



FINAL PUBLISHABLE SUMMARY



Executive summary

Nowadays, different toilet solutions are sold. The most common is water flush toilet which has high water consumption and requires frequent maintenance. An environmentally-friendly alternative is dry closet. Main technologies of dry toilet come from Scandinavian countries and are dedicated to private uses.

Drycloset Demo project has been proposed to develop better solutions for different kinds of toilet for public uses. Primarily, it is born from the three properties developed in the first European drycloset project: **a biocide polymer**, an **anti-struvite precipitation compound** and an improved **biofilter** for odour removal.

Finally, **three high-quality DryCloset marketable product models** have been manufactured and validated in real conditions and they are currently sold by corresponding companies:

- **DryCloset Kit:** a kit-assembly dry toilet aimed at long distance shipment in containers with easy assembly and installation, demanded by public and private entities, such as ski resorts, natural parks, golf courses, campsites, areas with limited access to water and public infrastructures
- **DryCloset Truck:** compact dry toilets integrated in a mobile container mainly addressed to military missions, construction groundwork sites, public events and emergency situations
- **DryCloset Massive:** a high-frequency of use dry toilet, especially demanded on highways

Two companies, Sanisphere and Tecnove, helped with other members of the consortium, work to propose innovative solutions and to produce high quality products. Quality is guaranteed by ISO certifications and CE mark led during the project.

Summary description of project context and objectives

Nowadays, different toilet solutions are sold. The most common is water flush toilet which has high water consumption and requires frequent maintenance. Other well-known solution is chemical toilet which is mainly use where traditional plumbing is not possible. But, this kind of toilets uses environmentally harmful chemicals and requires high operation costs and specific waste treatment. Regarding current Dry toilet solutions, which need no water or liquids for working, these also contain several limitations in terms of logistics, costs and performance. Most important drawbacks are bad odors, low hygiene, generation of parasites and size limitations.

Hence, an innovative solution for providing an efficient and flexible dry toilet system is increasingly demanded, mainly by public entities or private organizations that must provide better sanitary services to their citizens or clients with lower O&M costs.

The Consortium partners of the DRYCLOSET Research project (256295-1) have achieved a prototype based on successful development of three results:

- The biocide polymer and the coating contained in the toilet, which ensures slippery properties, hygiene and parasites removal
- The anti-struvite precipitation compound for avoiding toilet pipe blockades and clearing of the toilet system pipes
- The improved biofilter, which eliminates bad odours

During the DRYCLOSET Demo project, the objective is to make those prototype adjustments and develop three marketable products, which will bring an added value product to fill more market needs and will expand our commercial spectrum. The models will match with three primary identified market needs:

- Kit-assembly dry toilet addressed to long distance shipment in containers and easy assembly installation
- Compact dry toilet integrated in a mobile truck mainly for military, emergency and public events needs
- High-frequentation use dry toilets, specially demanded in highways (DryCloset Massive)

The DRYCLOSET toilet will be a suitable solution for more clients and its market horizon will considerably enlarge in Europe and beyond. In 2011 public toilet sales in Europe accounted for more than 1,2 million units, from which 1% corresponds to dry toilets.

Public dry toilets market becomes more and more competitive and particularly in France. Thus, companies of the consortium wish to improve their organizations to be more competitive and to guarantee high quality products and services to their customers.

Simultaneously to technological tasks, the consortium works on ISO certifications (ISO9001, ISO14062 and ISO668) on one hand and CE mark. On the other hand, the three marketable products are supported by the elaboration of business and exploitation plan and dissemination activities.

To put it in a nutshell, the technological objectives of the DryCloset Demo Project are an extension of the developed prototype of the research project, plus the inclusion of added value technological implementations. Thus, validation relies on good working of the technical system, no odor, autonomy and resistance against vandalism and in time.

Additionally to the technological objectives, we have established other overall objectives for the Demo project. A set of certifications must be reached to improve quality of services and products. As prerequisites to sell, a deep knowledge of the market through market studies and final business and dissemination plan have been accepted by the different partners.

