Household Dry Toilets

An overview of current theory and practice in various countries, with suggestions for supporting the sector in France.

SUMMARY

OCTOBER 2010

TOILETTES DU MONDE

PREAMBLE

This document summarises the study on household dry toilets which was carried out by the French organisation Toilettes Du Monde, following the inclusion in 2009 of dry toilets within the regulatory framework which governs on-site sanitation[1]. The objective of this research has been to bring together available information on household dry toilets, as well as information about how this sector is being developed and managed within France, in other European countries, and elsewhere in the world. In the light of these findings, suggestions have been made for a proposed framework in order to better support household dry toilets in France.

The full report is available for download on Toilettes du Monde's website: www.toilettesdumonde.org

CONTENTS

[1] Assainissement Non Collectif (ANC)

I. Current theory and knowledge

How household dry toilets work

By 'household dry toilets' we mean systems which are, for the most part, managed by their user-owners. It is however relatively difficult to give a simple definition of the term 'dry toilet'. The lack of a flush is not on its own a defining criterion; other more general objectives must also be included in the definition, such as protecting the environment, public health, etc.

There are many types of dry toilets, each functioning in a different way. The most common way of classifying these design variations is to make the distinction between those toilets which collect urine and faeces together (called compost toilets or biolitter toilets) and those which separate the two types of excreta (called urine diversion toilets). The size of receptacles for collecting matter, which are usually directly under the toilet seats, may also vary. There are both compact systems, in which the receptacle is simply placed directly on the floor of the room, and 'connected' systems, in which the receptacle is put in a room or chamber below the toilets, therefore enabling it to be much larger in size.

By-products management

The ways in which systems are maintained and the type(s) of by-products to be emptied depends on the dry toilet model used. The main by-products must be managed by the users and include both liquids and solid matter, such as: urine, leachate, compost and faecal matter (either dehydrated or not yet dry). When using a biolitter toilet (BLT)[2] solids are usually emptied on a weekly basis, whereas when using compost or separation systems which manage large volumes, emptying can be done yearly, or even every few years. However, though they require frequent emptying for solid matter, BLTs produce no liquid by-products, whilst other systems can produce tens or even hundreds of litres per person, per year. Any potential dry toilet owner-user should be well aware of these issues when deciding which system is best adapted to his or her needs.

At household level, by-products are generally collected and re-used in the garden. It should be emphasised that these by-products have significant agronomic importance, and are highly beneficial. As for other fertilisers and soil-improvers, recommended doses should be followed, depending on the soil-type and the crop grown. Collective management of sanitation by-products is also possible, enabling them to be beneficially re-used on a larger area of agricultural land.

However, from a sanitary perspective, certain precautionary measures should be taken when dealing with these by-products, due to the pathogenic organisms which are present, particularly in faecal matter. Knowledge and understanding of hygienisation techniques (composting, dehydratation, alkaline treatment, etc) at a household level remains incomplete, though the World Health Organisation (WHO), as well as numerous countries, has made specific recommendations concerning

[2] The BLT is a compost toilet. It consists of a bucket (15-40 litres), inside a wooden casing, with a toilet seat on top. Every time the toilet is used, carbon matters (such as sawdust or woodshavings) are added. When the bucket is full, it is emptied onto a compost heap outside, where the composting process takes place.

such practice. At a household level, urine is especially easy to use directly as a fertiliser. Two years of composting is generally recommended for solid by-products before they are re-used on the garden. In parallel, good practice concerning the handling of by-products, the length of time they are treated, and their re-use (methods of applying, type of crops) also help users to manage dry toilets in a healthy and clean manner.

II. Current practice in different countries

France

France is characterised by the fact that household dry toilets are primarily used in principal residences (owner-occupied homes). Between 3,000 and 6,000 homes are equipped with dry toilets. One other characteristic of France is that there are a large number of organisations working in the sector (nearly 60 organisations are listed[3]), of which two-thirds offer dry toilet rental services for events. This type of activity has developed significantly over recent years, building a high level of public awareness around dry toilets.

The market, however, remains relatively limited and the sector is still dominated by self-build models. Most of the models available to buy in France are actually imported; nevertheless, a few French organisations/companies offer BLT artisanal systems and one company offers a French dry toilet model with urine separation using gravity.

Dry toilets have been authorised for on-site sanitation since changes were made to the regulatory framework in September 2009.

