

**MARKET SURVEY -
EXTREMELY LOW FLUSH TOILETS**
PLUS URINE DIVERTING TOILETS AND URINALS,
FOR COLLECTION OF BLACK WATER
AND/OR URINE

February 2001



Preface

The interest in low flush toilets and blackwater systems for single family homes, as well as for blocks of flats, has in recent years increased among homeowners and in the municipalities in Sweden. A number of different products and systems have been developed which are now commercially available. SwedEnviro has in our contact with municipalities, regulatory authorities and others noticed a need for an updated and well documented summary of what toilets and blackwater systems are available in Sweden, Scandinavia, and Europe. Therefore, we took the initiative to compile information about the extremely low flush toilets that are commercially available today.

The survey has been financed by the following actors:

Coalition Clean Baltic
Ekobyggcentrum, Degerfors kommun
Falu kommun
Hedemora kommun
Konsumentverkets testlab
LIP-kansliet i Stockholm
Stockholm Vatten
Sycon Teknikkonsult
Södertälje kommun

Coalition Clean Baltic (CCB) has financed the translation of the report into English.

The authors of the report are Ebba af Petersens, Mats Johansson, and Jonas Andersson. This market survey does not claim to be complete and will have to be updated. If you have information about products that ought to be included, please contact us. Address information can be found on the back of the report.

Uppsala, 21st February 2001

Ebba af Petersens

WRS Uppsala AB
SwedEnviro Consulting Group

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Background

Water-saving sewage handling has many benefits. One of them, of course, is low water consumption. In a normal household, the flush water from the toilet constitutes 25% of the total water consumption (Naturvårdsverket, 1995). By replacing conventional water closets with more low-flushing installations, unnecessary water consumption can be reduced. This is very important in areas with limited groundwater, including many coastal regions. In many cases the settlement borders a sensitive receiving water, while the geology makes small-scale sewage treatment in soil filter beds or through infiltration difficult to achieve. To protect the environment, the nutrient-rich blackwater, which also contains most of the infectious matter in the sewage water, must often be collected in a closed tank. Therefore, another advantage is that lower flush water volume requires fewer emptyings and transports, which saves money for the home-owner.

In this market survey we have chosen to focus on *extremely low flush toilets*, i.e. toilets that flush with a litre of water or less. We have also chosen to include some products that use a somewhat larger water volume but which are part of a promising system or have a double-flushing function where the "small" flush is only a few decilitres. On the other hand, the more "conventional" low-flushing toilets with two and four litres respectively are not included, as these dilute the faeces and/or urine so much that recycling the nutrients to agriculture would be much more expensive. In Table 1 the water consumption for different types of toilets is compared, based on the assumption that each person makes one "large" and five "small" toilet visits per day.

Table 1. Presentation of flush water volumes from some different types of toilets. The compilation is based on the assumption that each person makes one "large" and five "small" visits per day. (Based on Norin, 1996)

Type of toilet	One flush (litres/flush)	Large flush (litres/flush)	Small flush (litres/flush)	Daily volume (litres/flush)
Extremely low flush toilets with gravity sewers (one or two push buttons)	0.6-1	2	0.2	3-6
Vacuum	0.8-2			4.8-12
Urine-diverting		4-6	0.2	5-7
Conventional low-flush (two push buttons)		4	2	14
Conventional (older)	6-12			36-72

Blackwater: a plant nutrient resource

Most of the plant nutrients in wastewater originate from urine and faeces. By diverting the blackwater from the greywater, 80-95% of the plant nutrients nitrogen, phosphorous and potassium in the household sewage water are recovered. These are considered pollutants when discharged to water. Consequently, the pollutant discharge from the household is decreased by the same amount. Furthermore, the discharge of pathogens is decreased, as the main source of bacteria, viruses and parasites is the faeces.

If only toilet paper and matter that has passed through the body are flushed down, the toilet fraction is very clean, and contains a good balance of plant nutrients. The blackwater from an extremely low flush toilet resembles pig slurry very much, in terms of nutrient content, water content, and organic material.

For the blackwater to be usefully recycled to agriculture, it cannot contain too much water. The more the blackwater is diluted, the larger the volume of water that has to be stored, transported, and spread on the fields for the same nutrient content. This also increases costs per household for transport and spreading. Furthermore, disinfection methods require a certain dry matter content.

Handling and treatment of blackwater

In order for blackwater to be used as a fertiliser, it first has to be disinfected and stabilised. One method for reducing pathogens is to treat the blackwater in a liquid composting reactor. Liquid composting is a treatment method where organic material mixed with water is stabilised in a reactor by adding oxygen, to promote the activity of aerobic microbes. The aerobic decomposition generates much heat; temperatures of 60-65 °C can be reached if the sludge has a high enough organic matter content. Sludge that is going to be subjected to liquid composting ought to have a dry matter content of between 3 and 10%. If extremely low flush toilets (less than 1 litre per flush) are used, the mixture of blackwater and organic household waste can be so rich in energy that no extra input of organic matter is necessary. Larger flush water volumes make the system dependent on extra input of manure or other organic matter (Norin, 1996).

Reduction of pathogens can also be achieved through digestion, a process that occurs anaerobically and produces biogas, which can be used for warming of houses, or as fuel in vehicles. Digestion in a biogas reactor is a rather expensive process that is more suited for larger systems.

Storage is another way to treat blackwater. In Sweden, blackwater is treated according to the recommendations for sludge from wastewater treatment plants, which require six months of storage before application to agricultural fields. An expert we discussed this with indicated that this provision will probably be made more stringent in the future.

Example of on-site sewage treatment with blackwater diversion

In a system with blackwater diversion, the blackwater is collected in a closed tank. The remaining wastewater (the greywater) is treated separately. Figure 1 shows an example of on-site sewage treatment with blackwater diversion. The blackwater is collected in a tank, while the greywater is diverted to a septic tank, after which it is treated further. The greywater by itself has much lower levels of nutrients and pathogens than mixed wastewater. A somewhat simpler, less expensive treatment can therefore be used for greywater than would be used for mixed sewage water. In the example below, the greywater treatment consists of a compact filter bed, which is a surface efficient sand filter bed where a folded geotextile together with sand is the substrate for the biofilm, which consists of bacteria, microfungi, and other decomposers.

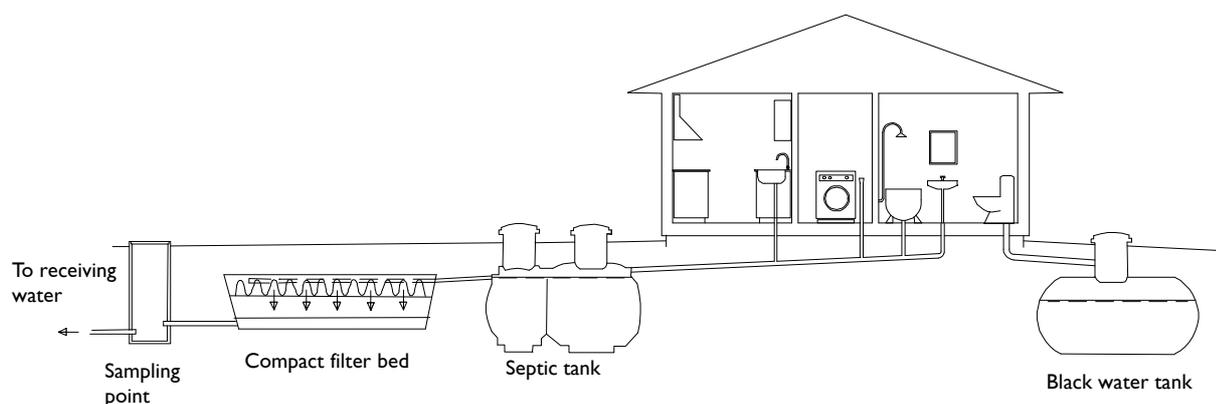


Figure 1. Example of an on-site sewage treatment with blackwater diversion. (Illustration: VERNA Ekologi & Miljökonsult)

Market survey

The facts that are presented in the market survey have been collected during December 2000 and January 2001 and are based on information provided by the manufacturers/retailers. Each product is commented on by the authors, but no close scrutiny has been made. The manufacturers have been located by the internet, by personal contacts, and in relevant literature. About half of the products in the survey have no retailer in Sweden, but all have retailers in northern Europe. A questionnaire (Appendix 1) has been sent out to all, and in most cases this has been followed up by telephone and/or e-mail contact.

Division of the products

The products have been divided into the following four categories based on function:

Water flushed toilets with gravity sewers (page 12 - 19)

The water-flushed toilets with gravity sewers that are described here are often constructed with a cleverly designed trap, which results in a very low flush water volume. Some of these were originally developed for boats or cottages with closed tanks, with the intent of creating as small a liquid volume to handle as possible. Others have been constructed for water saving purposes in areas with a limited water supply. These toilets often have strict requirements for the slope and material of the pipes. If the slope is too level, the waste is not transported away, and if it is too steep the water tends to rush past and leave the waste behind. A plastic pipe is often preferable to a concrete pipe, which has an uneven surface and produces a lot of friction. The space between toilet and tank should generally not be more than 20 m. Otherwise, some kind of pump is required.

Vacuum flushed toilets (page 20-33)

The vacuum-flushed toilets are based on a non-water transportation system; water is only used for rinsing the toilet bowl. The pressure in the pipes is created by means of vacuum pumps, ejectors or compressors. The vacuum toilets were originally mainly developed for use in aeroplanes, on ships, and on trains, but are now becoming more common in ordinary households. A vacuum system requires airtight pipes, but the pipes can be narrow than in systems based on gravity sewers. There are no requirements for slopes or length of the sewage pipes. On the contrary, the sewage can be transported long distances, and can even be transported to a higher level.

A vacuum system is dependent on electricity and can be relatively expensive to install. Many systems today are designed for a larger scale than a single-family household, e.g., schools, hotels and whole villages. The systems require regular service, in many cases by a professional. However, there are also small scale, so called “soft vacuum systems” which are suited for single-family households with a closed tank. In these the vacuum generator is only activated while the toilet is in use, and not running constantly, which leads to lower energy consumption.

Urine diverting toilets (page 34 - 41)

The urine diverting toilets which are described in the market survey below have two bowls and/or two outlets, and two different flush water volumes for the “small” and the “large” flush. A urine-diverting toilet where the large flush is used only at one out of six toilet visits uses much less water than a conventional low flushing toilet. In some models the urine diverting function is combined with a low flush system for the flushing of faeces, e.g., soft vacuum or dry collection of the faeces. In this compilation we have chosen not to describe the latter type of product. Many of these can be found in the market survey by The Swedish Consumer Agency (Konsumentverket), “Dry toilets” (2000, only in Swedish).

