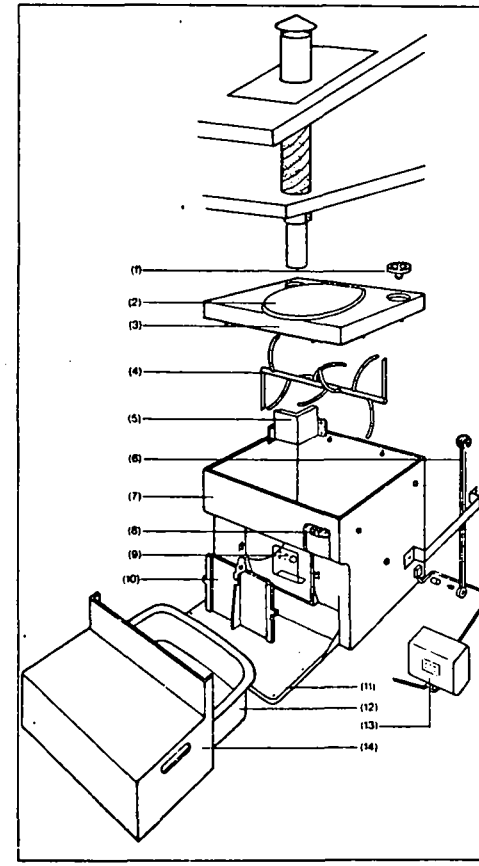
This unit utilizes an electric fan and heating coil. A levelling mechanism is hand operated. The unit weighs 33 lbs (15 kg).

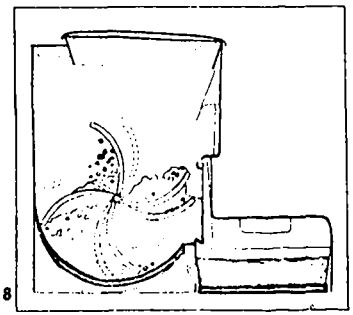
Manufactured by:
AB Gustavsbergs Fabriker
Fleminggatan 62B, Box 12159
10224 Stockhom 12, Sweden.

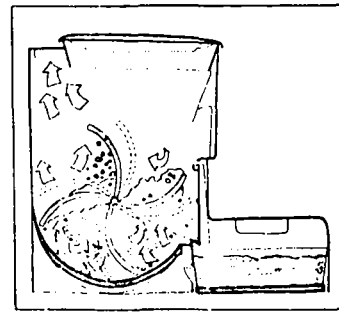
Distributed in Canada by Crowdis Conservers , in the USA by Clivus Multrum USA Inc. (see pp.53).

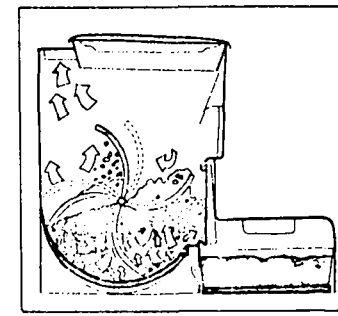
Cost: $ 795.00

This composting toilet (marketted originally as "Mulltoalett" in Sweden) incorporates a manually-operated rotor that prevents solidification of the wastes; a common problem in small composting toilets with electric heaters and fans is de-hydration and "cementification" of the excreta. The heater maintains a steady temperature of 30°C. When the storage chamber below the seat is full the partially composted material is moved to the pasteurization chamber located below the footstool. Here it is heated to 70°C for about 6 hours, and all bacteria and parasitic eggs are destroyed.









Source:
"Drum Privy Guidelines"
By Steve Matson & Peter Warshall
Box 42, Elm Road, Bolinas CA 94924, USA

Cost: (Materials) $50.00

This design utilizes oil-drums as the composting container. The drum is wheeled up on a dolly, located below the toilet seat, and jacked-up tight against the underside of the floor. When full the drum is set aside for further composting. A certain amount of aeration is achieved. The urine input should be minimized, according to the designers, or a drain should be provided. Each time the toilet is used about 2 cups of wood chips are added to the drum.

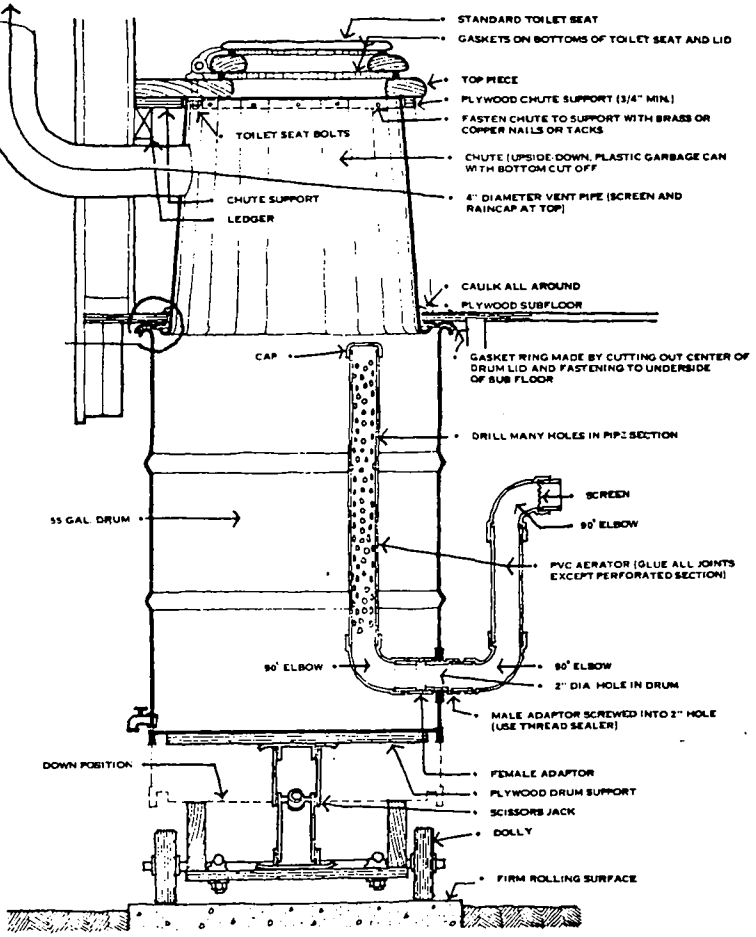


FIG. 1 CROSS SECTION
MATSON DRUM PRIVY

✱ MULTRUM

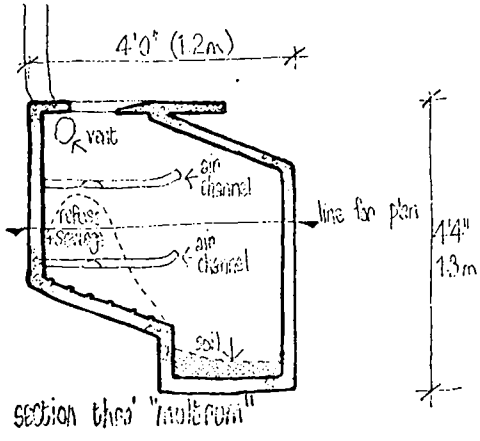
DECOMPOSITION
1. Compost Privy.

Designers:
SCAN PLAN
3 Sankt Kjelds Gade,
DK-2100 Copenhagen,
Denmark.

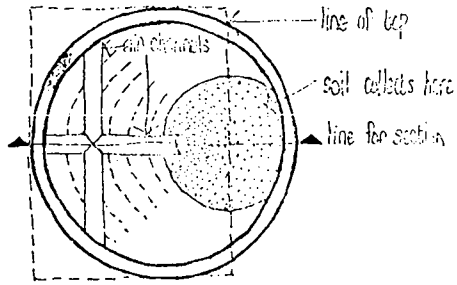
Cost: Unknown.

As far as we have been able to ascertain, no working model of this design has been built, so the operational capability remains unknown. The small size of the chamber could cause problems.

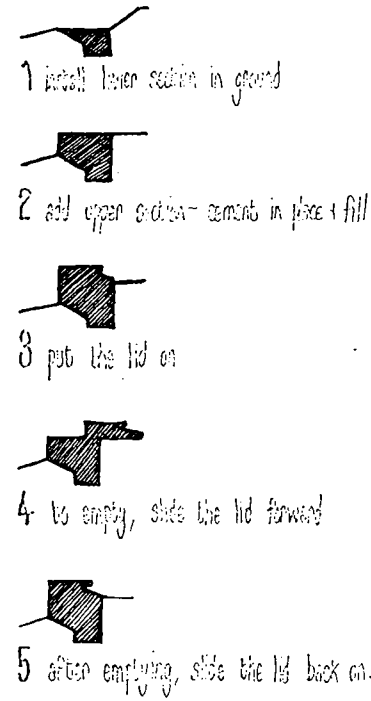
The Multrum devise for biological destruction of human waste was invented in Sweden about 30 years ago. The version shown here was developed by SCAN PLAN for use in African communities. It uses simple materials and techniques. Water is supplied by the urine and human and kitchen wastes mix with a layer of peat, grass or leaves. Humidity and carbon dioxide are vented out. The aerobic process is supplied air by the channels. The volume of the refuse is reduced to 10% of the original, and slides to the lowest part of the container. The residue, consisting of soil, humus and nutritive salts, is removed once every one or two years, to be used as fertilizer. No water, power or chemical is used.



section thro' "multrum"



plan of "multrum"

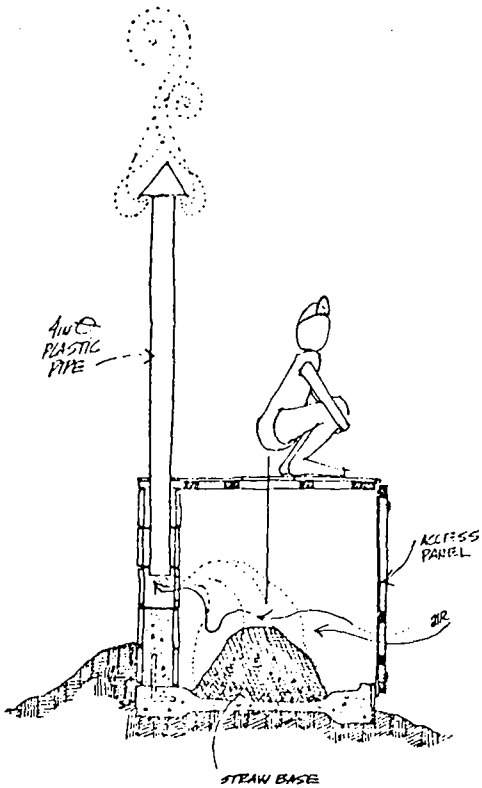


DECOMPOSITION
1. Compost Privy

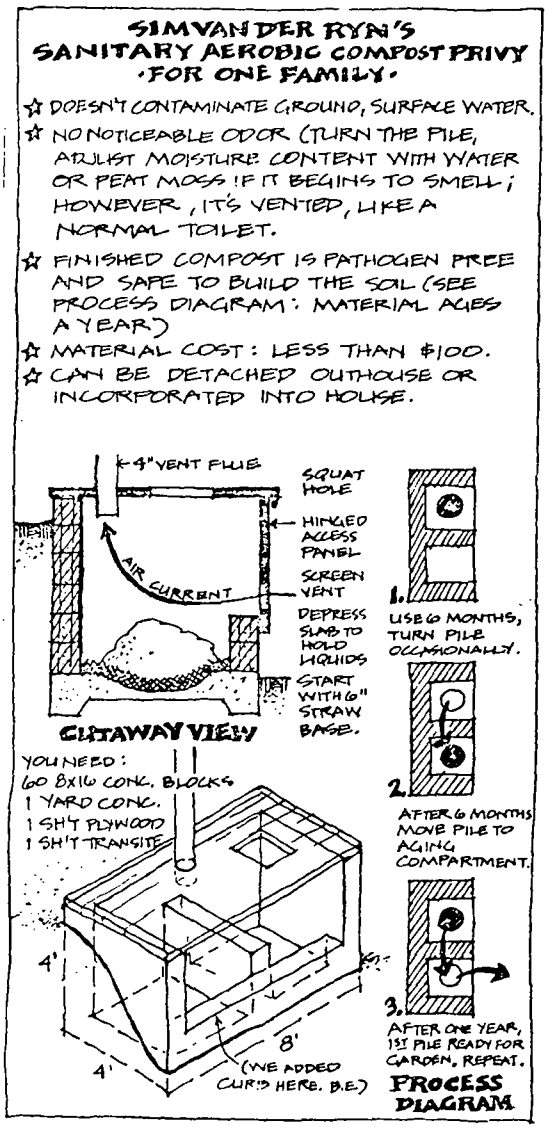
Designed by:
Farallones Institute
Point Reyes Station
California 94956, USA

Cost: under $100.00
Plans available from above address for $1.50 postpaid.