Finland

In Finland, dry toilets are mainly used in second homes, where it is the main sanitation technique. 500,000 dry toilets are in use throughout the country, mostly in outhouses. Only 20,000 are actually installed inside homes. In Finland there is a real public demand for modern toilet systems that function without water; this demand has enabled a large number of models to be developed and manufactured, by various different companies.

The regulatory framework does not explicitly cite dry toilets, but nevertheless creates highly favourable conditions for them. The 542/2003 decree, which provides the sanitation framework for residences not connected to the public sewage system, is much less restrictive for domestic greywater treatment than it is for wastewater effluent. The Finnish Environmental Institute is in charge of carrying out technical monitoring and control of existing on-site sanitation systems, and is responsible for making that information public. The Institute's website has a page dedicated to dry toilet systems.

[3] www.rae-intestinale.org

Germany

Many homes in Germany have vegetable patches or allotments, and there is specific regulation which governs the way in which they function. Garden sheds or outhouses cannot be linked to the main sewage system, and excreta must therefore be dealt with onsite via collective installations (sanitary blocks) or by individual dry or chemical toilets. Many gardening associations recommend the use of dry toilets and more than 30,000 of them are already installed in gardens or allotments across the country.

Approximately 180 apartments in Germany are equipped with large-volume dry toilets. These homes are part of ecological housing developments, in which the buildings are between two and four floors high. Apart from these projects, and a few functional buildings (such as kindergartens, shops and offices), dry toilets are relatively rare in individual homes. The German regulatory framework does not recognise dry toilets as a sanitation system.

However, a number of reknowned ecological sanitation specialists currently live in Germany. Numerous pilot projects have been carried out over the last twenty years, to test the principle of differentiated management of domestic effluent.

Sweden

The use of dry toilets in Sweden is fairly common, primarily in second homes (as in Finland). There are no national regulations specifically for on-site sanitation. Certain municipalities have set guidelines for dry toilets. A state-run website on sanitation systems has dedicated several pages to dry toilets, with specific recommendations for dealing with the by-products.

Over the last few years there have also been various experiments in Sweden on communal collection and re-use of the by-products of ecological toilets, such as for urine from separating toilets (whether dry or flush) and for the concentrated effluent from micro-flush toilets. As a country, Sweden has shown commitment to sanitation-related issues, such as the potential scarcity of the world's reserves of phosphorus, which is a risk even in the medium-term future.

Other European Countries

Switzerland, Denmark and Norway have also been actively involved in research on dry toilets, and on the differentiated management of domestic effluent.

There is a recognised certification system called 'Nordic Ecolabel', which offers certification for dry toilet systems. The criteria used are divided into two categories: firstly the quality of the toilet itself (materials, energy consumption, running costs, capacity, etc.) and secondly criteria for quality of the by-products (consistance, pH, carbon/nitrogen ratio, smell, thermotolerant coliforms, etc.).

Australia – New South Wales

A framework for dry toilet systems is clearly defined in the Australian state of New South Wales (NSW). Manufactured systems must be first approved by state authorities, based on the performance standards defined by the Australian/New Zealand norm 1546.2-2001. Self-build systems, made by the tenant or home-owner, are also permitted. In either case, the dry-toilet user must make a request to local authorities before such a system can be installed.

New South Wales' website clearly explains the shared responsability of individuals involved in on-site sanitation, and provides a number of guides, such as 'Environment & Health Protection Guidelines - On-site Sewage Management for Single Households', in which a number of wastewater treatment techniques are presented, including : dry compost toilets, wet compost toilets (compost systems for pre-treating all domestic wastewater together), combustion toilets and systems for re-using greywater.

United States

In the United States, regulations for on-site sanitation are drawn up by each state. As a result there are significant regulatory differences from state to state. In terms of dry toilets, some states only accept systems which adhere to the NSF/AINSI Standard 41, while other states have laid down their own criteria, allowing the use of various manufactured and self-build systems. In practice, the relevant departments which are responsible for on-site sanitation often have little awareness of dry toilet techniques. Therefore, in order to avoid a refusal, many users never make a formal request before they install their own dry toilets at home.

III. Greywater Management

Definition and characteristics

Domestic greywater is made up of all the wastewater produced by a household, except the blackwater from water-based toilets. In industrialised countries, the volume of domestic wastewater produced ranges from 100 to 150 litres per person per day, though it can be as low as 60 litres.