Urinals (page 42 - 49)

Urinals have many advantages – they take up less space than water closets and are easy to clean. In the same way as with urine diverting toilets, by combining conventional toilets with urinals, it is possible to reduce the number of “large” flushes. In a large-scale blackwater diversion (or urine diversion) system, urinals are a good complement to ordinary toilets in sports halls, schools, public lavatories, etc. However, urinals are still primarily useful for men.

A new generation of urinals is on the market, in which the idea of using water for flushing has been completely abandoned. Traps using oil-based liquids, floats, and other things have replaced the traditional trap. The installation is easier, since only an outlet pipe is needed. In Sweden, urinals are most common in public buildings, while in Holland, for example, urinals are often found in homes. An objection to installing urinals in private homes is that an ordinary toilet is always needed anyway, and that a urinal requires extra space and involves an extra cost.

Explanation of the headings in the presentation of products

The content is entirely based on information from the manufacturers, with the exception of “Comments” which are the authors’ own points of view.

Category	The products have been divided into four categories based on function: Water toilets with gravity flow, vacuum toilets, urine-diverting toilets, and urinals (see above). The category is found in the heading on the left-hand page.
Model	In the cases where a manufacturer has several products with similar design and function, these are presented together. There is also a picture of each product.
Function	A short description of the function of the product, focusing on the flush mechanism.
Water consumption	Flush water volume. When applicable, both large and small flush volumes are given. In some cases, it is possible to affect the water volume by adjusting flush time, for instance, by pressing the button for a shorter or longer time. The water consumption given is the daily consumption per person, and is based on the assumption that each person makes one “large” and five “small” toilet visits per day. Depending on the usage, the real water consumption can vary considerably. Note that very few manufacturers give actual measurements for water consumption or concentrations of nutrients and organic matter in blackwater.
Other consumption	Consumption of electricity, chemicals, or other resources can be found under this heading.
Design	Material, measures and, in some cases, a sketch of the product or a specific detail.
Installation	A description of how the product is installed, which pipe connections are needed, and what are the requirements concerning pipe material, slope, and distance between toilet/urinal and tank. An explanation of the abbreviations of technical terms that are used in the text can be found on page 51.
Maintenance	Replacement of parts, cleaning of pipes, general service, daily cleaning, specific maintenance instructions, and need for supervision by a plumber or other professional.
Price	For most products a price to the customer including VAT is stated. For products without a retailer in Sweden, the price is given in the local currency, with an approximate price in SEK in brackets. Also described is what is included in the delivery, such as refill liquid, pipes, screws, and guarantees.
References	Number of installed products of this model in Sweden or abroad, examples, etc.
Miscellaneous	Whether the product is part of a complete system, whether there are extra choices, any special commercial seals of approval the product has earned, technical approval, etc.
Contacts	Manufacturer and retailer in Sweden or closest country – address, telephone, homepage.
Comments	Comments from the authors.

MARKET SURVEY EXTREMELY LOW FLUSH TOILETS



(Illustration: Peter Ridderstolpe, WRS Uppsala AB)

PLUS URINE DIVERTING TOILETS AND URINALS,
FOR COLLECTION OF BLACKWATER
AND/OR URINE

Gustavsberg Miniflush

Model

Miniflush

Function

The toilet is constructed to flush with an extremely small flush volume through a flush valve, i.e. without a conventional flush reservoir. To achieve this, the water closet is constructed with a flexible trap with a small water volume. By activating the push button, water flushes into the WC-bowl via a flush tube. At the same time, the trap opens and faeces, toilet paper and water are flushed out. When the flush valve closes, the trap is also closed.

Water consumption

A flush volume of 1,0 litre at a water pressure of 3 bar is set at the factory. The flush time can be increased or decreased by means of an Allen wrench and thereby the flush volume is increased or decreased. The daily water consumption is estimated at 6 litres per person.

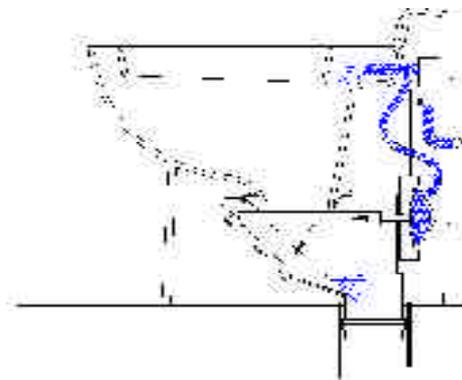
Other consumption

None.



Design

Miniflush is floor mounted. The bowl is made of porcelain, the lid of plastic, the trap and related parts of stainless steel, the flush valve of brass, the push button of chromed plastic, and the pressure chamber of plastic/rubber.



When the toilet is flushed a valve is pressurised at which a dipper is opened and the toilet bowl is emptied. After flushing the dipper is closed and the trap is filled with fresh water.

Measure	mm
Back to front	540
Width	375
Sit height	420

Installation

The pipe connections are placed by the floor. The outlet pipe is 110 mm and the incoming water pipe is 15 mm. The toilet is attached to the floor with screws.

A requirement to obtain good flushing is a water pressure of at least 3 bar. Requirements for the sewage pipe are a dimension of 90-110 mm, a slope of at least 2%, and a distance of no more than 20 m between toilet and the tank. The dimension of the water pipe should be 15 mm.

Maintenance

The same service as a conventional WC.

Price

The toilet is not commercially available at present (February 2001), but is expected to become available during the spring of 2001. Therefore the price is not fixed yet. A preliminary price to the customer is 6,500 SEK (incl VAT). The delivery includes a complete water closet ready to install.

Other

This model in porcelain is an improved model of a toilet with a similar function and the same name, which was made of plastic and metal.

References

The new Mini Flush is not yet available on the market. About 50,000 of the earlier plastic model were sold for 15 years by the former manufacturer, DP Sanitär AB. There are a number of these toilets installed at the camping site at Skara Sommarland in Sweden.

Contact

Manufacturer

AB Gustavsberg

Box 440

SE-134 29 Gustavsberg

Sweden

Tel: +46-(0)8-570 391 00

Fax: +46-(0)8-570 32 036

www.gustavsberg.com

Comments

The plastic model is well-proven. Many of those who work with large-scale blackwater treatment have great expectations for the model in porcelain. A toilet that uses such a small volume of flush water has strict requirements for the slope, material, and dimension of the sewage pipes.

Sealand Technology Inc

Sealand

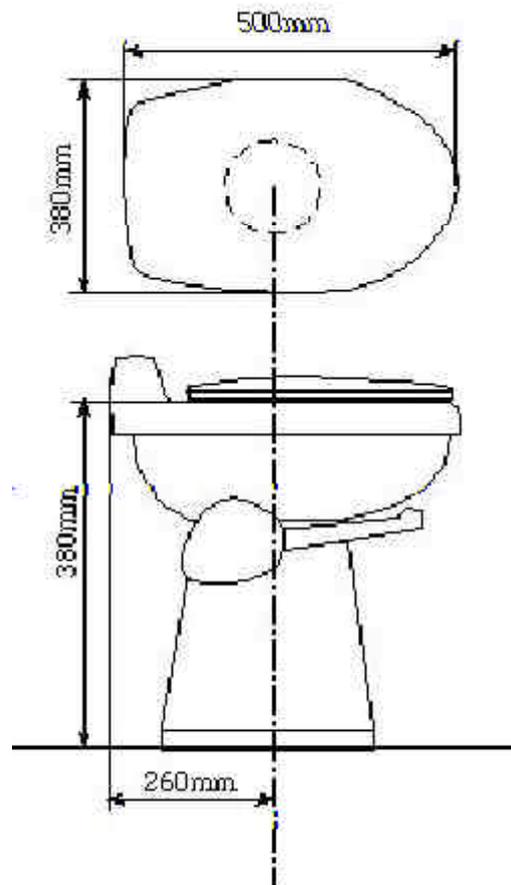
Model
Sealand

Function
The toilet is flushed like an ordinary water closet, but a ball valve that opens when the toilet is flushed replaces the trap of an ordinary toilet. Emptying and replacing water in the trap is what consumes the largest amount of water in a WC.

Water consumption
The amount of flush water when the toilet is used for urination is about 1-2 dl, which is used for replacing the water volume above the ball valve. The flush water volume for transportation of solid waste and paper is about 1 l and can be accumulated either before or after use by lifting up the flush pedal with the foot. The flush water volume is affected by how long the flush pedal is pressed. The estimated daily water consumption per person with this toilet is 2 litres.

Other consumption
None.

Design
The toilet is made of porcelain; the seat and lid are available in plastic or wood. Other details are in plastic and stainless steel.



Measure	mm
Back to front	500
Width	380
Height	380

Installation

The toilet is connected to the sewage pipe with a 110 mm connection, and to water with a 1/4" connection. The recommended slope of the sewage pipe is 5%, and the distance between toilet and tank should not be more than 10 m.

Maintenance

Overhaul by a technician should be done once a year.

Price

The price of the toilet is about 3,200 SEK (incl VAT).

Miscellaneous

Organic household waste can be added to the blackwater tank through the toilet or through a separate sink grinder. The toilet can be purchased by itself or together with Clivus Multrum composting tank. It is suited for summer cottages as well as permanent houses.

References

Clivus has sold about 40-50 Sealand toilets in Sweden, mainly to private persons. They can give references if asked.

Contact

Manufacturer

SeaLand Technology, Inc.
P.O. Box 38, Fourth Street
Big Prairie, OH 44611, USA
Tel: +1-330-496-3902,
+1-800-321-9889
Fax: +1-330-496-3128
E-mail:
sealand@sealandtechnology.com
www.sealandtechnology.com

General agent in Sweden

Plastimo Nordic
Box 28
SE-473 21 Henån
Tel: +46-(0)304- 360 60
Fax: +46-(0)304-307 43
E-mail:
mikael.andersson@plastimo.se

Retailer

Clivus Multrum Int. AB
Ålberga Boställe
SE-610 50 Jönåker
Tel: +46-(0)155-72310
Fax: +46-(0)155-72390
E-mail:
torb@clivus-multrum.se
www.clivusmultrum.com

Comments

The flush water volume is very low with this toilet. This means that the requirements for the slope and length of the sewage pipes are especially strict. There are, as far as we know, no follow-up studies on the function of this toilet and the frequency of blocked pipes, but it is a popular boat toilet. As it is made of porcelain, the toilet does not give a particularly "camping" feeling.

Thetford Aqua Magic

Model

Aqua Magic Starlite

Function

The flush mechanism of the toilet is constructed to give a good flush effect with a very small flush water volume. Flushing is controlled with two foot pedals. When the larger pedal is pressed, a valve is opened and the toilet is flushed. If only the little pedal is pressed, the valve remains closed and water fills the toilet bowl. The larger pedal is pressed quickly for a small flush and for a longer time for a large flush.

Water consumption

The flush water volume is controlled by the time the foot pedal is pressed; approximate consumption is 2 litres of water for the large flush and 0.2 litres for the small flush. The daily water consumption per person with this toilet is estimated at about 3 litres.