This do-it-yourself toilet is most suitable for a rural location, both because of its area, and the operation (the manure requires to be turned once a month). Simple and cheap.



A number of these have been installed in northern California. As little urine as possible should be introduced into the composting chamber, and with good management this model seems to be working out well.

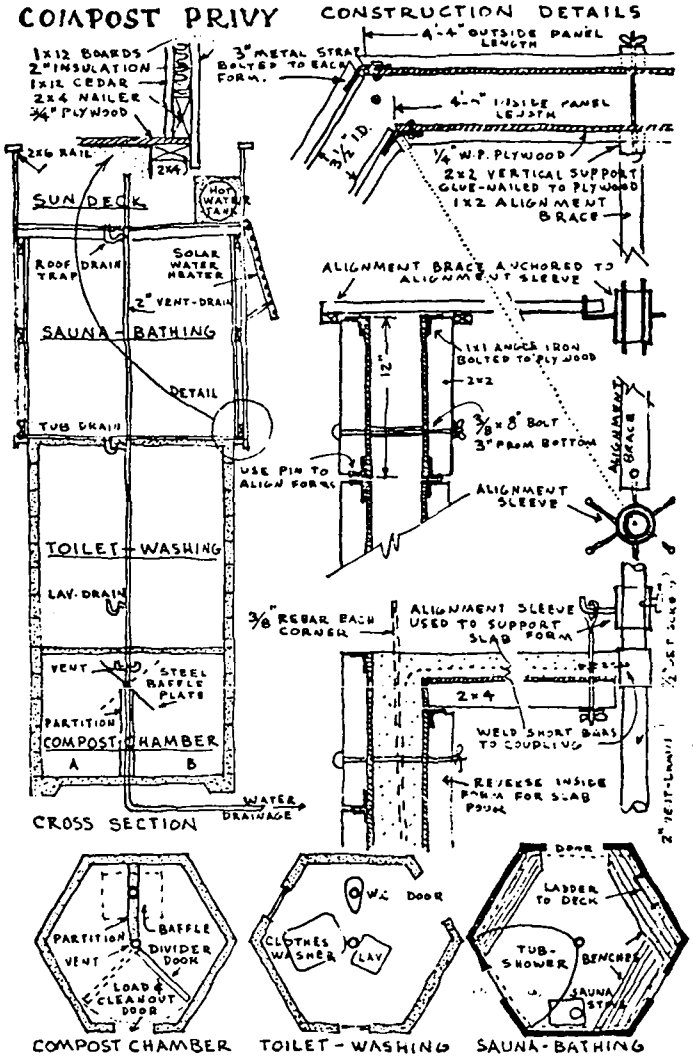


KERN COMPOST PRIVY

Designed by:
Ken Kern
P.O.Box 550
Oakhurst
California 93664, USA

Reference:
The Owner-Built Homestead
by Ken Kern 1974

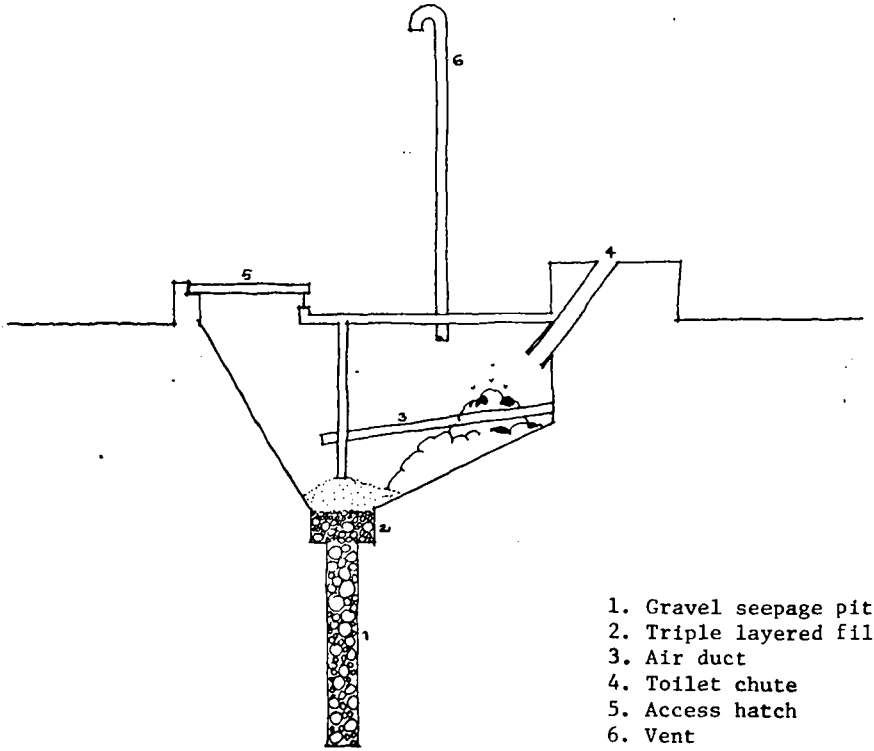
This is a design that was first published in "The Owner-Built Home" and has subsequently, with modifications, been built by Ken. It incorporates a sauna and water heater on the upper level, and a shower and toilet on the lower floor. The composting chamber, below the floor, is divided in two compartments. A metal baffle directs the waste from one to the other, and twice a year alternate compartments are cleared of compost. The compost may have to be turned by hand from time to time. The water from bathing and washing is diverted from the toilet and separately carried to a tile field.



The fifth, and latest prototype built by Ken Kern incorporates an anaerobic chamber below the compost chamber, for handling the washing water and urine overflow from the compost. This design, which is not shown, utilizes a circular slip-form and concrete construction.

Designed by:
Krisno Nimpuno and Stig Regnell
Arkplan AB
P.B.53156, S-40015
Gothenborg, Sweden.

The Biopot was developed in 1972 for specific application in developing countries. It attempts to deal with the common limitation of all small composting toilets, that is, excess humidity from liquid waste. This is accomplished by providing a concrete grill at the bottom of the tank, and filtering the liquids. The two compartment tank achieves complete decomposition through high temperature composting. Humidity is controlled by a triple layered filter consisting of sand, limestone or ashes, and charcoal. The limestone serves to lower the Ph of the urine, which then becomes alkaline. One compartment of the toilet is used until full, then sealed to allow complete decomposition. In the meantime the second compartment is used. After six months the dry manure can be removed, together with the filtering materials, that are renewed. Although tests have been carried out in Sweden, to our knowledge there have been no prototype installations yet in developing countries.



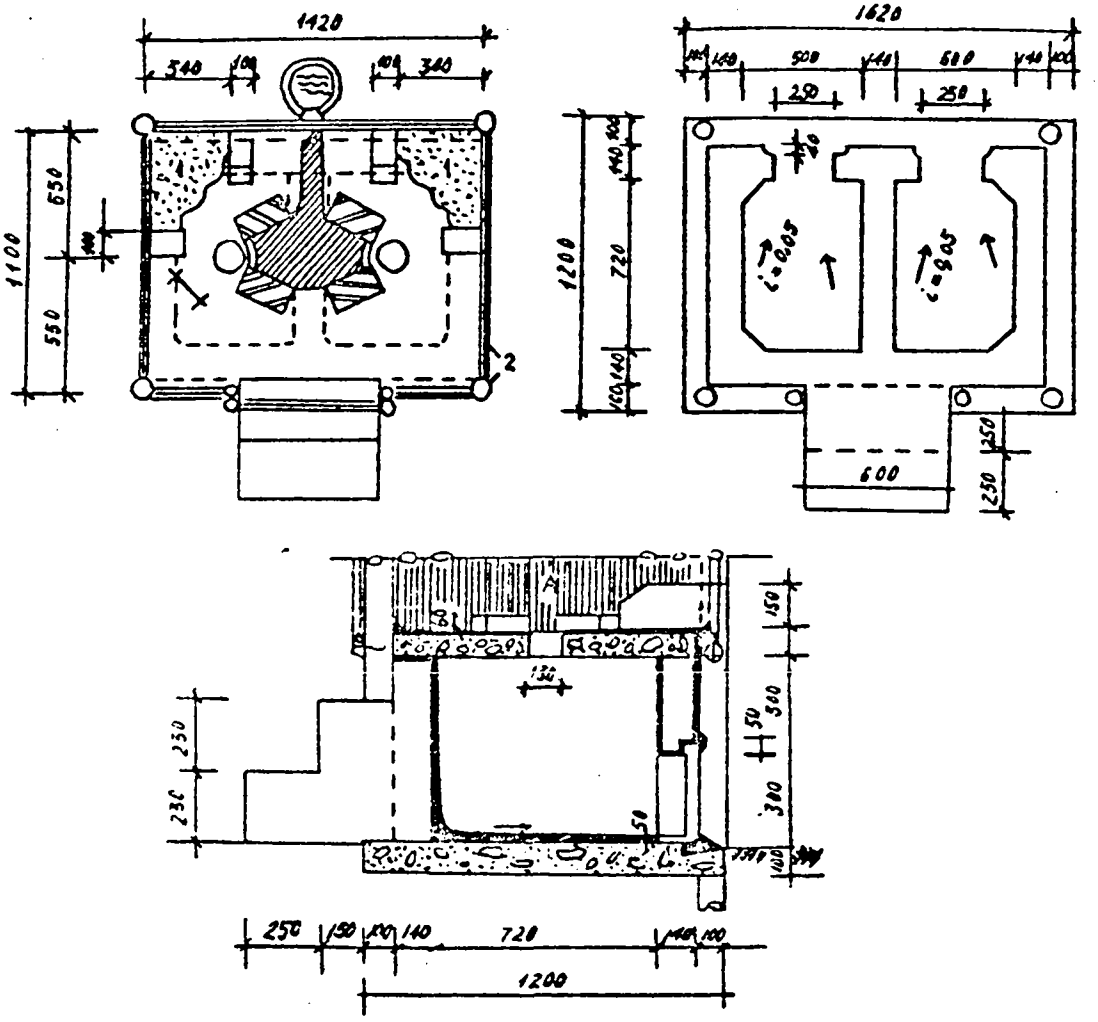
1. Gravel seepage pit
2. Triple layered filter
3. Air duct
4. Toilet chute
5. Access hatch
6. Vent

Pictured above is the BIOPIT, a single chambered version of the BIOPOT, that incorporates features of the CLIVUS MULTRUM (pp.53) and the ROEC (pp.19). Nimpuno plans to realize the first installation in Mozambique.