The organic pollution contained in domestic greywater represents approximately 60% of the organic pollution of the domestic effluent. Greywater content is very low in nutrients, particularly in nitrogen, which is mainly (90%) found in excreta.

Domestic greywater also contains organic pathogens. Studies have shown that the amounts of faecal pathogens can vary from about 10^3-10^6 UFC/100 ml to a maximum of 10^7-10^8 UFC/100 ml. However, a high concentration of easily biodegradable organic matter encourages enteric bacteria to redevelop. As these bacteria also indicate faecal pollution, this can lead to a considerable over-estimation of the risks.

Domestic greywater management

There are many techniques for treating domestic greywater, from basic systems that use the soil's natural capacity to purify, to complex systems that purify used water above ground. There are also micro-treatment plants within households, which enable greywater to be recycled for domestic re-use (flush or washing machine). Other greywater treatments include reed-bed filtration systems, greywater septic tanks and spreading of waste matter, etc.

A new approach, specific to domestic greywater management, has also begun to develop in the United States: mulch bed systems. This approach maximises the soil's purifying capacity and is therefore similar to other sanitation systems which also use spreading of pre-treated wastewater. There are a number of points however which make mulch bed systems distinct from other conventional systems:

- There is no pre-treatment phase, or it consists simply of a filtration stage.
- Greywater is spread out thinly, so that the top-soil helps in the purification process.
- Vegetation plays an integral role in the system and also benefits from the flow of water.

When designing a mulch bed system, the objectives are two-fold: ensuring that the domestic greywater is purified while simultaneously making optimal use of the effluent. Putting in place such a system requires carrying out a preliminary study and certain precautions must be taken (particularly protecting against frost). Though mulch bed systems are still little developed and not often used in France, the importance of this approach should be emphasised. It appears to be particularly well adapted for domestic greywater management for on-site sanitation systems due to its low ecological impact and the beneficial re-use of domestic water.

Frameworks in various countries

A number of countries have put in place specific regulations and guidelines for domestic greywater management. In Finland, for example, the on-site sanitation regulations only allow domestic greywater treatment systems to have lower purification performace (allowance rates) than systemes designed to treat all wastewater.

In the United States, each state defines its own regulations. While certain states only allow a reduction in the size of septic tanks and fields for domestic greywater management (in comparison with systems which deal with all wastewater), other states permit systems without tanks and lay down specific guidelines which enable domestic greywater to be re-used for gardening (Washington and Wyoming states).

In Australia, the re-use of domestic greywater at household level is a relatively widespread practice. It is also encouraged by the state, notably by central government which gives $500 rebates to households which install such systems for greywater recycling, within the framework of the 'National Rainwater and Greywater Initiative'. There are two possible approaches for re-using greywater:

- Domestic greywater is directly diverted to shallow irrigation areas.
- Domestic greywater is treated with the help of a specially designed sanitation installation, so that the water can either be re-used inside the home, or outside (washing the car, watering the garden).

IV. Ideas and suggestions for supporting the dry toilet sector in France

In France, dry toilets have become a legal technique for on-site sanitation, since a ministerial decree was passed on September 7th 2009. Article 17 of this decree, entitled 'Techniques' (NOR: *DEVO0809422A*) defines how it applies to dry toilets.

These regulatory changes have meant that a number of individual households which were already equipped with dry toilets have been able to legalise their situation, though some questions do still remain unanswered. This last chapter of the current document analyses the current regulations on on-site sanitation, based on information gathered, and makes suggestions for providing a framework to support dry toilets in France.

A. Regulatory measures and suggestions

The definition of dry toilet, given by Article 17, is the following:

Article 17

"By exemption to article 3, dry toilets (without added water to dilute or transport) are authorised under certain conditions: that there is no negative impact to the surrounding area, nor any liquid overflow from the plot of land, nor any pollution of surface water or ground water.

Dry toilets are implemented in two ways:

- either to treat urine and faeces together. In this case they are mixed with organic matter in order to produce compost;

- or to treat faeces through a drying process. In this case, urine should be redirected and treated with domestic greywater, in conformity with the provisions stipulated in articles 6 and 7.

Dry toilets consist of a watertight tank which holds faeces or urine. The tank is regularly emptied out onto a hermetic area, which is designed so as to avoid any leakage, while also being protected from the weather.

The by-products from dry toilets should be beneficially re-used on-site, and should have no negative impact to the surrounding area, or cause any pollution."