Other consumption

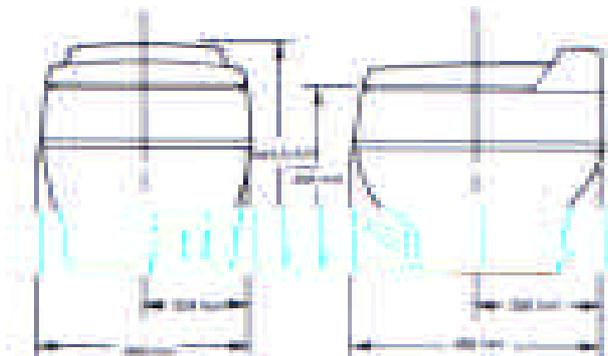
None.



Design

The toilet is floor-mounted and made of polypropylene (hard plastic that resembles porcelain).

Measure	mm
Back to front	480
Centre of outlet to back	260
Width	410
Sit height	432



Sketch of Aqua Magic Starlite high model.

Installation

The toilet is connected to the sewage system with a 110 mm pipe connection that is placed right under the toilet. The incoming water valve has a 3/8" (R10) internal pipe thread. The toilet is fixed to the floor with two screws. To avoid blockage of the pipes, no 90° bends on the sewage pipe should be used (2 x 45° instead).

When the distance between toilet and tank is more than 4-5 metres, the pipes should have a slope of 4-5%. The manufacturer recommends a distance of not more than 10 m, even though 15-20 m has worked well in some cases. It is an advantage if a clearing door is placed on the way to the tank, so the pipes can be cleaned easily without removing the toilet. The sewage pipe should be 110 mm and made of polypropylene or PVC.

Maintenance

A mild soap solution is recommended for cleaning the toilet. Chlorine-based products should not be used as they can harm the finish

Contact

and gaskets. Also, polishing products should be avoided as they may scratch the surface of the toilet.

Price

Recommended price to the customer is 3,718 SEK (incl VAT). The price includes the toilet and everything that is needed for connection (connection flange, fix bolts, sponge rubber gasket).

Miscellaneous

The toilet is technically approved (no T 1107-72) in Sweden and in all Nordic countries. There is also a shorter model suited for boats.

References

Between 30,000-50,000 toilets of this model have been installed in Sweden since 1969. The toilet has mainly been sold to private persons. An example is a toilet at Torsten Nilsson's home in Ludvika, (tel +46-(0)240-19 419), which has been in use since 1973. Aqua magic toilets can also be found in a number of tourist coaches.

Manufacturer

Thetford B.V.
Repres. Office Scandinavia
Brodalsvägen 7
SE-433 38 Partille, Sweden
Tel.: +46-(0)31-336 35 80
Fax: +46-(0)31-44 85 70
E-mail: infos@thetford.nl

General agent in Sweden

Prodema
Box 165
SE-592 24 Vadstena
Tel: +46-(0)143-120 70
Fax: +46-(0)143-310 22
E-mail: e-post@prodema.se
www.prodema.se

Comments

Aqua Magic has been on the market a long time and is well proven. A motivated user can save a lot of water, as the flusher controls the amount of flush water. The flushing control mechanism, which is a bit different from a conventional WC, may seem awkward at a user's first visit. As the toilet is not made of porcelain, but of plastic, it might give a certain "camping feeling" and might be more difficult to keep clean.

The same toilet is also marketed as Porso Spoltolett by Porso VVS Agenturer, but is then not imported through the Swedish importer.

Wost Man Ecology Clever

Model

WM Clever (with or without urine diversion)

Function

The toilet has a patented trap that is bent down by means of a foot pedal, whereby the waste and flush water are washed away. The flushing and refilling are controlled by 12 V solenoid valves, a technique which produces less noise than what is produced by ordinary toilets when the reservoir is refilling.

Water consumption

The toilet is flushed with about 0,6 litres of water. In toilets with urine diversion, the urine bowl can be flushed separately with 0-0.4 litres of water. The large flush can be varied by pressing the foot pedal for shorter or longer times. The urine flushing can also be varied by pressing the push button for shorter or longer times. The daily water consumption with this toilet is estimated at 0.6-2.6 litres per person.

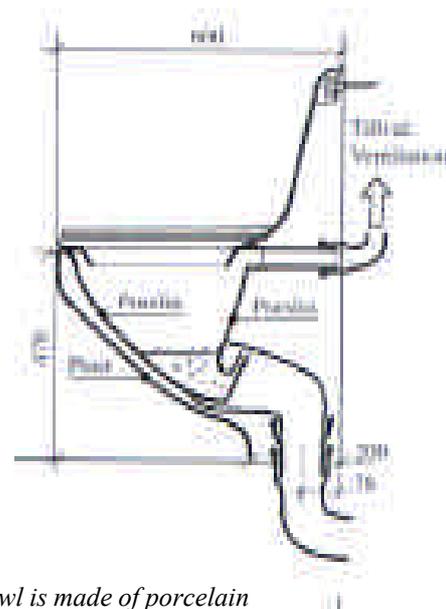
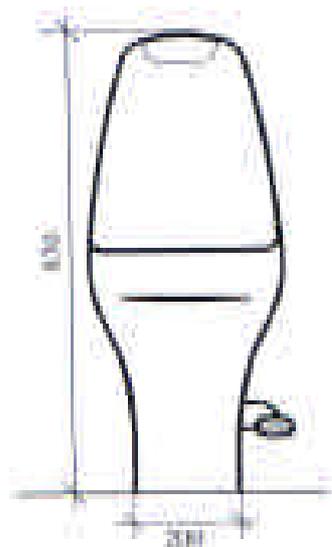
Other consumption

None.



Design

The toilet is mounted against the wall but rests entirely on the floor. The toilet bowl (with or without urine diversion) is made of porcelain, and the coating is made of sanitary plastic. Seat and lid are made of plastic and are of the usual size.



Measure	mm
Back to front	600
Width	370
Height	870
Sit height	470

The toilet bowl is made of porcelain and the coating as well as seat and lid is made of plastic. Ventilation is available as an extra choice.

Installation

The toilet is mounted to the wall with four screws. It is connected to the sewage system with a 110 mm connection. The connection is through the floor, and can be up to 110 mm away from the wall. The incoming water is through a R15 connection, and an optional urine pipe connection is 50 mm. In the urine-diverting model, the urine pipe is placed directly beside the ordinary sewage pipe.

A slope of no more than 1% and a distance of not more than 10 m between toilet and blackwater tank are recommended. For the urine pipe there are no distance limits. Pipes with dimensions of 50 mm or more and slopes of 1% are recommended.

Maintenance

No specific service is needed; the toilet is handled in the same way as an ordinary WC.

Price

Price to customer is 8,425 SEK (incl VAT). The delivery contains a toilet including seat.

Miscellaneous

The toilet can also be ordered with a so-called "bowl ventilation", i.e., ventilation of the toilet bowl, which removes all possible stench after a toilet visit. This is designed for use in public toilets.

References

There are around five Clever systems installed in Sweden. Examples can be found at Kompost Center at Överjärva Gård in Solna, Sweden (toilet used by visitors), and in a house that is part of a research project that Stockholm Vatten has been running since the spring of 2000. Some toilets have been delivered to Denmark.

Contact

Manufacturer

Wost Man Ecology AB
Sprängarevägen 18
SE-132 28 Saltsjö-Boo
Tel: +46-(0)8-715 13 20
Fax: +46-(0)8-715 13 21
www.wost-man-ecology.se

Retailer

KompostCenter AB
Överjärva Gård
Magasinet
SE-170 68 Solna
Tel: +46-(0)8-655 07 50
Fax: +46-(0)8-655 0810
E-mail:
kompostcenter@telia.com
www.kompostcenter.se

Retailer in western Sweden

Porso VVS Agenturer AB
Sofielundsvägen 50
SE-429 44 SÄRÖ
Tel: +46-(0)31-93 55 64,
+46-(0)31-21 22 14
Fax: +46-(0)31-93 55 98
E-mail: info@porso.se
www.porso.se

Comments

The toilet is relatively new on the market and is still unproven. Since it is now being tested in a research project there will be more knowledge about the product in the future. It is important to be extra careful with the plumbing for a toilet with such a small volume of flush water and gravity sewers.

Evac Oy Evac

Model

Evac 900, Evac 90

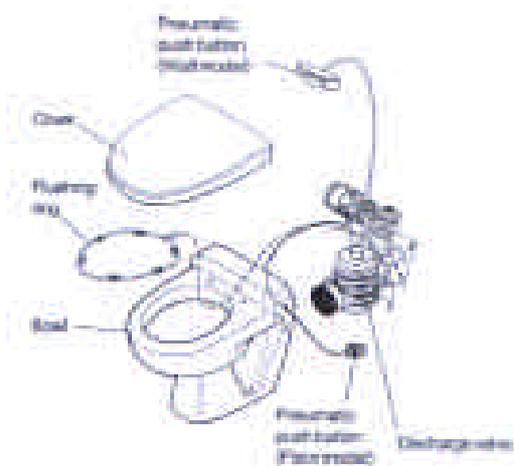
Function

The toilet is flushed by a vacuum instead of water and gravity. Water is only used for rinsing the toilet bowl and not for transporting the waste. The vacuum system makes it possible to lift the waste vertically limited distances and to transport the waste long horizontal distances.

Evac's vacuum systems consist of vacuum toilets and intake units that carry the sewage water to a central vacuum unit via a system of pipes. The pipes from toilets and intake units are connected in sections on each floor to the main pipe, which leads to the vacuum unit. The vacuum system is pneumatically run and only requires a water connection to the toilets and electricity for the vacuum unit.

Water consumption

The water consumption is 1.2 l per flush. The flush water volume can be adjusted by setting the toilet's water valve, to 0.7-1.5 litres per flush.



*Evac 900,
wall mounted*



*Evac 90,
wall mounted*

The daily water consumption with this toilet is estimated at between 4.2 and 9 litres of water per person.

Other consumption

The vacuum system is run by electricity. The amount of electricity consumed depends on the size of the system.

Design

The toilets are available in both wall-mounted and floor-mounted models. The toilet stool is made of white porcelain; seat and lid are made of polypropylene. Evac 900 has a slightly more modern design and is quieter than Evac 90. Furthermore, it has hinges of metal that can tolerate heavy use in, for example, a public lavatory.

Measure	Evac 900 silent wall mounted	Evac 90, silent floor mounted	Evac 90, silent wall mounted
Back to front	550	560	560
Width	415	385	385
Height	430	465	415

Installation

The wall model is fixed to the wall with two stud bolts and the floor model is fixed to the floor with screw and plug. The sewage connection is 50 mm and the water supply is 1/2". The outlet connection is placed on the wall between 100 and 150 mm from the floor, depending on the model.