* DOUBLE SEPTIC BIN FOR ON-THE-SPOT COMPOSTING

Reference:
"Health in the Third World...Studies from Vietnam"
By Joan McMichael, Spokesman Books, England 1976.

The North Vietnamese composting toilet is anaerobic, unlike most compost privies. During the period 1961-1965 hundreds of thousands of these toilets were built in rural North Vietnam, and it is estimated that they cumulatively produced 600,000 tons of fertilizer annually. The tank is made out of concrete, stone or clay and consists of two compartments that are used alternatively. Only feces are introduced and urine is drained away separately. Each time the toilet is used a small quantity of wood ash is sprinkled over the fresh excrement. When the first compartment is almost full, ash is added to top up the tank and the hole is sealed. About three months are required before the material can be retreived. In the meantime the adjacent compartment is in use.

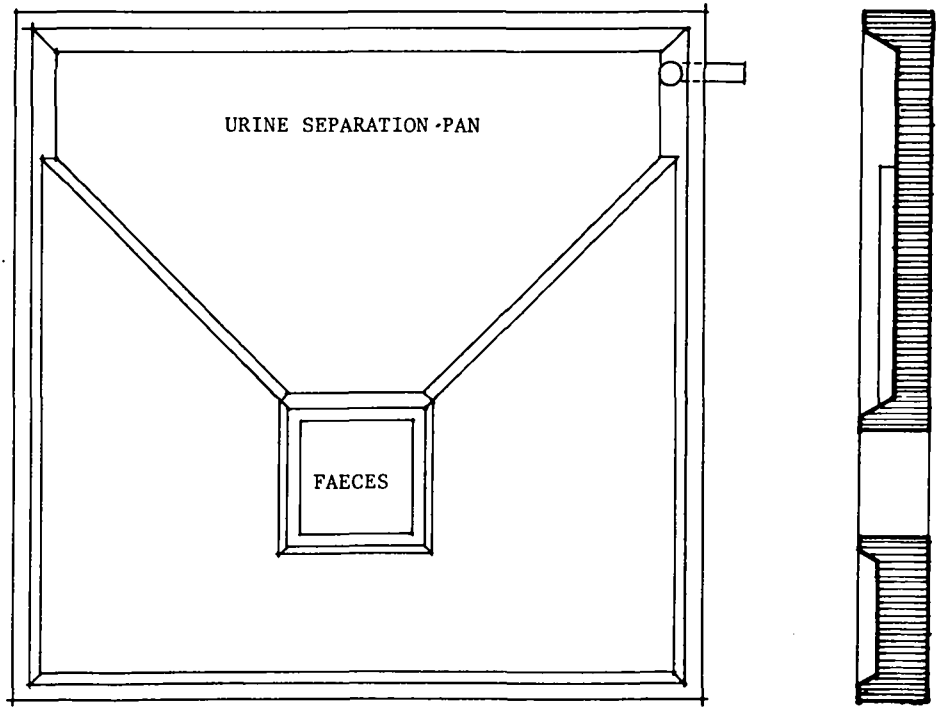


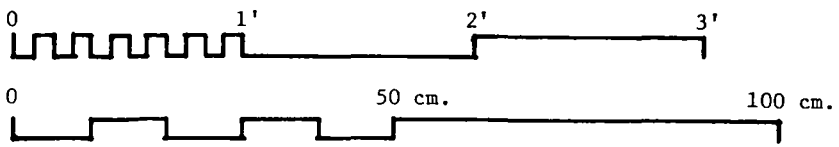
* URINE SEPARATION SQUATTING PLATE

DECOMPOSITION
1. Compost Privy

Designed by:
Minimum Cost Housing Group
McGill University
Montreal, Canada.

Composting toilets with limited or no aeration, such as the MATSON DRUM PRIVY (pp.59), the FARALLONES PRIVY (pp.61) or the NORTH VIETNAMESE COMPOSTING TOILET (pp.64) require a reduction, or elimination, in urine input to avoid flooding. Such a reduction can be achieved by means of a drain , as in the MATSON DRUM PRIVY(pp.59) or BIOPOT (pp.63). However, since urine can be regarded as a sterile liquid, it would be better to separate the urine before it comes in contact with the feces. This can be done through the use of a squatting plate designed to separate the urine, and carry it off to one side. The urine can be collected in a container, diluted with water, and disposed of in the field. The squatting plate can be fabricated from concrtete, or better still from sulphur concrete.





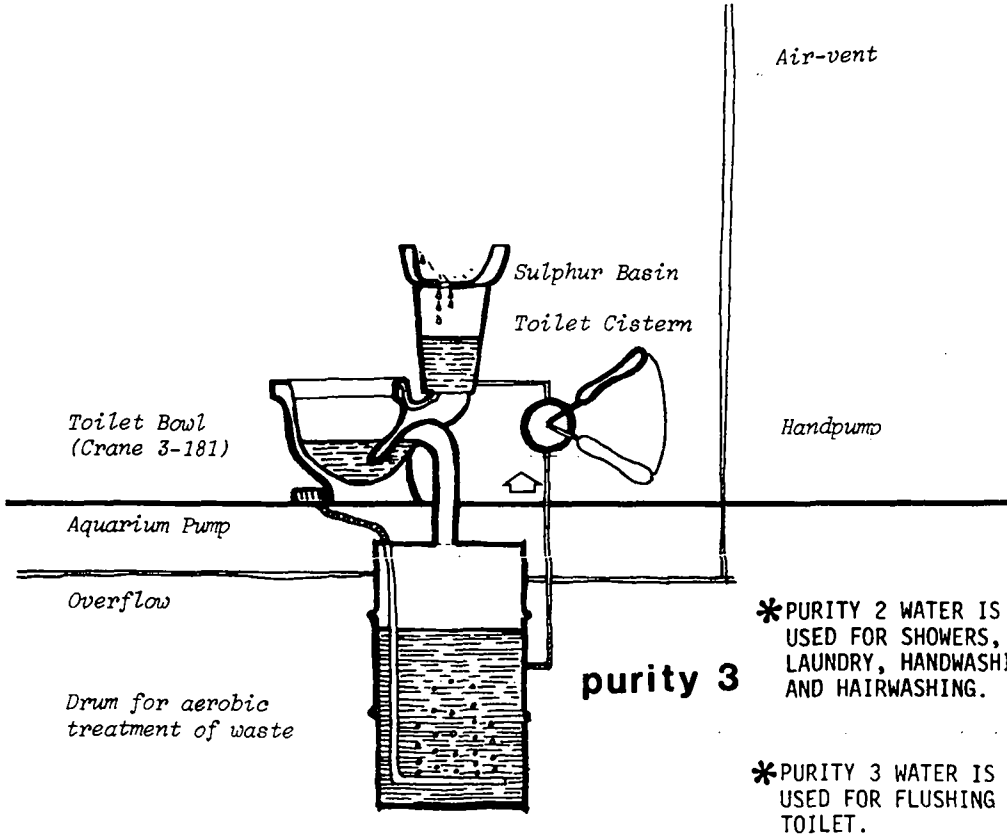
* ECOL SANITARY UNIT

Designed by:
Minimum Cost Housing Group
Brace Research Institute
McGill University
Montreal, Canada.

Cost: $175.18.

DECOMPOSITION
2. Continous Aeration

This toilet is based on the idea of recycling aerated water for use in flushing. A 12 v. aquarium pump, powered by batteries changed by a wind-machine, aerates the waste on a continuous basis, in a re-used 45 gallon (202 litres) oil drum that is buried beneath the toilet. A pipe leading to the outside vents the gases to the air. It is estimated that solids will build up at the rate of 2" - 3" (5-10 cm) per year. Dirty wash water is also used for flushing. This unit has been in operation for one year and it is too early yet to have definitive data on success of operation. This design is included to show a direction for research.



Reference:
World Health Organization
Geneva, Switzerland.

Cost: Unknown.

The WHO publication "Composting" gives plans for constructing a methane-recovery plant that combines human-waste with animal wastes, to produce methan gas. Horses and cows produce about 10-16 tons of manure per year, while humans add only 30-60 pounds (14-28 kg)) per capita per year, however human waste is rich in nitrogen and phosphorus, necessary for biological digestion and methane production from cellulose and other materials with a high carbon content. A ton of waste will normally yield about 65-90 cubic yards (50-70 cubic metres) of gas per digestion cycle, though this depends on the temperature, and cycles can vary from one to twelve months. An efficient size of digester is 10 cubic yards (8 cubic metres). The methane gas can be used for domestic cooking, heating and lighting, or as fuel for providing power. Initial cost is relatively high, but operating and maintenance costs are insignificant.

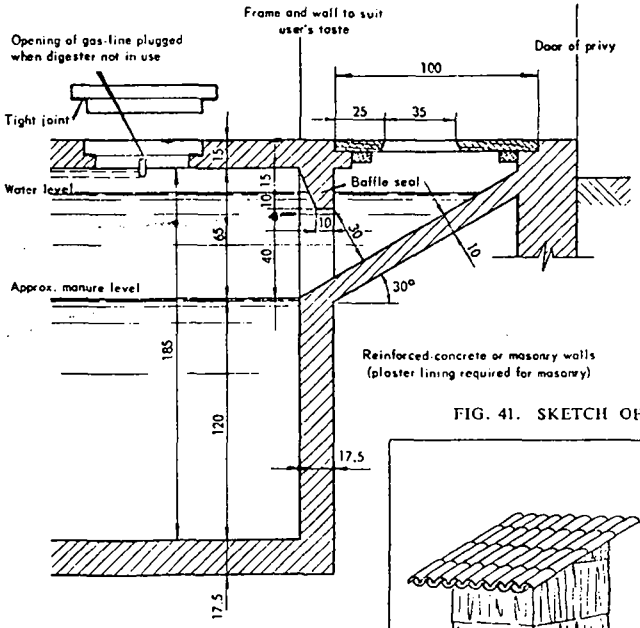
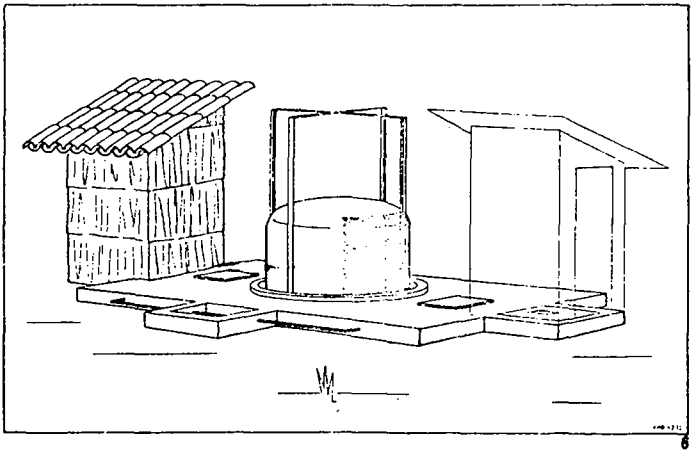