Description of the main S&T results/foregrounds

Drycloset project has been led around the development of three products. Before designing and producing these products, needs have been studied to be in tune with market specificities.

Here, we show the main S&T results by product.

I. KIT MODEL

1 Background and first results

Sanisphere offers innovative public dry toilets, very different from the other dry toilets available on the market. The company has had a high growth rate between 2012 and 2013, some 30%, and a lot of activity in developing products (from the Kit model to the Massive model),

During the last years, Sanisphere has tried to export its products but with average results. The international attempts met logistic difficulties. An important reason for this is that Sanisphere's buildings are part of the technical system (for natural ventilation) but they cannot be sent in a container which is problematic for long-distance journeys. A kit model which can be sent in pieces and assembled on site is a very good compromise to answer both technological and logistic issues.



Saniter in Forêt de Vatable, Martinique (2014)

During the project, all the value chain has been tested for an installation in Martinique Island. After a detailed design of each piece: from the cutting of pieces to the assembly on site including packaging and shipping into a container.

Strong with its first success, the two companies developed another kit model to give different choices to customers.



Sanilight in kit

2 The Need

In some cases, dry closet looks like the best solution for public toilets settlement. This is typically the case under some of the following conditions:

- No water access where the toilet is needed - expensive to install water system
- No existing wastewater treatment system capable of handling toilet effluent where the toilet is needed – very expensive to install a suitable system
- Cold weather conditions during the year, water pipes freeze
- The pipework in water toilets gets clogged – high maintenance
- High maintenance costs of water closets
- Environmental concerns relating to toilet handling

The kit model answers to all the requests and is even more efficient:

It proposes **natural ventilation**, performing solution to avoid bad odours into the cabin.

Indeed, our toilets are often isolated and far away from different networks and especially electric network. So, if electric fans are needed, they must be plugged on photovoltaic devices. But, that latter are sensible to vandalism and require low maintenance like the changing of the battery every 4 to 5 years. This low maintenance is often forgotten by the manager of the toilets and so bad odours appear into the cabin. At the contrary, natural airflow uses no active devices and works by itself.

The maintenance process of public toilets is usually expensive and time consuming. Sanisphere proposes products with **high selling price** but with **very low maintenance time and cost**.

3 Our solution

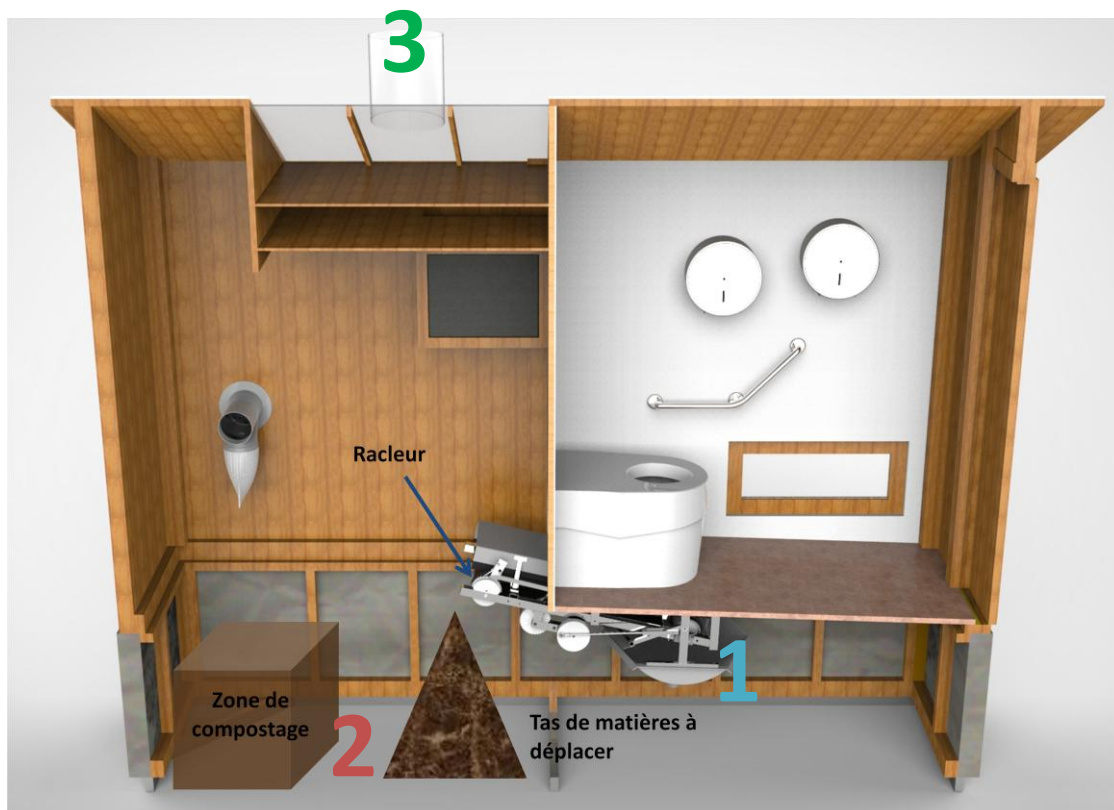
3.1 Product description of the Kit model