The main sewage pipe should have an outer dimension of 50-75 mm, depending on the number of toilets connected to the system, and should have a slope of 0.5%. Recommended pipe materials are steel, PVC, or HDPE. The piping should be tight and at least of pressure class PN10 and must be equipped with inspection hatches and transport pockets. The distance between toilet and tank can be 2-1000 m.

Maintenance

Like all technical systems, Evac's vacuum system requires regular service. Most components

(valves, filters, etc.) should be examined and cleaned annually, and replaced about every five years in a private house. In public lavatories some components have to be changed annually. The service should be done by a professional.

Price

All three models presented have a recommended price of 580 EUR each (about 5,180 SEK). A complete vacuum system starts at 18,000 EUR (about 160,000 SEK).

References

Several thousand vacuum toilets from Evac have been installed in Sweden. Evac's toilets can be found at PUB Hotel in Stockholm, at the school of Kvikksund in Eskilstuna, and at Green Zone rest area in Umeå. Abroad, Evac's toilets have been installed in Australia, Brazil, Great Britain, Finland, France, Italy, Germany, the US, etc. Furthermore, Evac's toilets are found on a large number of ships around the world, including on most ferries between Sweden and Finland.

Contact

Manufacturer

Evac Oy, Building Systems
Purotie 1
FIN-00380 Helsinki
Finland
Tel: +358-9-506 761
Fax: +358-9-506 763 33
www.evacgroup.com

General agent in Sweden

PoV, Pump- och
Vakuumsystem AB
Jägerhorns Väg 10
SE-141 75 Huddinge
Tel: +46-(0)8-680 03 60
Fax: +46-(0)8-710 11 62

Comments

Evac's vacuum toilets are very appropriate for a large-scale blackwater system. They are suitable for hotels, hospitals, shopping malls, etc., but also for villages and assemblies of houses, as the sewage pipes between the toilet and tank may be up to a kilometre long. This system is not meant for the home owner with an individual tank.

Jets Standard AS

Jets

Model

Jets 50, Jets 59

Function

The toilet is sold as part of a system consisting of a patented vacuum generator, called a “vacuumator”, a toilet, and electrical controls. When the user presses the button, the vacuumator is started and builds up necessary vacuum in the pipe system. After a few seconds the toilet valve is opened and the content is sucked into the vacuumator. There, the waste is ground into fine particles and then pumped on to a tank or external sewer system.

Water consumption

The water consumption is 0-1.2 l per flush. That corresponds to an estimated daily water consumption of 0-7.2 l per person. The amount of flush water can be changed by adjusting the water valve on the toilet. This is done when installing the toilet and can not be adjusted during the toilet visit.

Other consumption

The energy consumption has been measured at 0.002 kWh each toilet visit, which corresponds to about 10 kWh/year in an average-sized family.

Design

There are wall-mounted as well as floor-mounted models. The toilet bowl is made of porcelain and the seat and lid are made of plastic. The toilet is also available in steel.

Measure (mm)	Wall mounted	Floor mounted
Back to front	535	535
Width	363	382
Sit height	425	465

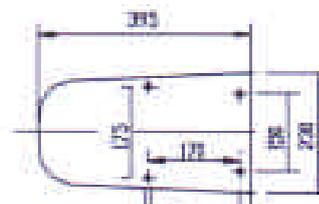


Jets 50

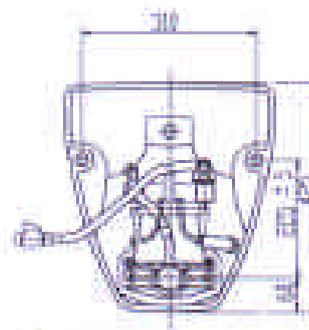


Jets 59

Sketch from bottom
Jets 50
(floor mounted)



Sketch from back
Jets 59
(wall mounted)



Installation

The wall model is fixed to the wall with two 12-mm screws. The floor model is fixed to the floor with two bolts. The outlet connection is placed in the wall 100 or 115 mm above the floor with a 50-mm connection. Connection to the water is done through a 1/2" threaded ball valve.

The sewage pipe can be 32 or 50 mm and made of PVC, PEH, stainless steel, etc. There are no requirements for pipe slope, and the sewage water can be transported horizontally, or even vertically to a higher level.

Maintenance

The toilet requires about the same service as a conventional toilet.

Price

Price per toilet is NOK 5,000 (about 5,440 SEK). The cost of a complete system including vacuumator with electrical controls, a toilet and pipes for a toilet is NOK 29,900 (about 32,500 SEK). The products have a one year guarantee.

Miscellaneous

It is possible to buy a system with constant vacuum in the pipes, if required. The vacuumator is available in various models. The company also manufactures tanks.

References

About 100,000 Jets toilets have been sold since 1986. In Sweden, 185 Jets toilets have been installed since 1993.

Contact

Manufacturer

Jets Standard A/S

Postboks 14

N-6069 Hareid

Norway

Tel: +47-70 03 91 00

Fax: +47-70 03 91 02

E-mail: post@jets.no

Comments

Jets has developed a vacuum system designed for the single family home with a tank.

Vacuum is built up when pressing the push button, so the vacuumator does not run between the toilet visits. Even if this system is relatively cheap to install for a vacuum system, it is still a costly way to transport the toilet water to the tank. Treatment of the greywater and emptying of the tank is still

needed. However, it is possible to connect several toilets to the same vacuumator.

KTH Arkitektur

LVS Low vacuum system

Model

LVS (Low Vacuum System) toilet

Function

The toilet is flushed with low vacuum. The idea is based on an efficient flushing and low water consumption, at a moderate vacuum for a silent function. The toilet has no trap, but an outlet valve. Garbage grinders can also be connected to the system.

Water consumption

The toilet consumes 0.35 l of water with the small flush and 1.9 l with the large flush. The daily water consumption is estimated at 4 l per person.

The flush water volume cannot be adjusted during use, only via the electrical controls.

Other consumption

The manufacturer puts the electricity consumption for a family of 2.8 persons at not more than 250 kWh/year, including ventilation. However, the manufacturer also rates each toilet at 275 W power consumption, which is closer to 2500 kWh/year.

Design

A wall-mounted toilet with flush mechanism, outlet valve, electrical controls. In all other ways, it is as an ordinary toilet. Measurements have not been decided on yet, but will follow industry standards. The toilet stool is of double-glazed porcelain, the seat and lid of thermosetting plastic.

Installation

The toilet is fixed to the wall with the help of a strengthening steel frame. The two connecting points are of standard dimension and placement. Pipe connections to the sewage system have a 63 mm outer dimension. The vertical transport of the blackwater is done with pipes with an outer dimension of 75 mm. The vacuum unit has 75 mm discharge pipes.

There are no requirements for pipe slope, but the distance between toilet and tank should not exceed 5 m. Welded polyethene pipes are recommended. If necessary, cleaning of the pipes can be done from the pipe shaft or by removing the toilet.

Maintenance

Service of the system should be done by a professional.

Price

The product will be sold as a complete package, including toilets, emptying equipment for garbage grinders and collection units that contain fan and pump. The product is not commercially available yet, and the price has not been set.

Miscellaneous

The system is primarily designed for a multi-storey building with one collection unit per stairwell. There will be a function guarantee on the system.

References

The product is still not installed and is found only as a laboratory prototype today. An article about the system will probably be presented at the Stockholm Water Symposium in August, 2001.

Contact

Manufacturer

Bo-Göran Hellers
KTH Arkitektur,
Konstruktionslära
SE-100 44 Stockholm
Tel: +46-(0)8-790 8528
Fax: +46-(0)8-14 94 19
E-mail:
bogoran@arch.kth.se

Comments

A new exciting system for multi-storey buildings. The idea to tie garbage grinders into the system is not new, but nevertheless interesting. This should give a good waste product to treat and then recycle to agriculture, without needing an extra supply of organic material in the form of manure or the like. This vacuum system is designed for a larger sewage system than the single-family home.

Microphor Microflush

Model

Microflush

Function

The toilet is air assisted, using compressed air to evacuate the toilet along with about 2 litres of water.

Water consumption

The toilet consumes 2 litres of water while flushing. The water volume for a standard flush can be set to less than 2 litres, while the volume can also be increased by pressing the push button longer. The daily flush water volume with this toilet is estimated at 12 litres per person.

Other consumption

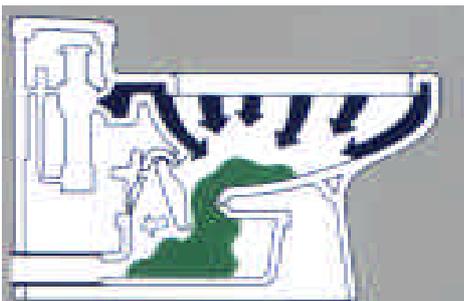
As with all vacuum operated sewage systems, electricity is consumed by the vacuum compressor. However, the energy consumption is small. The toilet's flush pressure is created by means of a compressor as small as or smaller than the one in a refrigerator.



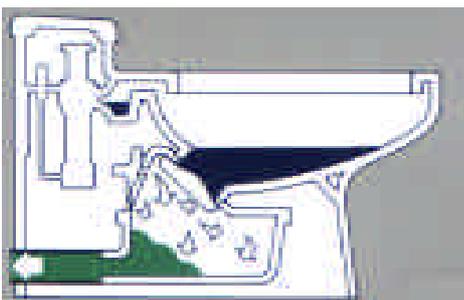
Design

The toilet is floor-mounted and made of porcelain with plastic components inside. The lid and seat are available in various materials, from plastic to luxury seats in teak and other materials.

Measure	mm
Back to front	623
Width	419
Height	476



When the push button is pressed, the hatch is opened and the waste is flushed down. When the hatch is closed water continues filling up the bowl. The waste and water is then flushed away with vacuum.



Installation

The toilet is fixed to the floor with 4 closet screws (6 mm). Water hook-up is a 1/2" straight pipe on the side of the toilet. The toilet outlet is 1 1/2", and the outlet can be connected through the floor or the wall. The wall connection is 556 mm above the floor.

If the distance between toilet and tank is less than 10 m, the sewage pipe can have a dimension of 1 1/2", otherwise the pipes should be 3 or 4". If the distance is longer a gravity sewer is needed with a minimum slope of 2%.

Maintenance

The toilet should be serviced every 3 years by installing an air and water valve rebuild kit. This can be accomplished by the owner if he/she is handy, otherwise a plumber is suggested.

Price

The toilets have primarily been sold to large installations, and no price to individual customers is available.

Miscellaneous

The toilet is mainly sold in a system suited for ships or trains, the "Microphor-system", which is based on a compost tank where the toilet waste is composted before being let over board.