FIG. 41. SKETCH OF MANURE GAS PLANT WITH LATRINES

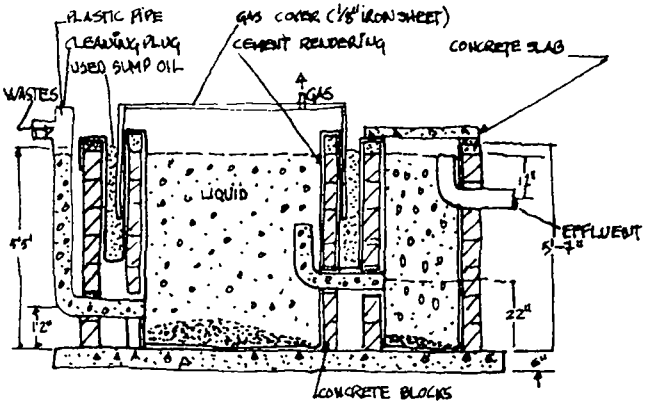


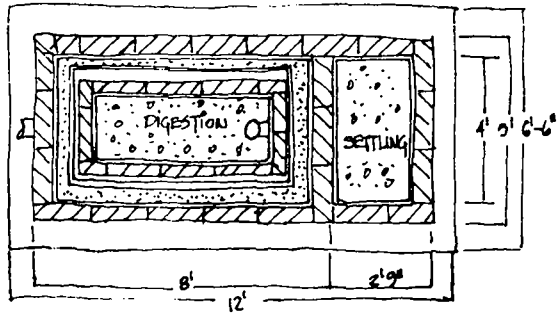
Designed by:
George L.Chan
University of Papua
New Guinea

Cost: $300.00

This is a small, 300 gallon (13,500 liters) rural installation which is designed to accomodate waste from 30 pigs, 30 chickens, as well as human waste. The gases formed in the anaerobic digester are 60-70% methane, and are stored in the gas cover, which is painted black to take advantage of solar heat to encourage digestion. The waste from this digester will yield about 10 cubic meters of gas daily (in the Melanesian region), adequate to provide cooking, lighting, and refrigeration for a family of six.

This deigester has been installed in Fiji and on New Guinea, and is used in conjunction with algae ponds into which the effluent from the digester is discharged. The algae provide protein and vitamins to enrich animal feed. The effluent from the algae ponds is in turn used for fish and shellfish cultivation.

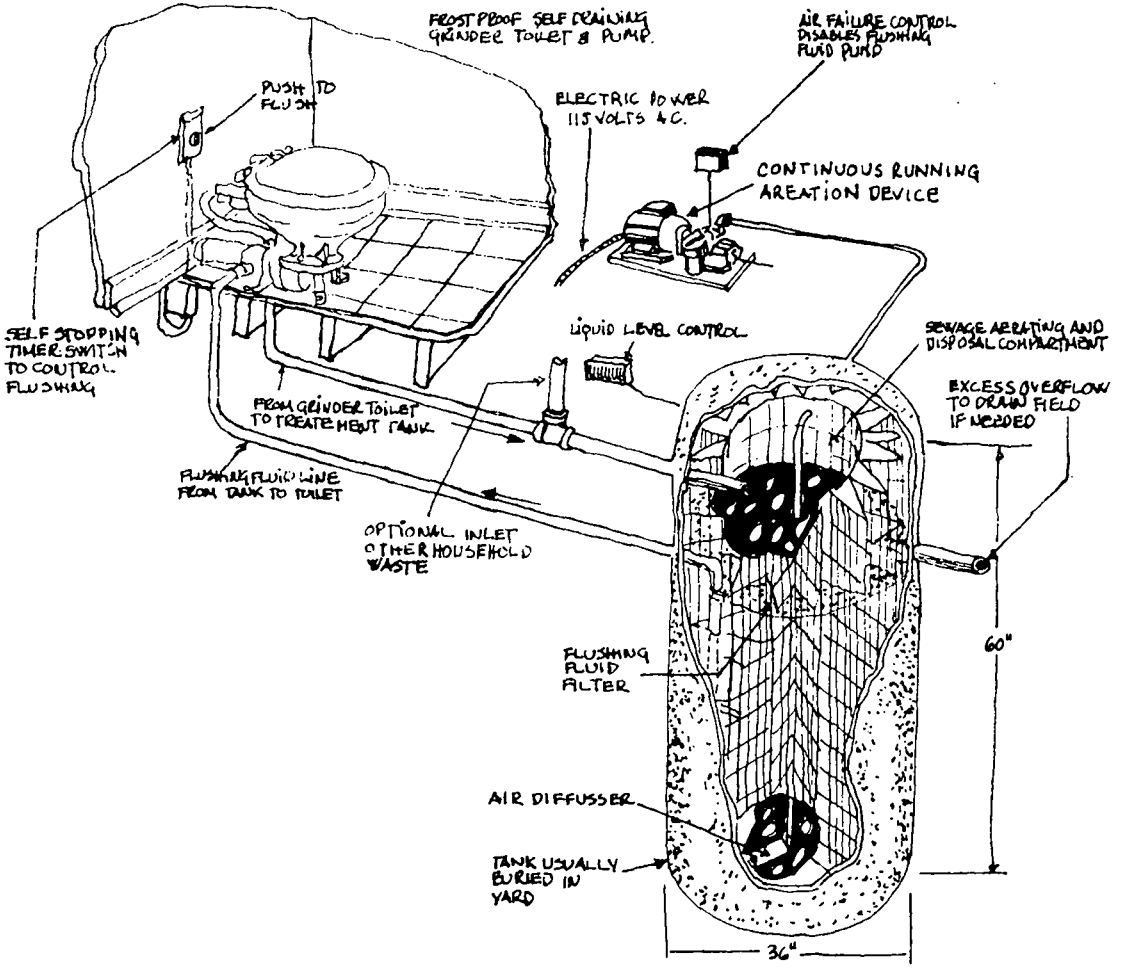




Manufactured by:
On-Site Sewerages Inc.
P.O.Box 567
Lafayette
Indiana 47901, USA

Cost: $1,020,000

This extended aeration system recycles the treated fluid to be re-used as flushing water. A grinder below the toilet pulverizes the solid waste and a pump re-cyles the water; a second pump runs a continuous areation device within the treatment/filtration tank. The 300 gallon (1130 liters) tank is filled with water on installation, and subsequently there is no need for continuing water supply.
The continuous aeration toilet has been a continuing obsession of Carl Boester's since 1952 when he introduced his first sewerless toilet.



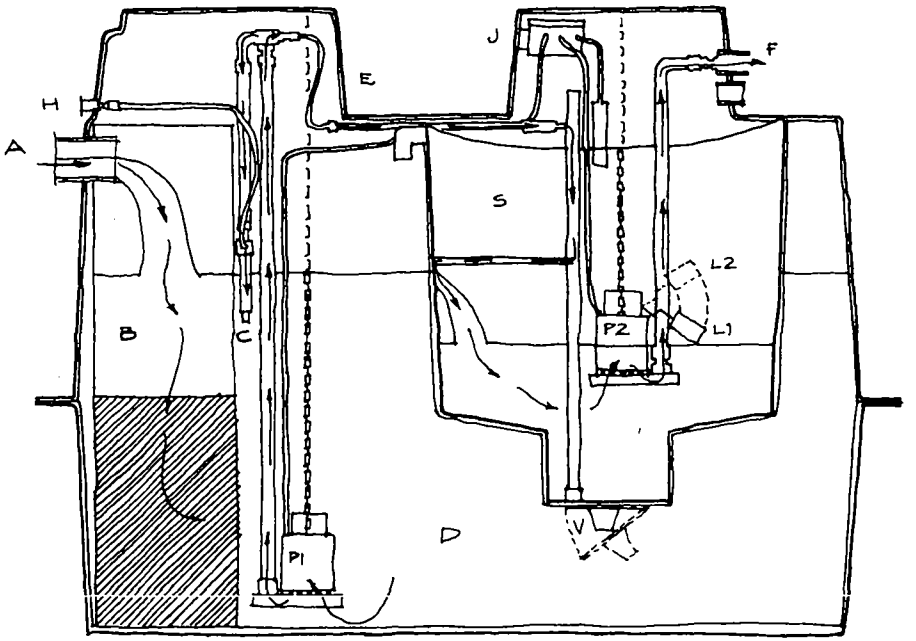
✱ CROMAGLASS C-5

HOUSEHOLD WASTE TREATMENT PLANT

Manufactured by:
Cromaglass Corporation
Williamsport
Penna. 17701, USA

Cost:

This is a small-cale sewage treatment plant for treating water-borne waste of one household, and discharging a semi-clear, odourless fluid. The unit is housed within a 830 gallon (3735 litres) fibreglass tank and weighs 437 pounds (196 kg). Aerobic decomposition is achieved by recirculating the waste-water and mixing it with warm air, pumped from the outside. The activated sludge is allowed to settle, and the "95% treated" fluid is pumped out, into a water course or tile-field. The unit operates on a ¼ HP electric motor. The company makes a larger unit that will handle the waste from 25 people a day (Model CA-1510).



Sewage from source flows through entry pipe (A) to comminution chamber (B). Aeration pump (P1) runs continuously - drawing mixed liquor through bottom and out through air nozzle - venturi assembly (C). Air supply is pulled from within heated area through polyethylene hose (H). Discharge from nozzle is directed toward wire basket and ensuing turbulence causes material in basket to abraid and come apart after which mixed solution passes into main aeration chamber (D).

Small bypass hose (E) directs approximately 25% of (P1) pump flow to settling chamber (S). All power to pumps (P1) and (P2) comes from control or junction box (J). Control box contains a level control switch which activates an alarm circuit within home if water level rises too high in tank (i.e., electrical or pump failure or overloading).

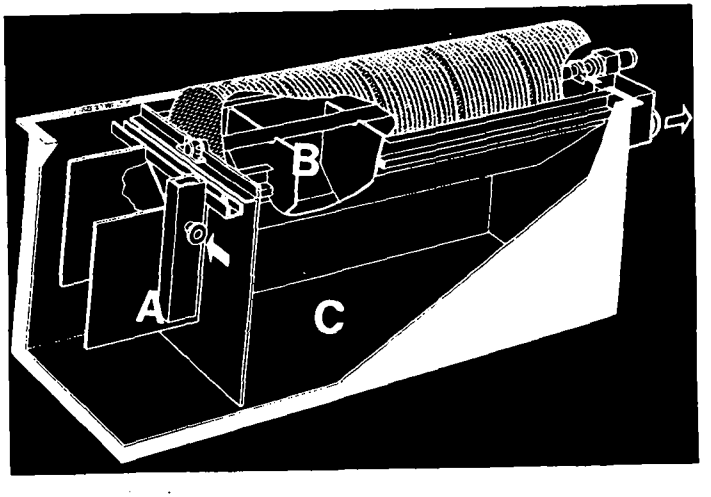
Pump (P2) discharges treated - settled effluent at level L2 and ceases at level L1.