The kit model is a dry toilet that can be easily transported and assembled, “IKEA”-style, at the site of operation.

Composition

Sanisphere’s public dry toilets are made from technological bricks that are specifically assembled depending on the targeted market.

There are three technological bricks that were defined, designed and improved for the last 20 years.



The 3 technical bricks

1. The mechanical brick

- Tilted conveyor belt to separate urine from feces
- Self cleaning urine tray to avoid pipes clogging



Technological bricks

2. The biological brick

- Worms *E.fetida* transform feces and toilet papers in compost, with associated process to maintain good living conditions (for worms)
- Tests with others organisms that could complete worm's actions or replace worms (woodlouse, snails...)
- Flies traps to avoid the uncontrolled development of flies inside the technical area

3. The natural airflow brick

This brick enables the air to go from the cabin to the technical area through the toilet bowl. This process removes odors from the cabin without using any electric devices like fans. It uses no active devices but it works with air movements resulting from daylight, sun and eventually wind. The air is sucked through the toilet bowl.

Natural airflow is a very complex system whose theory is linked with fluid mechanics so finding means to have a good natural airflow is pretty hard. It depends on material choices in term of thermal properties (thermal conductivity, thermal mass...) and design, and once these means are well-identified they are often simple but their implementation must be done very carefully. For example, the technical area where the vermicomposting is done has to be very airtight.

How to use it

Everyday use

Two different uses can be distinguished for Sanisphere's toilets:

- User part: he just has to push the pedal after utilization
- Manager part: The toilet cabin has to be cleaned on a regular basis (the frequency depending on the actual use). The maintenance of the toilet mechanism and technical area is done once a year. It could be done by Sanisphere (see below).

Maintenance

The dry toilet needs very little maintenance, only once a year, but Sanisphere has developed a new service few years ago, the free maintenance process. This service is included in the selling price and clients can have this service during 2 to 5 years. Beyond these years, they can subscribe for a charged maintenance once a year.

3.2 Specifications of the Kit model (size, performance, etc.)

- Location: worldwide, parks, isolated sites, city
- Middle rates of frequentation, 5 000 to 10 000 utilizations per year
- Size: 2 X 4 m
- Main materials: plywood, wood class 4, compact
- Maximal weight of each component in the kit: 70 kg
- Kit installation: 40 hours of work on site (about 2 days for 2 people)
- Waste: Liquid inert waste (urine); Solid waste (vermicompost)



Assembly of the kit model

3.3 Advantages of the Kit model

Sanisphere is the only company who propose drytoilets working by gravity separation of urine from liquid-solid waste coupled with vermicomposting process. The technological bricks permitting this product's working are described above.

A key feature of the dry toilet is that it requires very little maintenance. Another important feature is the natural ventilation. Thus, the product is really autonomous from all kind if networks and even electricity or any sources of energy (except foot of the user).

II. Truck model

1 Background and first results

TECNOVE is a company specialized from its inception in mobile solutions and the idea of incorporating the technology of Sanisphere tries to meet the need for a mobile toilet in special situations, taking full advantage of the drycloset offerings.