References

Microflush is installed on ships, trains, and buses all over the world. In the Nordic countries about one hundred Microflush toilets have been sold to smaller cargo- and fishing vessels, portable buildings for construction sites, etc., primarily in Norway and Finland. Examples of this toilet can be found with British Rail and Alaska Coast Fisheries (a complete reference list can be ordered from the manufacturer).

Contact

Manufacturer

Microphor
452 East Hill Road
Willits, CA 95490
USA
Tel: +1-707-459-5563
www.microphor.com

General agent in Finland

Oy Wiwaco AB
P.O. Box 60
FIN-00421 Helsingfors
Finland
Tel: +358-(0)9-546 1680
Fax: +358-(0)9-546 1680
E-mail: wiwaco@sci.fi

Comments

The water consumption of the Microflush-toilets is rather high, considering that they are vacuum flushed. We have no information about the degree of treatment in the compost tank that the toilet often is sold together with. Price information for single toilets is not available as they are mainly sold in systems or to wholesalers.

Roediger Vakuum + Haustechnik

Roovac Vacuum Toilet

Model

Roovac vacuum toilet

Function

The vacuum toilet is connected to a vacuum sanitary system via interface valves. After use of the toilet, flushing is triggered with the push button. The intermediate valve opens for approximately 4 seconds and the bowl is flushed with water. After flushing, the bowl is refilled with water.

Water consumption

The toilet is flushed with about 1 litre of water per flush, measured during use. The toilet is estimated to give a daily flush water volume of 6 litres per person. The amount of water used per flush cannot be changed.

Other consumption

Energy consumption is low, since the pumps are not running constantly. The yearly consumption is about 10-12 kWh per person.

Design

The toilet is made of sanitary porcelain and is available in a wall-mounted or floor-mounted model.

Measure	mm
Back to front	530
Width	340
Height	350



Installation

The toilet is connected to the vacuum system with a DN 40 connection and to water intake with a 55 mm connection. The toilet is fixed to the wall with screws.

The sewage pipes should be suitable for vacuum (PN 10), and made of PVC or PE. No slope is required. It is not necessary to be able to flush the pipes, as the speed and turbulence in the pipes are high and no sedimentation occurs. This system is suitable for buildings situated at some distance from each other, as there can be a long distance between toilet and tank.



*Roovac vacuum toilet
inside the cover.*

Maintenance

Service should be done annually.

Price

The toilet is not sold separately but as part of a complete system including pipe systems and vacuum station. The price depends on the extent and layout of the whole system.

Miscellaneous

The toilet is approved by the German institute for Building Technique in Berlin, approval no Z-53.6-410, dated July 31, 2000, valid through June 30, 2005.

References

About a hundred toilets have been installed in Germany. Examples can be found at Sparkasse in Frankfurt, at the train station in Darmstadt, and other places. No toilets of this type have been installed in Sweden. The manufacturer is participating in a pilot project in Lübeck where an integrated sewage system with three separate fractions (blackwater and organic kitchen waste, greywater and storm water) is being tested. The blackwater and kitchen waste is treated in a small-scale biogas plant.

Contact

Manufacturer

Roediger Vakuum. und Haustechnik
GmbH
Kinzigheimer Weg 104-106
D-63450 Hanau
Germany
Tel: +49-(0)6181-30 9-0
Fax: +49-(0)6181-30 92 80
E-mail: info-vacuum @passavant-
roediger.de

Comments

As with most vacuum toilets, these toilets are designed for larger systems like multi-storey buildings, hotels, etc., and are not sold separately. This system could also be suitable for villages and small groups of houses, as short pipe distances are not required.

Sealand Technology Inc Sealand Vacuflush

Model

Sealand Vacuflush

Function

The system consists of a toilet and a vacuum generator. The flushing is done with a foot pedal.

Water consumption

The flush water volume has been measured at 0.5-0.9 litres per flush. The flush water volume can be changed by pressing the foot pedal for a longer or shorter time. The estimated daily flush water consumption is 3-5.4 litres per person.

Other consumption

The generator runs about 30 seconds during each flush. The pump uses 24 volts, 2 amp, which means 0.018 amp/h. This has partly been documented.

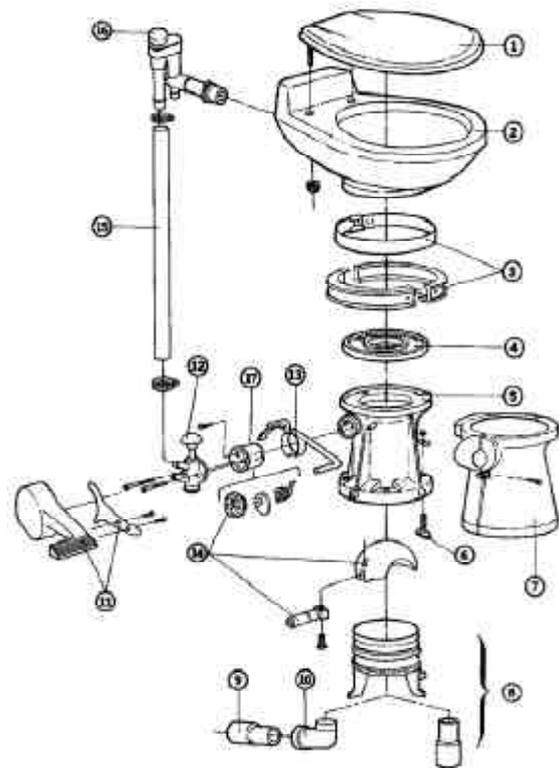
Design

The toilet is floor-mounted and made of porcelain. The lid and seat are made of plastic.



Measure	mm
Back to front	508
Width	378
Height	467

Diagram of Sealand Vacuflush. This picture is taken from Sealand's homepage, where an explanation of the numbers also can be found.



Installation

The connections are of PVC, 1/2" outer thread for incoming water and 38 mm (outer diameter) for sewage outlet.

The distance from the toilet to the vacuum generator should not be more than 6 m. No recommendations are given for distance to the tank. A special tube that is sold together with the toilet or a gravity sewer pipe (38 mm) of PVC, is recommended between the toilet and the tank.

Maintenance

The reverse valve of the vacuum generator should be replaced annually (as a precaution). This can be done by the house owner. If there is a risk of frost, the incoming water pipe should be emptied.

Price

The price for a toilet including vacuum generator is 12,500 SEK (incl VAT). The manufacturer gives a 2-year guarantee.

Miscellaneous

Sealand Vacuflush is available in many different sizes and colours.

Sealand also manufactures a water-flushed toilet. It is, for example, sold together with the Clivus Multrum composting tank.

References

The toilet is, as far as we know, not installed in buildings, but is manufactured as a boat toilet.

Contact

Manufacturer

SeaLand Technology, Inc.
P.O. Box 38, Fourth Street
Big Prairie, OH 44611,
USA
Tel: +1-330-496-3902,
+1-800-321-9889
Fax: +1-330-496-3128
E-mail:
sealand@sealandtechnology.com
www.sealandtechnology.com

General agent in Sweden

Plastimo Nordic
Box 28
SE-473 21 Henån
Tel: +46-(0)304- 360 60
Fax: +46-(0)304-307 43
E-mail:
mikael.andersson@plastimo.se

Comments

This toilet is primarily designed for boats, but can probably work well in a house, as long as the tank is placed close to the house. The vacuum generator requires 24 volts, so a transformer connected to the power source is required. The toilet might be suitable, for example, in a cottage with no electricity, where the toilet is connected to a 24-volt battery. Sealand is made of porcelain, which is easy to keep clean.

Wost Man Ecology Clever-Vac

Model

WM Clever-Vac (with or without urine-diversion)

Function

The vacuum is created in the moment the push button on the toilet is pressed. The vacuum engine is placed close to the blackwater tank. In the urine-diverting version the urine bowl is flushed with a special push button and the urine-water flows out by gravity, separate from the vacuum system.

Water consumption

The toilet is flushed with 0.5 litres (large flush) and 0-0.4 litres (small flush). It is not possible to adjust the large flush during a toilet visit, but only by adjusting the electronics of the toilet. The little flush is adjusted by how long the push button is pressed. The estimated flush water consumption is 0.5-2.5 litre per person and day with this toilet.

Other consumption

The energy consumption for running the vacuum engine is about 2 kWh per year.

Design

The toilet is “wall standing”, which means that it is fixed to the wall but rests entirely on the floor. The toilet bowl (with or without urine diversion) is made of porcelain, and the outside is of sanitary plastic. The seat and lid are of plastic and of standard design.

Measure	mm
Back to front	600
Width	370
Height	870
Sit height	470



Installation

The toilet is fixed to the wall with four screws. The outlet connection is placed through the floor up to 110 mm out from the wall and can also be placed in the lower part of the wall. The pipe dimension of the outlet connection and a possible urine pipe connection is 50 mm, and the incoming water pipe is a R15 connection. In the urine-diverting version, the urine outlet is placed right beside the ordinary outlet.

No specific recommendations are given concerning the slope of the sewage pipe. Steep uphill runs and sharp bends should be avoided. The distance between toilet and tank should not exceed 20 m. There are no distance limits for the urine pipe, but the pipe should have a dimension of at least 50 mm and a slope of 1%.

Maintenance

No specific service is needed; the toilet is handled in the same way as an ordinary WC.

Price

Price to the customer for a toilet stool: 7,450 SEK, vacuum engine 1.4 kW: 4,000 SEK and a vacuum lock: 3,125 SEK (all prices including VAT).

Miscellaneous

The toilet can also be ordered with a so-called "bowl ventilation", i.e. ventilation of the toilet bowl which removes all possible stench after a toilet visit. This is especially designed for public toilets.

References

About 50 Clever-Vac systems have been installed in the last four years, mostly in Sweden but also in Finland, Denmark, and Germany. An example is installed in a house that is part of a research project run by Stockholm Water from 2000 to 2003.

Contact

Manufacturer

Wost Man Ecology AB
Sprängarevägen 18
SE-132 28 Saltsjö-Boo
Tel: +46-(0)8-715 13 20
Fax: +46-(0)8-715 13 21
www.wost-man-ecology.se

Retailer

KompostCenter AB
Överjärva Gård
Magasinet
SE-170 68 Solna
Tel: +46-(0)8-655 07 50
Fax: +46-(0)8-655 0810
E-mail:
kompostcenter@telia.com
www.kompostcenter.se

Retailer in western Sweden

Porso VVS Agenturer AB
Sofielundsvägen 50
SE-429 44 SÄRÖ
Tel: +46-(0)31-93 55 64,
+46-(0)31-21 22 14
Fax: +46-(0)31-93 55 98
E-mail: info@porso.se
www.porso.se

Comments

This model is recommended by the manufacturer when a system with a closed tank is required, when water supply is scarce, or when gravity sewers are impossible. The energy that is used by this toilet is small. As always with electronic technology, of course, there is a certain risk of shutdown. Clever-vac is relatively new on the market. However, as it is now being evaluated in the project that Stockholm Vatten is running, there will in

the future be more knowledge available on the function of this toilet.