Float assisted flapper valve (V) allows settled solids to void back into main chamber (D) when settling chamber (S) refills after each discharge. Discharge is via PVC fitting (F).

Manufactured by:
Ames-Crosta Mills(Canada)
105 Brisbane Road
Downsview, Ontario, Canada

Cost: $4300.00 (5 person unit)

This British system, invented in 1963, features a series of slowly rotating discs onto which the sewage adheres to form a biologically active surface that feeds upon the sewage impurities. The sludge settles to the bottom of the tank, and requires emptying two or three times a year. Actual tests indicate that within a range of influent BOD_5 strengths of up to 700 mg/l, effluent strengths are 10-20 mg/l.
The plant requires motive power to drive the rotating discs; consumption is about 20 watts/person/day, which compares favorably with the 40-160 watts/person/day consumed by extended aeration type plants.
A five person unit costs $860 per person, however eceonomies of scale reduce this cost to $110 per person for a five hundred person installation (the largest suggested by the manufacturer).



A - primary settlement zone
B - the Biozone, with its discs and baffles
C - sludge zone

ACM
Process Equipment for Pollution Control

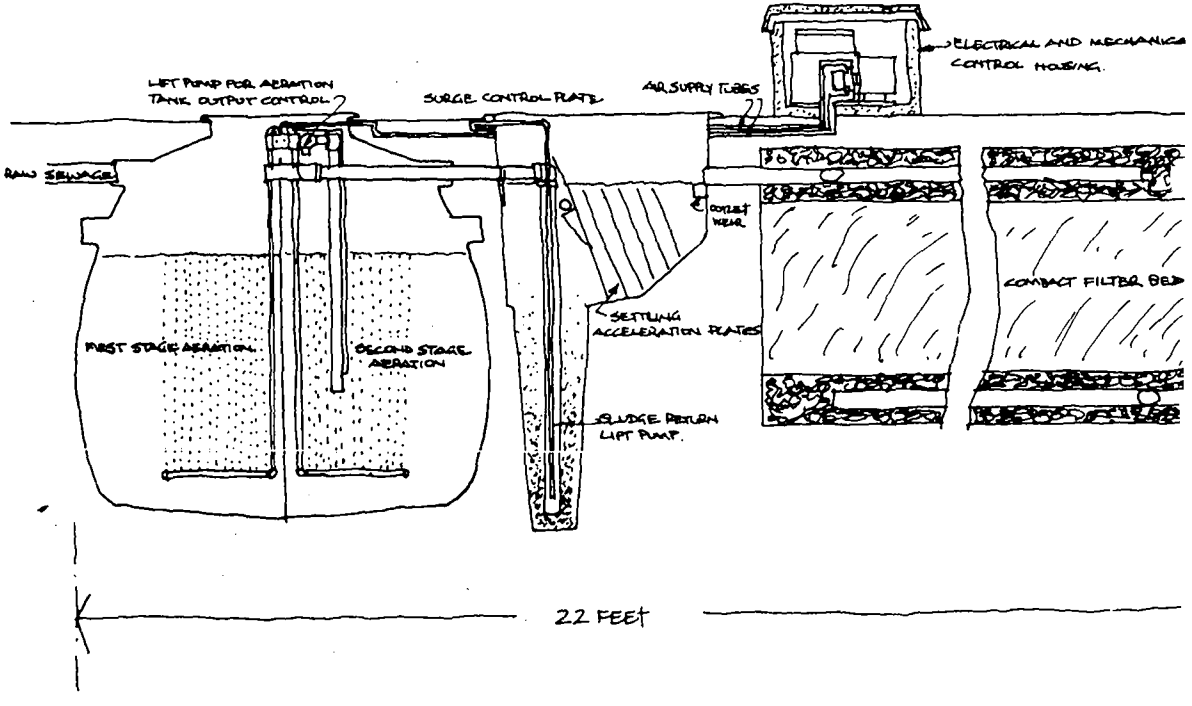
✱ AQUAROBIC

HOUSEHOLD WASTE TREATMENT PLANT.

Manufactured by:
Waltec Industries Limited
Wallaceburg
Ontario, Canada.

Cost: $1700 - $2000 (incl. installation)

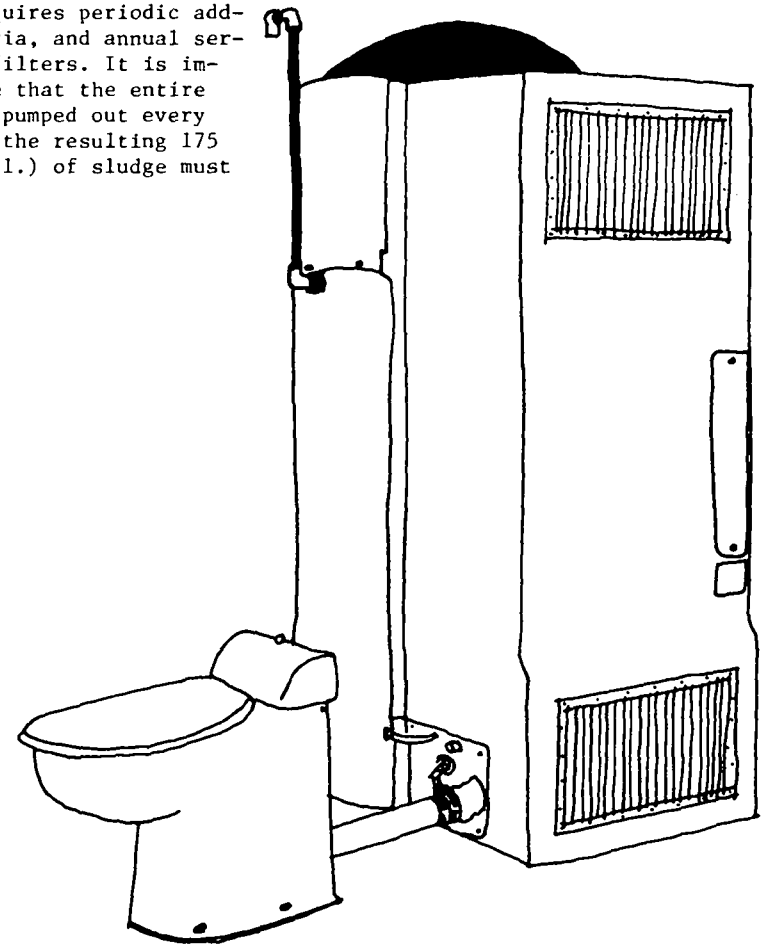
This is essentially a household version of a sewage treatment plant, using a 3-stage system. In the first tank there is 2 step aeration of the sewage, to destroy the pathogenic bacteria by aerobic action. The air-activated microorganisms from an 'activated sludge' that is allowed to settle in a settling tank. The clear, purified water flows out of the system via a compact filter bed. On a periodic basis the sludge is returned to the aeration tank to maintain the action. It is estimated that excess sludge will have to be removed every 4-8 years depending on use. The system is designed to handle waste from up to 8 people. The water out-put can be discarded into water-courses or into the soil with no danger of pollution, but is not designed to be re-used.



Manufactured by:
Thetford Corporation
P.O.Box 1285, Ann Arbor
Michigan 48106, USA.

Cost : $3000 - $7000, depending on capacity.

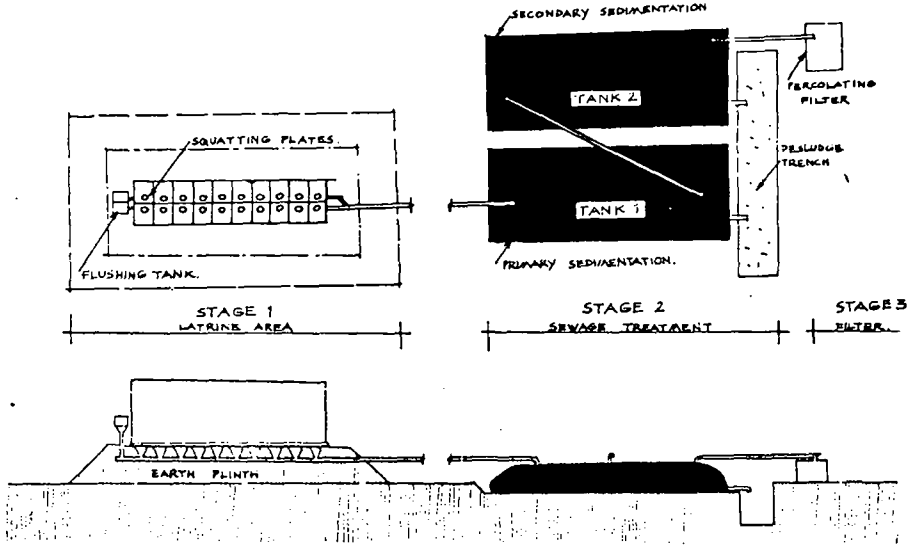
This is a self-contained system that re-cycles all "black water" for flushing use only. This is done by passing the effluent through an-aerobic and aerobic digestion, sedimentation, filtration and ultra-violet purification stages. The unit, which is about the size of a common refrigerator and weighs 325 Lbs. (160 kg.) empty, can handle the wastes from eight people on a continuous basis, consuming about 200 Kwh of electricity per month. Routine maintenance requires periodic addition of bacteria, and annual servicing of the filters. It is important to note that the entire system must be pumped out every two years, and the resulting 175 gallons (787.5 l.) of sludge must be disposed of.



Manufactured by:
Marston Excelsior Ltd.
Fordhouses, Wolverhampton
WV106Ql , England.

Cost: $500.00 (not installed)

This emergency sanitation unit was developed specially for Oxfam to be used in the Bangladesh refugee camps. No systems presently exist that can cope with thousands of people at extremely short notice. The unit consists of a latrine area with 20 fibreglass squatting plates and an enclosure that is built out of the unit's packing case. Below this are two sewage containment tanks, or more properly, two 18,000 liter butyl rubber bags, for primary and secondary sedimentation. These tanks are filled with water and provide anaerobic conditions and for a retention period of about eight days. They have a life expectancy of ten years. Liquid effluent from the second bag is passed through a percolating filter. Every three months the bags are desludged into an adjoining trench. The sludge is covered with soil and retained for a period of three months, when it may be dug out and used as compost. This extra-ordinary system was designed for a daily use by 500 people. The first installation was in 1974 in Dacca, and functioned successfully though used every day by 2,000 people.



Conclusions

1. The main objective of this study had been to look at alternative waste disposal systems which will conserve resources. The conventional flush system is well known and has many advantages, but its general application is not feasable, due to the large initial investment in order to supply and distribute water, and to dispose of and treat sewage.