Although the first part of the definition of dry toilet, given by Article 17 is very large, the following provisions in terms of the functioning of dry toilets, severely limit the options technically. It would be preferable to focus on the over-arching operating principles (such as the absence of water to dilute or transport) as well as on the general objectives (health and environmental protection, absence of nuisances).

Technical instructions applicable to dry toilets

Article 17 makes provisions for the design of dry toilet installations. It is specified that a watertight tank should be placed under the dry toilet, and that there should be a leakproof and weatherproof treatment area outside.

The fact that the system should be waterproof, leakproof and weatherproof aims to reduce the potential sanitary and environmental risk of liquids (urine, leachate) infiltrating the soil. This risk should however be qualified. Though there is a certain risk if the outside treatment area is near to a catchment area for drinking water, the requirement should be more flexible elsewhere, where the risks are much lower. The volume of liquids is actually very small, making it highly unlikely that a real risk is incurred. Field case studies would enable more accurate evaluation of these risks, providing evidence to support greater flexibility in the regulations.

Other technical requirements for the design and installation of dry toilets can be outlined as followed: installation of fly screens (mosquito nets) on airvents, measures to deal with the run-off liquids, design of outside treatment areas, adaptations for areas prone to flooding, etc. It is perhaps not necessary to lay down regulations for these technical issues, but they should at least be emphasised in official documents (the Ministry's internet portal, circular letters, etc.).

The techniques for managing the liquid and solid by-products of dry toilets (methods for treatment and re-use) should also be further specified. There are numerous examples of official recommendations from other countries, these which could be used as an example for France. Furthermore, though composting at ambient temperature is the treatment method most commonly used in Europe for solid by-products, the hygienisation performance of this type of treatment is little measured and known. Further studies should be carried out in this area.

Installation quality control

Annex 2 of the decree 'Control', September 7th 2009, lays down numerous general points to be checked during a quality control visit by the on-site sanitation Public Service (SPANCs, *Service Public d'Assainissement Non Collectif*) for dry toilet installations. This part of the law has attempted to translate general points into operational guidelines. Apart from the question of waterproofing, which has caused much debate, certain technical requirements discussed above (flyscreens, dealing with run-off and flood-prone areas, design of outside treatment areas) could also provide useful pointers when carrying out an installation control.

As well as fulfilling its role in terms of quality control, SPANCs could also provide help and advice to users (dealing with by-products, using a users' guide, information on specialist organisations).

Reflections on domestic greywater management supervision

In order to support the development of a wider system for domestic greywater management, specific provisions need to be added to the on-site sanitation's new regulations of 2009. The setting up of such a system appears to be essential for homes equipped with dry toilets, and could also potentially be of interest to individual households which have flush toilets but would like to re-use all (or part-of)

their domestic greywater. It seems necessary to re-consider the obligation to treat all used-water communally (article 3 of the decree 'Techniques'), by either encouraging more flexibility or abolishing the rule altogether.

The new regulatory framework does not allow much room for self-build dry toilets (either in terms of design or in terms of construction) as it forces users to choose between either traditional sanitation methods (septic tanks for all wastewater and soil-based treatment) or those methods which have been approved by state authorities. Those organisations or companies which promote the Do It Yourself approach for the wider public do not have the means to get the designs that they use approved by the authorities. It is therefore important that solutions are found in order for these initiatives to continue, initiatives which generally work for the overall goal of environmental protection.

B. Communication and promotion strategy

Much has been written about dry toilets and information is currently available to the general public. However, information is mainly available from specialist organisations, and would benefit from being more widely disseminated.

The new internet portal for the on-site sanitation (ANC) department of the Ministry of Ecology[4] provides a very good opportunity to improve the dissemination of information concerning dry toilets, to both the general public and to professionals within the ANC. The portal could contain one or more pages dedicated to dry toilets, as do similar websites in other countries.

C. Additional studies

This study has highlighted the need for additional studies on a number of subjects:

- Although composting at ambient temperature is the treatment method most commonly used in Europe for solid by-products, the hygienisation performance of this type of treatment is little measured and known; further research would be useful.
- The need to seal and waterproof outside composting areas, so that they do not come into direct contact with soil, has been much debated. Better understanding of the leachate produced (volume and composition) by such installations would enable us to better envisage the way in which they are designed.
- Domestic greywater management methods remain relatively unknown. It is necessary to carry out more complete research studies on existing techniques or on techniques currently being developed.

[4] http://www.assainissement-non-collectif.developpement-durable.gouv.fr/