BB Innovation & Co AB

Dubbletten

Model

Dubbletten

Function

The toilet is urine diverting and the construction is based on two well-separated bowls, a rear for faeces and a fore for urine. The faeces bowl has a collar that effectively stops the flush water from the large bowl from reaching the urine bowl. The toilet is flushed with two independent flush systems. The toilet is equipped with a trap to prevent stench.

Water consumption

The toilet is flushed with 4 l for the large flush and 1.5-2 dl for the small flush. The large flush can be adjusted to between 4 and 6 litres, by adjustment of the float. The small flush is affected by how long the push button is pressed. The daily water consumption for this toilet is estimated at 5-7 litres per person. Measurements have shown that the volume of urine + flush water from the small flush is 1.5-2 litres/person/day.

Other consumption

None.

Design

The toilet is made of porcelain, with lid and seat of birch or plastic. The seat is constructed so that children, too, can sit in the proper position for proper sorting of urine and faeces. The toilet is available in two models, wall mounted or floor mounted.

Measure (mm)	Wall mounted	Floor mounted
Back to front	570	680
Width	370	340
Height	400	805
Sit height	365	415



Installation

The floor-mounted model is fixed to the floor with screws, and the wall-mounted model is attached via a reinforcing fixture behind the reservoir. The toilet is connected to incoming water with a 1/2" connection. The outlet connection is 110 mm and the urine outlet connection is 75 mm.

Maintenance

The toilet should be cleaned with a biodegradable detergent. Wood and metal surfaces should be oiled once a month. If the urine outlet is getting blocked the manufacturer recommends pouring down a teaspoon of lemon acid mixed with a litre of hot water and leaving it overnight.

Price

Both models cost about 6,190 SEK. The fixture for the wall mounted model is about 1,190 SEK. The price of the wooden lid is about 1,190 SEK and of the plastic lid is about 410 SEK. All prices include VAT.

Miscellaneous

The toilet is also sold in a complete system where a urine tank and septic tank for the faeces and greywater are included. The urine tank is made of concrete and has two chambers. It is filled from below and equipped with a float and rubber gasket to protect the urine from contact with the air. The septic tank is made of concrete, and faeces and organic household waste are collected in a basket in the upper part of the septic tank. The liquid is drained off. The greywater inlet is placed below the compost basket.

References

Dubbletten has been sold since the early 1990s. Two places where it has been installed in Sweden are the eco-village Understenshöjden in Björkhagen and the housing area Palsternackan in Enskede.

Contact

Manufacturer

BB Innovation & Co AB
Carl Larssons väg 30
SE-168 50 Bromma
Tel: +46-(0)8-87 71 00
Fax: +46-(0)8-37 05 28
E-mail: info@dubbletten.nu
www.dubbletten.nu

Comments

The information above is collected from the manufacturer's home page and brochures, as it has not been possible to reach the manufacturer for comments.

Dubbletten was one of the first urine diverting toilets on the market and has been used in several research projects on the subject. The toilet looks less ordinary than some other urine diverting toilets with its characteristic "lid in the lid" for children. The

high middle wall and collar create a barrier, which prevents flush water from the faeces bowl contaminating the urine outlet. A rather undiluted product with little faecal contamination is obtained with this toilet.

By connecting both the ordinary outlet and the urine outlet to the same tank, a urine-diverting toilet can be used for reducing the amount of flush water, compared to a conventional WC, provided that the large flush is used only for faeces.

Gustavsberg Nordic

Model

Nordic 393 U

Function

The toilet consists of two bowls where the rear is for faeces and paper while the fore is for urine. The flushing is triggered by a push button.

Water consumption

The toilet has a large and a small flush of 4 and 2 litres, respectively. When the toilet is flushed, about 10% of the flush water volume ends up in the urine bowl. The estimated daily flush water consumption is 14 litres per person. The flush volume can easily be adjusted.

Other consumption

None.

Design

The toilet is wall mounted and made of porcelain. The standard seat and lid are of white propylene plastic. There is also a hard seat with plastic or stainless steel attachments available as an option.



Installation

The toilet is fixed with bolts to the wall. The bolt projection should be 50 ± 2 mm. Incoming water connection is with a R 1/2" thread.

Measure	mm
Back to front	640
Width	345
Height	760



The fore bowl is for urine and in the rear bowl faeces and paper is flushed down.

Maintenance

The toilet is maintained in the same way as a conventional WC.

Price

The price of the toilet with the standard seat is 6,125 SEK (incl VAT). With hard seat and metal attachments it is 6,598 SEK (incl VAT).

Washers, gaskets and M12 nuts are enclosed, but not bolts. Rubber sleeves and a hose clamp are included.

Miscellaneous

To connect the urine-diverting pipe, the manufacturer recommends a 40 mm attachment through the wall, which can be ordered separately. When mounting on weak walls a fixture is recommended, which also can be ordered separately.

References

The toilet has been installed in the housing area Kullön in Vaxholm, Sweden.

Contact

Manufacturer

AB Gustavsberg

Box 440

SE-134 29 Gustavsberg

Tel: +46-(0)8-570 39 100

Fax: +46-(0)8-570 32 036

E-mail:

info@gustavsberg.com

www.gustavsberg.com

Comments

It is good that the large toilet manufacturers are aware of urine diverting technology.

Gustavsbergs new urine diverting toilet is part of their "Nordic" series and therefore looks more or less like a conventional WC.

This toilet gives a relatively diluted urine solution as about 10% of the flush water is rinsing the urine bowl, regardless of whether it is large or small flush.

This toilet is the one that has the highest

estimated flush water volume in the market survey, and is included to give a complete picture of what urine diverting toilets are on the market. The toilet uses as much flush water as "conventional" low flush toilets. Installing this toilet in order to reduce water consumption and to get concentrated black-water by emptying both outlets to the same tank is, therefore, pointless.

Roediger Vakuum + Haustechnik

Roevac No Mix Toilet

Model

Roevac No Mix Toilet

Function

This patented toilet has two separate outlets: one conventional outlet for faeces and paper placed in the rear part of the toilet bowl, and one for urine, which is closed mechanically. When the toilet seat is in use, a plug is opened by a lever. Urine flows to the forward outlet. When the person stands up, the plug closes again. The two parts of the toilet bowl are not separated by a barrier. As soon as the toilet is flushed the urine plug is closed. When needed, faeces and paper is washed away through the rear outlet. Urine is taken away undiluted. An incorrect use, e.g., by children, is not possible. According to the manufacturer, paper and faeces cannot enter the urine outlet.

Water consumption

The flush water volume for the small flush is zero and for the large flush around 6 litres. This amount cannot be affected through adjustment of flushing time, etc. The daily water consumption per person is estimated at 6 litres with this toilet.

Other consumption

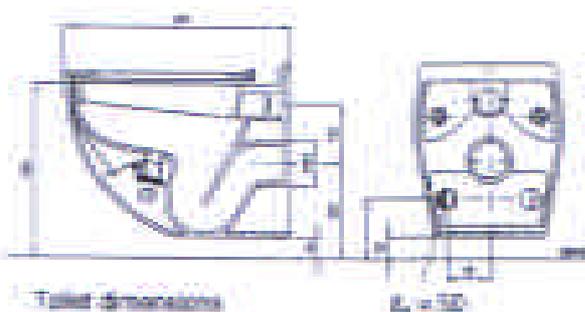
None.



Design

The toilet is made of sanitary porcelain and is at present available as wall mounted. A floor-mounted model will be commercially available at the end of 2001.

Measure	mm
Back to front	530
Width	340
Sit height	350



Sketch from the side and from the back of Roediger No mix toilet.

Installation

The toilet has two outlets plus an incoming water pipe, which follows European standards. The incoming water pipe is 55 mm, the urine outlet 50 mm and the sewage water outlet is 102 mm. The toilet is fixed to the wall with screws and can stand a maximal load of 400 kg.

There are no specific recommendations concerning slope of sewage pipe or distance between toilet and tank, and the installation should be done according to common plumbing practice. The urine pipe should be DN 50, and it should be possible to flush the urine pipe if necessary. The sewage pipe for faeces and paper should be DN 100.

Maintenance

No extra service is needed for toilet or pipes. The urine outlet should be cleaned from time to time. During normal use, no water enters the urine outlet. This prevents the sedimentation of urea, according to the manufacturer.

Contact

Manufacturer

Roediger Vakuum. und Haustechnik GmbH
Kinzigheimer Weg 104-106
D-63450 Hanau
Germany
Tel: +49-(0)6181-30 9-0
Fax: +49-(0)6181-30 92 80
E-mail: info-vacuum@passavant-roediger.de
www.roevac.de

Price

1,400 D-Mark (about 6,350 SEK). Two year guarantee.

Miscellaneous

The German manufacturer is interested in finding a retailer in Sweden.

References

About a dozen toilets have been installed in Germany, primarily at institutes, etc., for testing purposes.

Comments

This is a new model among urine diverting toilets. When collecting the urine, this toilet gives a good non-diluted product since no water is used for the flushing. There is also a lower risk of contaminating the urine, as faeces-contaminated flush water cannot enter the urine outlet. Something worth mentioning, though, is that urine diversion cannot be done while standing up as the plug for the outlet then is closed.

The large flush consumes 6 l of water. There is therefore no point in installing this toilet to get a concentrated blackwater by letting the urine and faeces outlets go to the same tank. There are cheaper and simpler toilets for this purpose, with the same or lower water consumption.

Wost Man Ecology WM-DS

Model
WM-DS

Function

The toilet works like an ordinary water closet, and is connected to existing water and sewage pipes. A special urine pipe is also connected. The toilet bowl is divided by a wall, where the rear part is for faeces and paper and the front part is for urine.

Water consumption

The flush water volume is 3.5 litres for the large and 0-0.7 litres for the small flush. By adjusting the float, the amount of water for the large flush can be increased or decreased. The small flush is easily adjusted by how long and hard the push button is pressed. The daily water consumption for flushing this toilet is estimated at 4-7 litres per person. Measurements have shown that the amount of the combined urine + flush water from the toilet is about 2.5 litres per person.

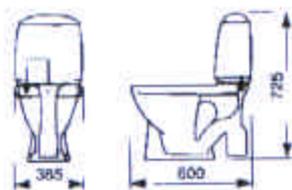
Other consumption

None.

Design

The toilet is floor-mounted and made of porcelain with a seat and lid of plastic. The seat is of standard design.

Measure	mm
Back to front	650
Width	350
Height	770
Sit height	410



Installation

To install the toilet, three connections are required: water R15, faeces water 110 mm, and urine outlet 50 mm. The toilet is fixed to the floor with four screws.