2. The flush system uses water solely as a transporting medium, and alternative solutions are required in regions where water supply is a problem. Flushing water need not be pure drinking water, and in some cities (e.g. Hong Kong) sea-water is used. More efficient cisterns can reduce the water supply required. Vacuum systems are another interesting innovation, though power-consuming. A new concept is the substitution of a special fluid that does not get polluted and is re-cycled for the flushing water.

3. The destruction of waste by incineration eliminates water-consumption and sewage treatment but there may be problems of air-pollution and energy consumption.

4. The use of chemicals is very widespread in rural areas as no water or energy is consumed. However, the accumulation of chemicals, when used intensively, can pollute groundwater and soil.

5. Probably the most beneficial system for dealing with human waste is decomposition, where the waste is transformed into a useful product to be used in agriculture. It is a re-cycling of chemical elements not used by the body.

6. There is no simple system that offers a solution in every situation. What is required is a combination of various approuches.

7. The greatest need is to reduce cost so that systems can be used by the greatest number of people. Until today the only truly low-cost system for low density settlements is the pit-latrine.

8. The Minimum Cost Housing Group hopes to be able to obtain financial support to test and evaluate some of the most promising methods of dealing with the problem of human waste, particularly those that cause less damage to the environment and at the same time avoid the waste of water and other resources. For example, a compost privy that uses solar energy to encourage decomposition.

9. We hope that this publication "Stop the Five Gallon Flush" will create some interest for others to work also towards this goal, and to exchange with us their experiences.

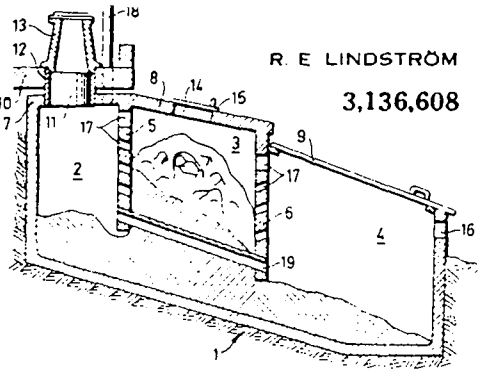
NAME	(Country)	PAGE REFERENCE	PRICE					WATER PER USE				POWER REQUIRED	CHEMICALS REQUIRED	WATER MAINS CONNECTED	TYPE
			$ 0-$ 25	$ 25-$ 100	$100-$ 500	$500-$1,000	over $1,000	0	up to 1 l.	up to 10 l.	up to 20 l.				
BICOQUE	(France)	16	*					*							INFILTRATION
CHIANG MAI SQUATTING PLATE	(Thiland)	17	*						*						1.Pit Latrine
WATERGATE	(Rhodesia)	18		*					*						
R.O.E.C.	(S.Africa)	19		*				*							
FLUSH-O-MATIC	(Canada)	20		*					*						2.Aqua Privy
HEAD-MATE	(U.S.A.)	21		*					*						
MARINE HAND TOILET	(Canada)	21		*					*						
PORTA POTTI	(U.K.)	22		*					*						MANUAL REMOVAL - 1.Bucket
PERDISAN STANDARD MINOR	(U.K.)	23		*				*					*		2.Chemical Toilet
RANCH	(France)	24		*				*					*		
IGLOO	(France)	24		*				*					*		
CLOSESSO PERFECTA	(France)	25		*				*					*		
MOBILCLOSET	(France)	25		*				*					*		
SANITAM STANDARD	(France)	26		*				*					*		
SANITAM SALUBRIS	(France)	26		*				*					*		
MARKT	(Norway)	27			*			*				*			3.Freeze Toilet
ELSTAR	(Norway)	28			*			*				*			
MINIHJARTAT	(Sweden)	29			*			*				*			
TE-BE T-1970	(Sweden)	29			*			*				*			
PACTO 101	(Sweden)	30				*		*				*			4.Packing Toilet
JETFLUSH MINOR	(U.K.)	31			*			*				*	*		5.Recirculating Chemical Toilet
MONOMATIC	(U.S.A.)	32			*				*			*	*		
POTPOURRI	(Canada)	33		*					*			*	*		
CRAFT TOILET	(U.S.A.)	34			*				*			*	*		

OJO 7000	(Sweden)	35			✱				✱			✱			MECHANICAL REMOVAL
OJO 7100	(Sweden)	35		✱					✱					✱	1.Vacuum Truck
TURQUO	(France)	36		✱						✱			✱	✱	2.Chemical Privy
MANOIR	(France)	37			✱					✱			✱	✱	
CASTEL	(France)	37			✱				✱				✱	✱	
CAUSTICA 128	(France)	38		✱					✱				✱		
CLOSENET STANDARD	(France)	39		✱					✱				✱		
BIO-FLO 512	(U.S.A.)	40			✱			✱				✱			3.Recirculating Fluid Toilet
BIOCYCLE MK 1	(Ireland)	41			✱				✱				✱		
JET-O-MATIC	(U.S.A.)	42							✱			✱	✱		
MAGIC FLUSH	(U.S.A.)	43						✱				✱			
TOTO 5	(Japan)	44		✱						✱				✱	4.Water Borne Network
M S U 2	(Canada)	44		✱						✱				✱	
DUAL FLUSH CISTERN	(U.K.)	45	✱							✱				✱	
NIBO	(Uruguay)	46	✱							✱				✱	
BRICK-IN-THE-TANK	(U.S.A.)	47	✱							✱				✱	
VACU-FLUSH	(U.S.A.)	48				✱			✱			✱			5.Vacuum Network
ELECTROLUX VACUUM SEWAGE SYS.	(Sweden)	49					✱		✱			✱			
DESTROILET	(U.S.A.)	50			✱			✱				✱			DESTRUCTION
ELONETTE	(Sweden)	51			✱			✱				✱			1.Incinerating Toilet
TOARETT	(Sweden)	51			✱			✱				✱			
ECETT	(Sweden)	52				✱		✱				✱			
ELEKTRO STANDARD	(Sweden)	52				✱		✱				✱			
CLIVUS MULTRUM	(Sweden)	53					✱	✱							DECOMPOSITION
MULTRUMMAN	(Sweden)	54						✱							1.Compost Privy
TOA-THRONE	(Sweden)	54						✱				✱			
SANITERM	(Sweden)	55				✱		✱				✱			
MULLBANK	(Sweden)	55			✱			✱				✱			

NAME	(Country)	PAGE REFERENCE	PRICE					WATER PER USE				POWER REQUIRED	CHEMICALS REQUIRED	WATER MAINS CONNECT	TYPE
			$ 0-$ 25	$ 25-$ 100	$100-$ 500	$500-$1,000	over $1,000	0	up to 1 l.	up to 10 l.	up to 20 l.				
MULL-TOA	(Norway)	56			*			*				*			DECOMPOSITION
BIO-SYSTEMS	(Canada)	57				*		*				*			1.Compost Privy
BIO-SYSTEMS TROPIC	(Canada)	57			*			*				*			
BIOLOO	(Sweden)	58				*		*				*			
MATSON DRUM PRIVY	(U.S.A.)	59		*				*							
MULTRUM	(Denmark)	60		*				*							
FARALLONES PRIVY	(U.S.A.)	61		*				*							
KERN COMPOST PRIVY	(U.S.A.)	62			*			*							
BIOPOT	(Sweden)	63		*					*						
DOUBLE SEPTIC BIN	(N.Vietnam)	64	*					*							
URINE SEPARTION SQUATTING PLATE	(Canada)	65	*					*							
ECOL SANITARY UNIT	(Canada)	66			*			*				*			2.Continuous Aeration
WHO METHANE PLANT	(Switzerland)	67			*				*						HOUSEHOLD WASTE TREATMENT PLANT
MELANESIAN METHANE DIGESTER	(New Guina)	68			*				*						
FLO-THRU	(U.S.A.)	69					*		*			*			
CROMAGLASS C-5	(U.S.A.)	70				*					*	*			
BIO-DISC	(Canada)	71					*				*	*			
AQUAROBIC	(Canada)	72					*				*	*			
CYCLE-LET	(U.S.A.)	73					*		*			*	*		
OXFAM SANITATION UNIT	(U.K.)	74				*			*						

Part Three

Composting Toilets



*Scandinavian Developments (pp.51,57)

The impetus for the development of alternatives to the flush toilet occured in Norway and Sweden in the mid-sixties when environmental protection laws virtually prohibited soakage pits and septic tanks in rural areas. One of the alternatives that proved popular was the mouldering toilet, and there were at one time as many as fifty commercial systems available. Not all proved successful, and at the moment there are about two dozen makes still on the market.

The original mouldering system was invented by a Swedish engineer, Rikard Lindstrom, in 1938. He patented his system in 1962 (U.S. Patent 3,136,608) and it was produced commercially in 1964, under the name Clivus-Mulltrum. Since 1974 it has been in production in the United States.

Lindstrom's invention was, like all germinal ideas, deceptively simple. It was based on the realization that the combination of human excreta with organic kitchen or garden wastes under conditions of extreme aeration would result, with time, in a first-class manure. The chamber where this took place was provided with air-ducts and a vent pipe to promote aeration, as well as a sloped bottom to move the decomposing matter towards the low end from whence it was periodically removed. The product, called humus, is a nutrient-rich fertilizer.

It might be useful at this point to distinguish between composting and mouldering. Composting is the relatively fast process of decomposition of organic matter that occurs in the common gardener's pile. When large amounts of oxygen are introduced into the pile, as in the Mulltrum, the cooling effect of the circulated air makes complete pasteurization of the excreta difficult. A longer-term storage, or mouldering period, is then required, lasting two or three years.

One of the striking characteristics of the Clivus-Mulltrum is its size. It is a fibreglass reinforced plastic container ten feet long and four feet wide, requiring a full seven foot height for installation. As we shall see, this was to turn out to be one case at least, where "bigger *is* better".

*Electric Composting Toilets (pp.52,53

Various efforts have been made to reduce the rather cumbersome size of the Mulltrum. Significantly enough, *not* by Lindstrom, who maintains

that the one hundred and sixty cubic foot container represents a minimum volume for slow, and safe, composting.

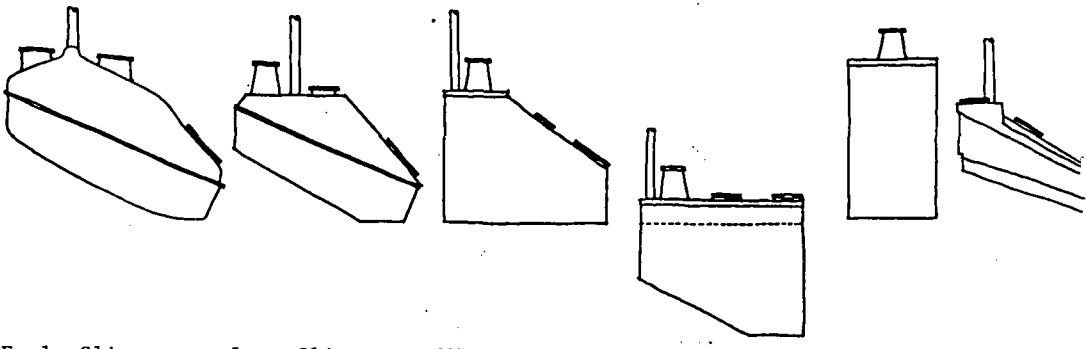
A number of systems have been put on the market which miniaturize the composting toilet by introducing temperature control systems, mechanical ventilation, and, in some cases, stirring devices. These devices are compact and generally stand on the floor.