The outlet connection is placed 110 mm from the wall. (All measurements are calculated to the centre of the holes from the wall.) The urine outlet is placed best directly under the toilet, i.e., 500 mm out from the wall, but it is also possible to connect the urine tube somewhere behind the toilet, e.g., in the wall. There is great flexibility, and the idea is that it should be easy to replace a conventional WC with this urine-diverting toilet without any major operations.

The recommendation from the manufacturer is a sewage pipe of 110 mm with a 1% slope. The urine pipe should be at least 50 mm.

Maintenance

No special service is needed; the toilet is cleaned like a conventional WC.

Price

Recommended price to the customer is 5,525 SEK. The price includes toilet with seat, plus a rubber device for connection of the urine tube to the sewage pipe. A two year guarantee is given.

Miscellaneous

A higher foundation to place the toilet on and a special trap for the urine tube, for internal mounting in the toilet, are available as accessories.

References

In the last seven years, about 2,400 toilets of this model have been installed. Most of the toilets have been delivered within Sweden and the Nordic countries. Some have been delivered to the rest of Europe, primarily to Germany, and a few to the States.

Contact

Manufacturer

Wost Man Ecology AB
Sprängarevägen 18
SE-132 28 Saltsjö-Boo
Tel: +46-(0)8-715 13 20
Fax: +46-(0)8-715 13 21
www.wost-man-ecology.se

Retailer

KompostCenter AB
Överjärva Gård
Magasinet
SE-170 68 Solna
Tel: +46-(0)8-655 07 50
Fax: +46-(0)8-655 0810
E-mail:
kompostcenter@telia.com
www.kompostcenter.se

Retailer in western Sweden

Porso VVS Agenturer AB
Sofielundsvägen 50
SE-429 44 SÄRÖ
Tel: +46-(0)31-93 55 64,
+46-(0)31-21 22 14
Fax: 031-93 55 98
E-mail: info@porso.se
www.porso.se

Comments

WM-DS was one of the first urine diverting toilets on the market and has been tested in several eco-villages. It has proven to work well. With the DS-toilet, the dilution of the urine is somewhat higher than with some other urine diverting toilets, since a larger amount of water is flushed down the urine outlet.

By connecting both the ordinary sewage and the urine outlet to the same tank, this

toilet can be used to decrease the flush water amount, compared to a conventional WC. As with all urine diverting toilets, it is essential that the large flush is only used for about one out of six toilet visits to get the required water saving effect. The handling of toilet paper can affect this.

F. Ernst Ingenieur AG Ernstsystems

waterfree urinals

Model

System Ernst model 3000 and 4000

Function

The urinal does not use any water for flushing; it is entirely based on gravity. The urine passes through an odour lock with a sealing liquid that works as a stench barrier. The urine, which is heavier than the liquid, sinks down through the liquid and further down the drain. The urinal is treated with a disinfectant coating to prevent the growth of bacteria that cause the stench.

Water consumption

The urinal consumes no water.

Other consumption

The sealing liquid is filled up each week; annual consumption is about 1,3 litres. The liquid is biologically degradable.



Modell 3000



Modell 4000

Design

The urinals are made of glass fibre reinforced polyester. White is the standard colour, and a number of different colours can be chosen for an extra cost. There is also a new model in sanitary porcelain, model 5000.

Measure	Model 3000	Model 4000
Back to front	290	290
Width	505	505
Height	960	680

Installation

The urinal is bolted to the wall with screws and plugs, which are included. The outlet connection is 50 mm. The pipe from the urinal can be connected to the sewage system straight through the wall or be connected just above the floor.



The stench trap consists of a liquid that is lighter than water. The urine, which is heavier than the liquid, sinks down through the liquid and further down the drain.

Maintenance

The daily maintenance consists of rinsing the urinal with cold water. Once a week the urinal should be cleaned with a special detergent marketed by the manufacturer. At the same time the barrier liquid is filled up. The urinal should be serviced 3-4 times a year if it is visited 100-200 times a day. The service consists of siphon replacement and application of a disinfectant coating.

Price

The price of the urinal is 800 DEM (about 3,630 SEK). A year's supply of the barrier liquid is 15 DEM (about 70 SEK).

Miscellaneous

The manufacturer has a number of different models; both wallhung single urinals and slab urinals, all based on the same waterless technique.

References

About 200,000 urinals have been sold in Switzerland and Germany, and about 100,000 in other countries. Examples are found in Wanderer's Cricket stadium in Johannesburg, and in a number of schools, public buildings, concert halls, etc., in Baden-Baden, Dachau, Nettetal and other cities in Germany and Switzerland. Written opinions from the customers can be ordered from the manufacturer.

Contact

Manufacturer

F. Ernst Ingenieur AG
Riedwiesenstrasse 18
Postfach
CH-8305 Dietlikon/ZH
Switzerland
Tel: +41 1/833 31 13
Fax: +41 1/833 18 36
www.ernstsystems.com

Comments

The water free flush system is interesting. It is good that the barrier liquid is biologically degradable. Of course, it sounds strange that the urinal can be free from stench, when no water is used for flushing and it is only cleaned once a week, apart from a daily rinsing with cold water, but this is what the manufacturer guarantees. The glass fibre model might be more difficult to keep clean. It is not known what effects the barrier liquid

might have if spread on agricultural fields along with the urine. The urinal is about half as expensive as some other similar urinals on the market.

Reese A/S

Uridan non water system

Model

Uridan non water system

Function

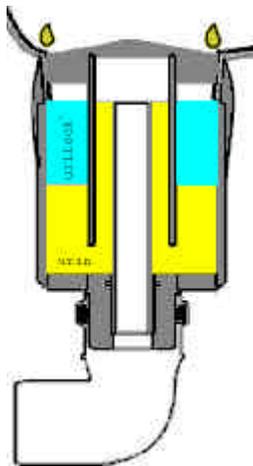
The urinal uses no water for flushing, but is completely based on gravity. The urine passes through a trap with a liquid with a lower density than water, which works as a stench barrier. Urine, which is heavier than the liquid, sinks down through the liquid and further down the drain.

Water consumption

The urinal consumes no water.

Other consumption

The barrier liquid in the water lock needs to be changed after 5000-7000 visits (i.e. once a year in a one-family-household). At each change 0.3 l liquid is used. The liquid has the brand name Urilock and is, according to the manufacturer, environmentally friendly.



The urine passes through a trap with a liquid with a lower density than water, which acts as a stench barrier. As urine is heavier than the liquid it sinks down through the liquid and further down the drain.



Design

The urinal is made of impact resistant fibreglass, with a hard and smooth surface. It is available in two standard colours, granite and white, and can be floor- or wall-mounted.

Measure	mm
Back to front	394
Width	412
Height	790

Installation

The sewage outlet connection is 50 mm. When connecting to the wall, the connection should be placed 380 mm from the floor.

Maintenance

For daily cleaning, the manufacturer's own product is recommended, an anti-bacterial protecting wax that is sprayed on the urinal and then wiped off. Fat-soluble detergents should not be used. Cleaning and change of the trap can be done by the user or owner; no special service is required.

Price

The urinal with a wall connected outlet is 5,080 DKR excl VAT (about 7,640 SEK incl VAT). The urinal with an outlet through the floor is 5,407 DKR excl VAT (about 8,130 SEK incl VAT). Special colours are available at a cost of 5% over the standard price. A one year guarantee is included.

The delivery includes urinal including mountings, a bottle of barrier liquid (0.3 l), a bottle of detergent (0.5 l) and a cloth. The barrier liquid costs 134 DKR excl VAT (about 200 SEK incl VAT).

Miscellaneous

Uridan is approved in Denmark (VA 2.54/11428), Norway, and Germany.

References

The urinal has been sold since 1999 in Denmark, where about 1500 are installed. Examples are found in St Gertrud's monastery in Copenhagen and Brøndby Stadion (224 urinals). A complete reference list with the names of contact persons and telephone numbers can be ordered from the manufacturer.

Contact

Manufacturer

Reese A/S
Snerlevej 3,
DK-6100 Haderslev
Denmark
Tel: +45-74 52 65 10
Fax: +45-74 82 71 71
E-mail: uridan@reese-as.dk
www.uridan.com

Comments

The waterless flush system is interesting, but the use of daily anti bacterial detergent raises questions. How does this affect the quality of the waste product, i.e. urine or blackwater, if the urinal is connected to a collection system? It is not known what effects the barrier liquid might have if spread on agricultural fields along with the urine. The urinal is rather expensive. As the urinal is made of glass fibre, it may be more difficult to keep clean.

Urimat Handels AG

Urimat

Model

Urimat

Function

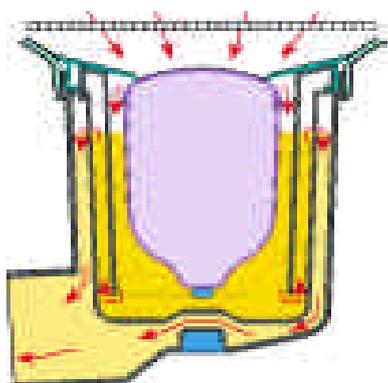
The urinal has no trap, but instead a patented stench trap insert in the form of a float. The urine passes into the cylindrical inner piece of the pan and from there to the overflow chamber, whereby the float rises and seals the inlet opening against a flexible sealing lip. When the urine in the overflow chamber reaches a certain level, it flows into the drain of its own accord. Every time the urinal is used, an electromagnet draws the float down again to ensure complete emptying of any residual urine.

Water consumption

No water is consumed in flushing this urinal.

Other consumption

The urinal requires a supply of electricity to keep the float down while in use. However, this only consumes 0,0027 kWh per visit.



The urinal has no trap but a patented stench barrier in the form of a float.

Design

The urinal is made of acrylic and is wall mounted. It is also available in ceramic. An advanced model with a lit advertising display is available. When a person approaches the urinal, the advertising is illuminated with a backlight.

Measure	mm
Back to front	389,6
Width	410
Height	880

Installation

The urinal is fixed to the wall and connected to a power source. The urinal is not connected to water, but only to the sewage system with a 50-mm connection. There are no special requirements for slope or distance to the tank. Sewage pipes of polyethylene or polypropylene, 50 mm, are recommended.

Maintenance

The urinal should be cleaned and disinfected, just like any other urinal. The stench trap should be replaced about once a year in an average-sized household. If the urine is not flushing down properly, it is time to replace the trap. With heavier use the stench trap should be replaced more often, up to 8 times a year.

Price

Price to the customer in Switzerland is 1,290 CHF (about 7,500 SEK). The model made of porcelain is 1,590 CHF (about 9,200 SEK) and the advanced model is 1,790 CHF (about 10,400 SEK). The manufacturer gives a 3 year guarantee. The cost for replacing the stench trap is 69 CHF (about 400 SEK).

Miscellaneous

The product has the Europe approval done in Germany.