In Sweden none of these small-scale plants has proved to be entirely satisfactory, and so far none of them can be regarded as an automatic, maintenance-free system. A number of this type of toilet are being tested in Canada with inconclusive results: two toilets installed in the Inuit community of Povungnituk in 1975 had to be removed after only a few months operation due to problems with ventilation and urine overloading. Units being tested in northern Manitoba showed ventilation problems and excess fluid accumulation in the lower part of the tank. Dr. John Evans in Newfoundland has had similar experiences. The excessive evaporation also tends to dry out the excreta without proper BOD reduction.

*The SCAN Composting Privy (pp.54)

A team of Danish architects led by Uno Winblad, made an important proposal in 1970 for African communities which grew directly out of Lindstrom's work. They suggested using simplified composting toilets as a basis for urbanization in developing countries, thus eliminating costly sewage and water lines. The small concrete container would be provided, one per lot, in what is called a "site and service" approach. The owner then occupies the land and builds his house as his needs, and budget, allow.

Winblad's contribution was to make the important link between the needs, and resources, of the developing countries, and this recent Swedish invention - the mouldering toilet. In the event, the design he actually proposed suffers similar drawbacks as the electric composting toilets, and it is unlikely, had any ever been built, that they would have functioned satisfactorily.



Early Clivus Late Clivus Minimus Above ground Minimus Below ground Nearing Mulltrumma

*North Vietnamese Double Mouldering Tank (pp.59)

The composting of human and animal wastes has been practiced for some time in some Asian countries. In these cases a *double vault* is provided so that while one side is in use the other side can be composting. One of the most widespread applications, and in fact one of the largest programs of rural sanitation in any developing country was undertaken in North Vietnam during the years 1961-65. Hundreds of thousands of double mouldering tanks were built and it is reported that *600,000 tons* of sterilized manure are produced annually in this fashion!

The concrete tank consists of two compartments where only faeces is collected. Urine is drained away separately. When the first compartment is almost filled, it is topped up with green leaves and sealed. The dry manure is retreived after about three months, meanwhile the other compartment has been in use, and the cycle starts again.

This system, whose simplicity accounts for its obvious success is primarily a rural solution as it does not prevent the occurence of disagreeable odours and requires that urine be drained separately, usually in an ash pit. This latter point is important to bear in mind.

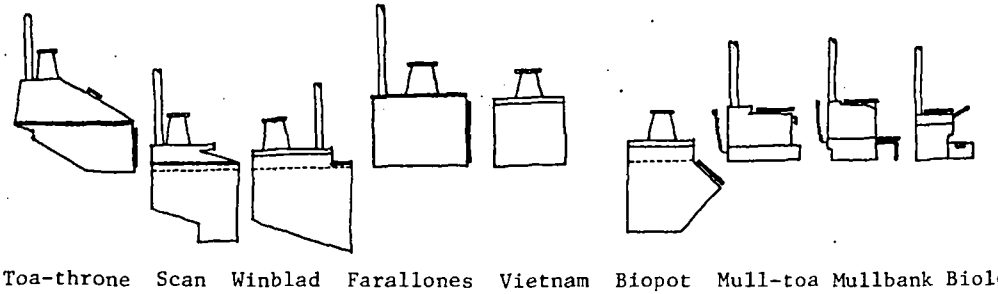
*Farallones Composting Privy (pp.55)

Whereas the *SCAN Composting Privy* adapted a device from an industrialized country to the needs of a developing country, the *Farallones Composting Privy* is essentially an adaptation of the Asian model to meet the needs of the American owner-builder.

The two compartment concrete box receives human and organic household wastes. Once a month the pile is turned with a pitchfork and after four to six months it is shifted to the adjoining compartment to age for another six months.

A number of this sort of composting toilet have been built in northern California in the last two years. If the privy is carefully managed and sawdust and leaves are added to keep the C/N and liquid content at the right proportions, it will work successfully. It should be emphasized that as in the North Vietnamese system the main problem is liquid waste, and as much as possible of the urine must be disposed of elsewhere.

As the compost is removed from the chamber more frequently, and as urine input is reduced, this system will be able to serve more people than the Clivus-Mulltrum. The physical handling of the fresh fecal matter would appear an unpleasant practice.



Toa-throne Scan Winblad Farallones Vietnam Biopot Mull-toa Mullbank Bioloo

*Kern Compost Privy (pp.56)

Ken Kern proposed a compost privy suitable for the North American owner-builder in "The Owner-Built Home", first published in 1970. It is essentially a two compartment composting privy of the Asian type, combined with a structure housing washing and bathing facilities. Since his first proposal Kern has modified this design and built four prototypes. This latest version provides an aerobic chamber (essentially a septic tank) which is located below the composting chamber and handles the excess urine as well as the bath water.

The fact that the volume of the composting chamber is considerable coupled with the provision for separate handling of the urine promises success for this design, when it will be built.

It should be stressed, at this point, that unheated mouldering toilets will only function in a temperate climate. In regions with below-freezing temperatures, it is necessary to locate the tank either in a heated basement, or below the house if it is well-insulated. Installations in unheated crawl spaces should be insulated and may need additional heat input.

In temperate or tropical climates, the composting toilet which is buried will probably maintain a more constant temperature and function more successfully (e.g. North Vietnam, Biopot, Minimus).

*Biopot (pp.58)

Another as yet unrealized composting toilet that attempts to deal with the excess humidity in small-size containers is the Biopot, proposed by the Swedish architect Krisno Nimpuno.

The Biopot is designed specifically for developing countries but would be adaptable to owner-builders' needs in temperate climates anywhere. It consists of two compartments that are used alternatively every six months, much like the North Vietnamese model. However urine *is* introduced into the container. The Biopot has a chemical drainage filter, and is therefore not a self-contained system. The cheap filter consists of three layers: the upper layer consists of leaves and coarse sand, the next layer consists of crushed limestone and ashes (to lower the Ph of the urine) and the third layer, below the toilet consists of coarse sand and charcoal. The top two layers are removed with the humus and replaced by new material every six months. When one compartment is full it is sealed and not used for six months while the composting process takes place.

It seems likely that any small composting toilet, in order to be successful, will have to resort to some such handling of urine. The Biopot has undergone testing in Sweden though no prototypes have yet been installed. It is being considered for use in a number of developing countries and it is hoped that results will be available soon.

*Minimus

Our own predilection is towards composting toilets of large capacity, and most experiences to date indicate that the Clivus-Mulltrum is fairly uniformly successful. Recent installations in northern Manitoba, carried out by James McKernan have borne this out, as has a research project in Tanzania which installed large capacity models.

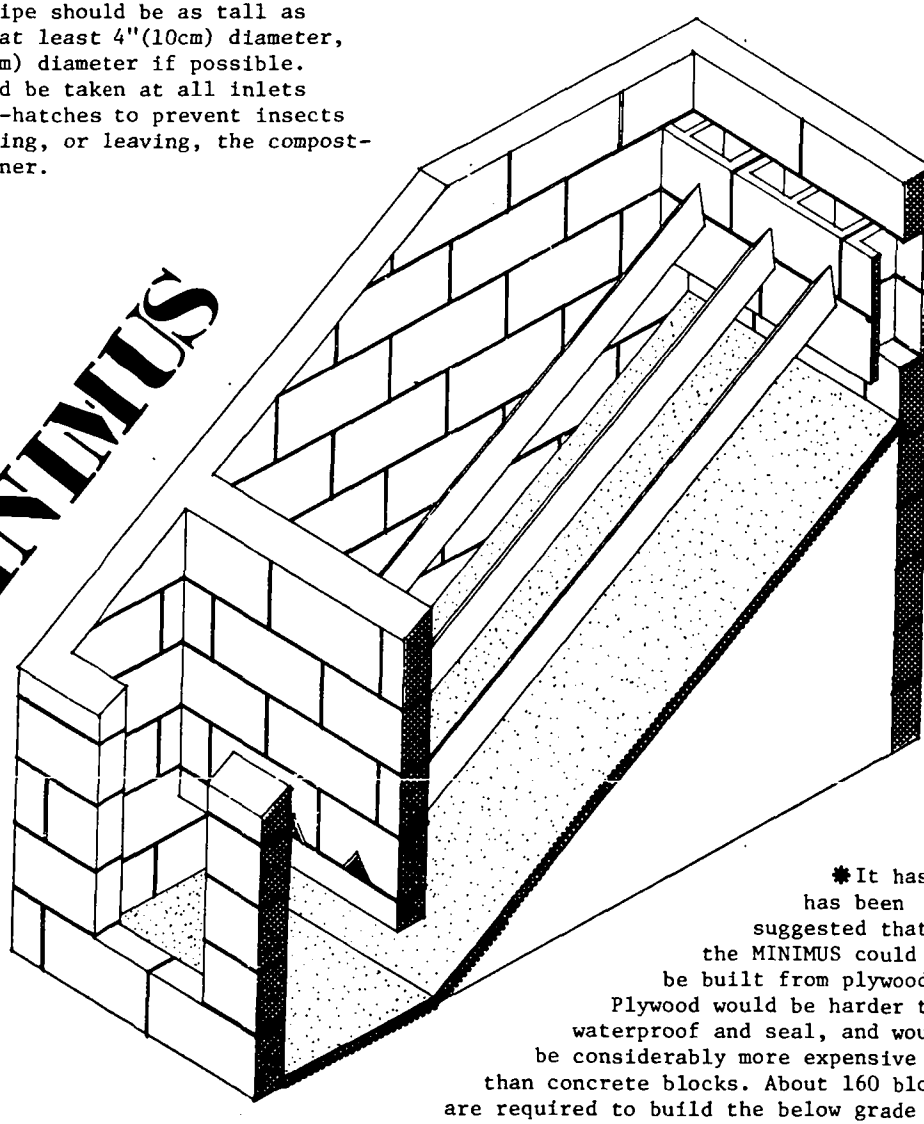
The MCHG has been involved in adapting the Clivus-Mulltrum to on-site construction with lower-cost and easily available materials. The first prototype was built in 1974 out of asbestos-cement, but was awkward to install due to its weight. The next two prototypes were built by Bernard Lefebvre, a member of MCHG, in the basements of two owner-built houses in Québec. These containers were out of concrete blocks and have been in constant use since.

The first tropical installation was in the Tondo, a squatter community in Manila. The material cost of the above ground version, in the Philippines, was US$65.Another tropical installation was tested in Dubai, in the United Arab Emirates, this time a below ground version.Other prototypes have been built in Canada by MCHG, which is currently planning a larger public facility.

The current limitation of the MINIMUS is a) the large size of the container, particularly in relation to small city lots, and b) the problems of installation in areas of high water table. The next step will involve a smaller volume container which can be prefabricated and totally buried, much like a septic tank.

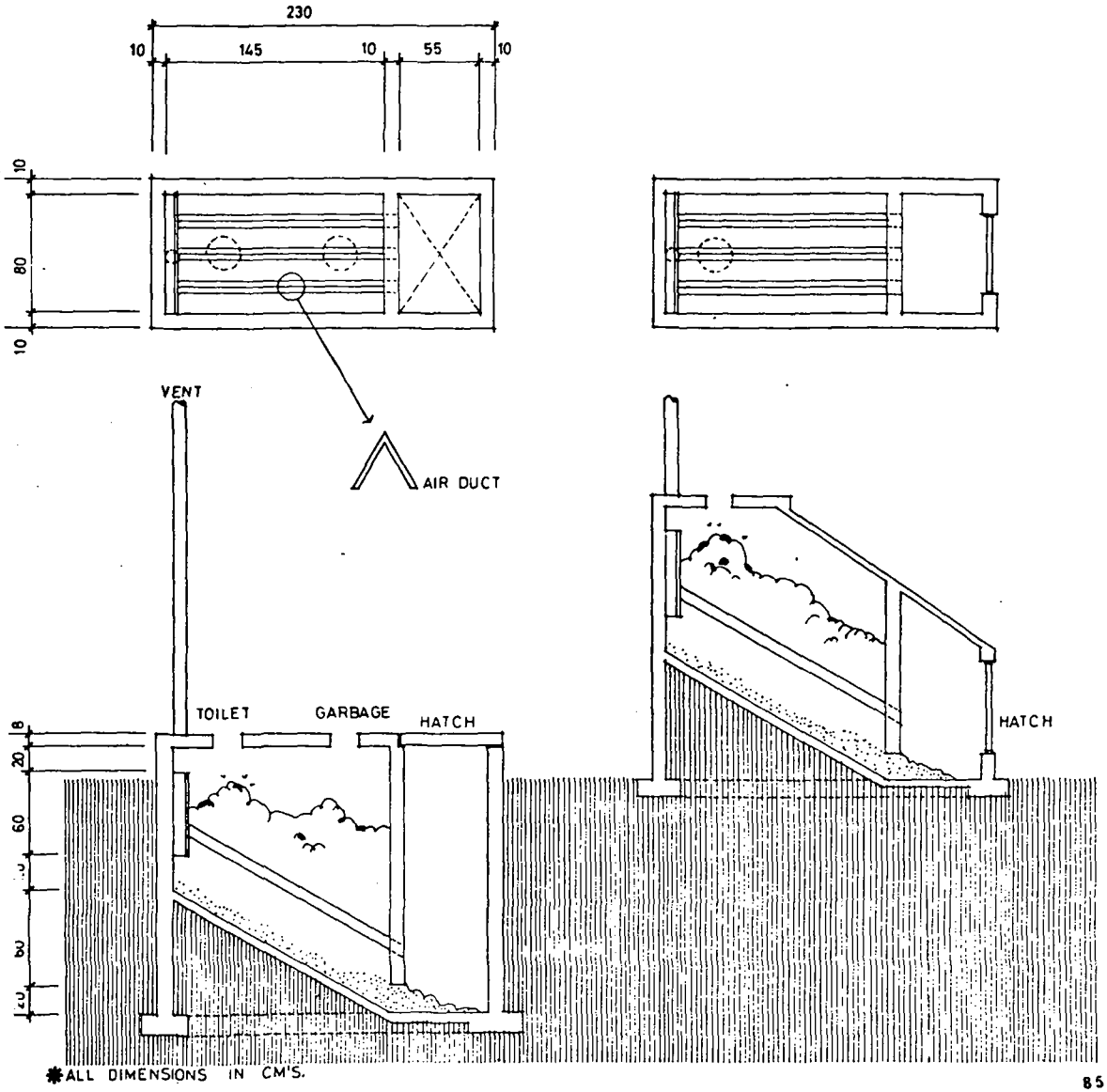
MINIMUS

✱The MINIMUS is fabricated primarily from concrete blocks. The concrete blocks (4", 10cm thick) are laid up in a conventional fashion, and a coat of cement plaster or bitumen is put on the inside face. Thicker (8", 20cm) blocks are used to form the baffle in the rear. The partition wall requires a concrete or steel beam for support. The floor of the MINIMUS is sloped 30°, and consists of a 2"(5cm) thick layer of concrete placed over sand and gravel fill. The three air ducts are made from a non-corrosive material (asbestos-cement, ferro-cement, plastic,aluminum or fibreglass) that is either custom shaped, or adapted from pipe (ABS,PVC) or gutter(plastic).The above ground version requires a roof from corrugated galvanized metal, whereas the below ground version is covered with either a concrete slab or a preservative-painted plywood floor. The vent-pipe should be as tall as possible, at least 4"(10cm) diameter, and 6"(15cm) diameter if possible. Care should be taken at all inlets and access-hatches to prevent insects from entering, or leaving, the composting container.



✱It has has been suggested that the MINIMUS could be built from plywood. Plywood would be harder to waterproof and seal, and would be considerably more expensive than concrete blocks. About 160 blocks are required to build the below grade version

✱ The MINIMUS can be built in two versions, above and below ground, depending on site conditions. The above ground version can be built in a basement or when groundwater presents a problem. The below ground version is suitable for warm climates, where groundwater or flooding are not constraints. In cold climates the composting chamber must not be allowed to freeze, and the air entering via the ducts should be warmed, or else it will not be able to absorb any humidity from the composting chamber. In cold climates the MINIMUS will generally be located in the basement.



OPERATING COMPOSTING AND MOULDERING TOILETS

Temperature

*The temperature within composting toilets varies. A moildering toilet, such as the Clivus, builds up to a temperature of about 90°F (32°C), below body temperature, and consequently pathogenic organisms are not destroyed by the heat, but rather by the long pasteurization period. A composting toilet on the other hand builds up high temperature and virtually acts as a combustion chamber. Temperatures may reach as high as 160°F (88°C) and virtually all pathogens are destroyed.

Volume

*It has been assumed that the volume output of organic waste and human excreta is in the order of 10 ft^3/person/year (0.3 m^3/person/year), of which only 20% is excreta. A short-term composting toilet will hence require a holding volume of 60 ft^3 (1.7 m^3) for one year. A long-term mouldering toilet will require 180 ft^3 (5.1 m^3) for the three year period. In either case the humus production is estimated to be about one or two buckets per person annually.

Starting

*In order to start a mouldering toilet it is necessary to build up a layer of rich soil on the bottom of the container in order to introduce micro-organisms to facilitate composting. A layer of peat moss or dry leaves is also required to absorb the urine until the mass of the pile is adequate.

Flies

*Most composting and mouldering toilets seem to have a common problem with flies at the beginning of their operation. This may be due to the internal balance of the pile not yet having been established, a situation which seems to last only a few weeks. The addition of sawdust to the pile helps at this point.

Management

*Small composting toilets require simple management. This primarily concerns regulating the humidity of the pile (it should not get too soggy) and the Carbon/Nitrogen ratio (too much urine raises the nitrogen level, resulting in an ammonia smell. The addition of cellulose containing materials such as leaves, sawdust or paper will raise the carbon level. Mouldering toilets, because of their size need less exacting management, though similar practices would encourage effective decomposition.

What goes in

*Urine, excrement, toilet paper, kleenex, tampax, kotex, paper diapers,paper towels, grease and fat, dust, vegetable and meat scraps,peelings, bones, and eggshells.

What doesn't go in!

*Cans, glass, plastic, paints, toxic liquids, chemicals, pesticides, cardboard boxes, unshredded paper, and especially any chemical sanitary agents.

Capacity

*The Clivus toilet is designed for regular use by no more than six people. Larger models can accomodate up to ten people. Heavier use for short intervals will not affect the toilet, but if more than the recommended number of people use the toilet for any length of time, urine will start to accumulate in the lower chamber. The small composting toilets will, oddly enough, handle waste from more people, since their holding period is so much shorter. The Farallones privy is used by over a dozen people on a regular basis, and as long as urine input is controlled will work well. The Vietnamese composting toilet is likewise used by a larger number of people.

This material is based on material from the Farallones Institute, Clivus Multrum USA and our own experiences in buulding three mouldering toilets.

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✸STOPPING THE FAECAL PERIL✸

Serious students of sanitation, as well as researchers and engineers, will be interested to know that an extensive bibliography of over 500 references dealing with low cost technologies for waste treatment and reuse is now available.

TECHNOLOGY OPTIONS FOR SANITATION - An Annotated Bibliography and Technical Review by Witold Rybczynski, Chongrak Polprasert & Michael McGarry, Published by the International Development Research Centre and the World Bank, May 1978.

This book is available free of charge for underdeveloped countries and for a nominal price if requested from North America, Europe or Australia, from:

International Development Research Centre
Publications Division
Box 8500
Ottawa, Ontario, Canada K1G 3H9

The Sludge Oozes Closer To Long Island

Sewage sludge that metropolitan area waste-treatment plants have been dumping into the Atlantic Ocean for more than 40 years is coming closer than ever to beaches on Long Island's South Shore, one of the region's prime vacation areas.

Last week, Dr. William H. Harris, a Brooklyn College marine scientist who has been studying the effects of sludge dumping off the South Shore, discovered isolated pockets a quarter mile off Atlantic Beach.

Last December, he had found sludge no nearer than a half-mile from shore, hence, the black, oozy substance appears to be moving closer and closer. Further, Dr. Harris said, sludge from the main dumping ground, ten miles offshore, has spread to within three miles of the beach. The scientist said that swimming waters would be contaminated by the sludge by the summer of 1976. The following summer, he added, sludge would be on the beaches.

1974

BEACHES DECLARED OFF LIMITS

MINEOLA, N. Y. (UPI) — A gooey mixture of oil, sludge and "sewage artifacts" washed ashore by the wind and tides Tuesday forced the closing of nearly 60 miles of beaches on Long Island's Atlantic shoreline.

Richard Ornauer, a spokesman for the Nassau County Health Department, said all the beaches were declared off limits because of "an onshore flow of a combination of old oil and sewage artifacts."

1976

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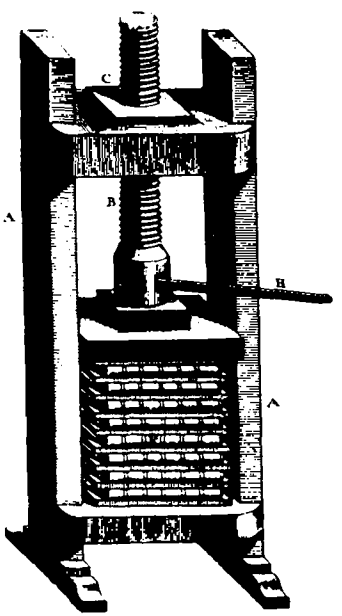
1978

Publications



* THE ECOL OPERATION - Ecology * Building * Common Sense *Describes the building of a house that incorporates sulphur lock-blocks, modular logs, rooftop solar still and recycling toilet.*
Revised edition, 128 pps, 1975.
Also available in French.
PRICE : Cdn.$5.00 postpaid.

* USE IT AGAIN, SAM *An investigation into the design of consumer containers for reuse in building. Chapter by Martin Pawley on garbage housing.*
60 pps, 1975.
PRICE : Cdn.$3.00 postpaid.

* ROOFTOP WASTELANDS *A two year project in community rooftop gardening, includes organics, solar cold frames, container gardening.*
32 pps, November, 1976.
PRICE : Cdn.$2.00 postpaid.