References

The urinal has been installed in Austria, Germany, Italy, Spain, Turkey etc. It has so far not been installed in Sweden. Examples can be found at the airport in Frankfurt, at the Mövenpick hotels, at McDonalds in Fuchsberg, Novartis, and other places.

Contact

Manufacturer

Urimat Handels AG
Alte Tannerstrasse 25a
CH-8632 Tann-Rüti / ZH
Switzerland
Tel: +41-55 251 52 30
Fax: +41-55 251 52 31
E-mail: info@urimat.com
www.urimat.com

Comments

Urimat's variant of stench barrier is interesting, as it does not require any chemical additives. If the stench barrier fulfils the manufacturer's promise and does not smell, this is an important development. Unfortunately, the urinal is relatively expensive. The energy consumption caused by keeping the float down at toilet visits is very low. The question is how reliable it is. The acrylic model may be difficult to keep clean.

Waterless

No-flush

Model

Waterless No-flush

Function

The urinal does not use any water for flushing, and is entirely based on gravity. The urinal has a coating that is liquid repellent and therefore hostile to bacteria. The urine passes through a trap with an oil-based liquid that acts as a stench barrier. The urine, which is heavier than the liquid, sinks down through the liquid and then down the drain.

Water consumption

No water is consumed in flushing this urinal.

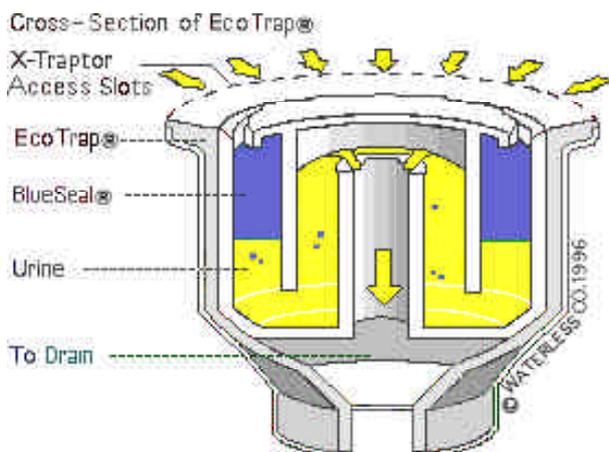
Other consumption

The barrier liquid with the brand name BlueSeal, that constitutes the stench barrier in the trap, contains mineral oils and aliphatic alcohols. It is over 95% biodegradable. Yearly consumption of this liquid is about a litre in an average-sized household.



Design

The urinal is wall-mounted and made of high performance composite.



Measure	mm
Back to front	254/356
Width	457
Height	711

Installation

The outlet connection is 2". The installation is done with two mountings and a gasket.

The slope of the sewage pipe should be 2%. The manufacturer recommends ABS-pipes or other approved plastic pipes.

The figure shows the trap (EcoTrap) in section, where the urine, which is heavier than the barrier liquid (BlueSeal), sinks down through the liquid and further down the drain.

Maintenance

The urinal is cleaned just like a conventional urinal. Sediment is retained in the trap. Therefore, it has to be changed about once a year in an average-sized household, and up to six times a year depending on frequency of visits. If the pipes have to be flushed, this is easily done through the outlet of the urinal.

Price

The price to the customer in the States is \$278.50 (about 4,500 SEK). The delivery includes urinal, BlueSeal liquid, a special tool for changing the trap, and mountings.

The liquid is \$16 (about 150 SEK) per litre (which is the annual consumption in an average-sized household). A three year guarantee on the urinal's material is standard.

Miscellaneous

The urinal is suitable for frequent use, for example, in public lavatories.

References

About 20 000 urinals of this model have been installed in the States the last 10 years. They can be found in federal buildings, schools, banks, restaurants, cruise ships, etc. Examples are in the Statue of Liberty, Hard Rock Café in La Jolla, California and the University of Arizona. A reference list can be ordered from the manufacturer. The product is approved in the USA, Germany, England, Israel, South Africa and Australia. It has not yet been installed in Sweden.

Contact

Manufacturer

WATERLESS CO.
1223 Camino Del Mar
Del Mar, CA 92014
USA
Tel:+1-858-793-5393
Fax: +1-858-793-5661
www.waterless.com

General agent in Great Britain

Relcross Ltd
Hambleton Ave., Devizes
Wiltshire SN10 2RT
UK
Tel: +44-1380-729 888
Fax: +44-1380-729 600
E-mail:
mcmaster @wyenet.co.uk

General agent in Germany

DRL Hygiene-systeme
GMBH
Ellerstrasse 101
D-40721 Hilden
Germany
Tel: +49-2103-5879-0
Fax: +49-2103-5879-49
E-mail: info@drl.de

Comments

The waterless flush system is interesting. If the product fulfils the promise of the manufacturer, and does not smell, this is an important development. It is not known what effects the barrier liquid might have if spread on agricultural fields along with the urine. However, there is a very small volume of barrier liquid compared to urine. Also, it might be possible to replace the mineral oil with a vegetable oil product. As the urinal is

not made of porcelain, it may be more difficult to keep clean.

Literature cited (most is only available in Swedish)

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- Stockholm Stads LIP-kansli. 2001. *System för separat uppsamling av matavfall och avloppsvatten från klosetter*. Invitation to technique competition .

Representatives from each company that have contributed information.

Torbjörn Lindström	Clivus Multrum AB
Mikael Wichmann	Evac Oy
Dr Bob W. Illy	F Ernst Ingenieur AG
Rolf Ling	Gustavsberg
Bjarte Hauge	Jets Standard AS
Bo Göran Hellers	KTH Arkitektur
Rurik Wahlstein	Oy Wiwaco Ab
Mikael Andersson	Plastimo Nordic AB
Eva Andersson	Prodema AB
John Reese	Reese A/S
Stefan Behnke	Roediger Vakuum und Haustechnik GmbH
Rainer Stadler	Urimat Handels AG
Klaus Reichardt	Waterless Co LLC
Bengt Ström	Wost Man Ecology AB/Kompostcenter

Definitions

Blackwater	Waste water from the toilet – faeces, urine, paper, and flush water
Greywater	Water from bath, shower, dishes, and washing machine
Nitrogen	A plant nutrient. Chemical term: N
Phosphorous	A plant nutrient. Chemical term: P
Potassium	A plant nutrient. Chemical term: K
Reservoir	The part of the toilet that holds the flush water.
Sewage water	Sewage water from a household
Storm water	Rain and melting water that does not infiltrate to the groundwater, and is not taken up by vegetation, but instead flows on hard surfaces such as roofs, roads, and parking lots.
Trap	A U-shaped or S-shaped bend in a drainpipe, filled with a water barrier, that prevents the stench of sewer gas from entering the house.

Explanation of abbreviations

Abbreviation	Explanation
DN	Nominal diameter
R10, R15	Pipe thread
PN	Pressure class
PEH	High density polyethene
PVC	Polyvinylchloride
PE	Polyethylene

Questions that have been put to the participating manufacturers

1. Name of your product (toilet or urinal) which is suitable for the collection of black water in a septic tank:
2. Is the toilet/urinal designed for usage all year around or primarily for summer cottages?

Function

3. How does the toilet/urinal work? Describe the principle and specially important parts of the construction. (E.g. if it uses vacuum, gravitation, hand pump, if it separates urine etc)
4. a) What is the water consumption per flush? (little or big flush respectively if there is a choice)
b) Has this been measured during real use?
5. Is it possible to affect the flush water amount by adjustments of the toilet, how long the pushbutton is pressed or such?
6. a) How much energy is used while using this toilet? How large is the yearly consumption for a normal-sized family living in a permanent house, in kWh? (e.g. for vacuum pumps, blowers etc)
b) Is there any documentation available on this?
7. If any chemical/soap solution or the like is used –
a) how much is an estimated yearly consumption of this for a normal-sized family?
b) what is the cost for a yearly consumption?
8. a) Is there any possibility of co-treatment with organic household wastes?
b) Describe how this can be done.
9. Which type of service is required for keeping the toilet, pipe system and collection in shape? Describe the work that is needed, how often it has to be done and what type of competence that is required for this (house-owner, plumber, manufacturer).

Design

10. a) How is the toilet/urinal constructed? (please enclose a drawing/sketch with measures, if possible)
b) Is it wall or floor mounted?
c) Measures from back to front?
d) Width?
e) Height?
11. What material is the toilet, lid and other details made of?

Installation

12. Pipe connections:
a) number?
b) dimension?
c) placing?
d) are they following any standard? (which?)
13. a) Is any kind of suspension device or attachment needed for the installation of the toilet?
b) number of attachments?
c) dimension?
d) are they following any standard? (which?)
14. What demands are there on pipes between toilet/urinal and tank?
a) dimension
b) slope
c) distance between toilet/urinal and tank
d) material
e) watertightness
f) possibility to flush or clean the pipes
g) etc

Market survey - Extremely low flush toilets

Price etc

15. What is the price (excl. V.A.T.) to a wholesale dealer? What is the recommended price to the customers (incl. V.A.T.)?
16. What is included in the delivery?
17. a) Do you offer complete sewage systems for black water collection in single family households or block of flats?
b) What is included in these systems? (e.g. tank, pipes, vacuum pumps etc.)
c) Price (excl V.A.T.)?
18. Is the toilet/urinal type approved in Sweden? Is it type approved in other countries?
19. Do you give any guarantee for function of the toilet/urinal and equipment, and if so, how long time?

References and documentation

20. a) How many toilets/urinals of this model are installed in Sweden?
b) Please, give some references and how long they have been in use.
21. a) How many toilets/urinals of this model are installed outside Sweden, where?
b) Please, give some references and how long they have been in use.
22. a) Are there any results in written form or scientific articles published about this product?
b) Please state the title and the name of the author.

Contact information

23. Manufacturer and general agent in Sweden (or closest country)
 - a) contact person (name and e-mail address)
 - b) address
 - c) telephone number
 - d) fax number
 - e) home page (if any)
24. Please enclose a picture (photo or sketch) of the toilet/urinal. (If digital pictures, send in tif-format or Jpg at least 300 dpi)



SwedEnviro Consulting Group has been formed by a number of small companies that work with soil, water, sewage, resource management, transportation, education and environmental management systems. Within this group, people with broad knowledge and many years' experience with small and large commissions, both in Sweden and abroad, work together.

The companies that constitute the group are: EcoManagement SE, Svenska Ekocentrum Konsult, Verna Ekologi & Miljökonsult AB, Vattenresurs AB and WRS Uppsala AB.

For further information about the group's activities and the companies that work together, please visit our homepage:
<http://www.swedenviro.com>

This report can be ordered from:

WRS Uppsala AB
Östra Ågatan 53:5
SE-753 22 Uppsala
Tel: +46-(0)18-60 41 03
E-mail: roaguide@swedenviro.com

You are invited to send information about new models, price lists and other facts that can be included in an updated version of this report, which probably will be released during 2002.