These special situations aforementioned have been defined as temporary camps, emergency situations, building of infrastructures and similar, all of which require the deployment of every kind of relief facilities as quick as possible for high amounts of people.

The specific design of the Truck model has been made consequently with these premises, trying to provide the maximum functionality in the smallest and most portable format available, adding value to the potential customer by cutting costs in infrastructures and logistics and also by providing flexibility in potential placement as there is no need for water or energy inputs.

As a brief note about the sizing and in order to ensure that the Truck model does not cannibalize the customer segments of its two sister products, the Kit and Massive models, a market study defines the target market of the Truck model as all conventional or unconventional Portable Toilet customers who are amenable to utilizing dry, mobile toilets and therefore considering two types of Portable Toilet products – “Standard” Porta-Potties and “Luxury” Mobile Toilets.



Truck model

2 The Need

As mentioned in the sections for the Kit and the Massive models, there are some situations that typically create a need for a dry toilet solution, including:

- No water access where the toilet is needed - expensive to install water system
- No existing wastewater treatment system capable of handling toilet effluent where the toilet is needed – very expensive to install a suitable system
- Cold weather conditions during the year, water pipes freeze
- The pipework in water toilets gets clogged – high maintenance
- High maintenance costs of water closets
- Environmental concerns relating to toilet handling

In some situations it would be highly beneficial to get the benefits of the dry toilet technology in a **mobile platform** and that is the reason for the development of the DryCloset Truck model.

Typical situations when a mobile toilet solution can show advantages:

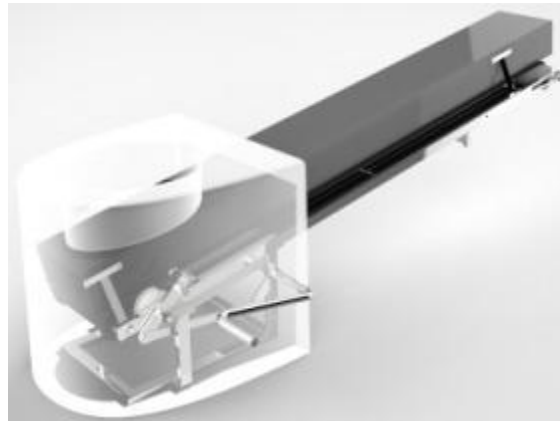
- Temporary camps or settlements in remote settings (military camps, construction sites for major construction or infrastructure projects, etc.)
- Harvest season or other seasonal events involving displacing a large workforce to farmlands or other areas away from public amenities where there is a need for access to toilets during the work day
- Cultural or sports events where there is a temporary (typically days) need for a toilet solution

Some specific needs that the Truck model dry closet targets to meet are:

- Save money - less auxiliary means for deployment (water tanks, energy, installations)
- Save time - In deployment but also in operation as there is no need to stop for emptying as often as with the standard flush toilet.

- More options - Less requirements on the locations where the toilet is to be deployed. No need to have a place near for waste disposal.

The areas identified to be deeply develop are: collecting process (constraint: small space), treatment process (constraint: little time) and disposal process (constraint: the system can be in any location).



Sanisphere's compact conveyor

3 Our solution

3.1 Product description of the Truck model

The truck drycloset is a mobile solution for complicated locations, with many people involved with limited access to water and energy.

Composition

The composition of the truck model is one ISO container (homologated according to CSC regulation) with all the elements required inside, including four toilet cabins, electric installation, ventilation-drying installation, waste collecting and waste disposal facilities and also a storage compartment.



Pictures of the Truck model

How to use it

Installation

It is very quick and easy to install. Basically, the two components to be removed/reinstalled are the solar panel for energy requirements and the chimneys for the waste disposal process and to guide inside gases to exterior.

Everyday use

Once deployed, the everyday use of the truck model is the same as any other drycloset model. It is a toilet in which the user has to press the pedal next to it five times after use. Disinfecting hands is made with an alcohol dispenser instead of water.

Maintenance

The tasks in this area are the normal ones of refilling alcohol and paper and cleaning the interior (floor and walls) plus the specific ones of the truck model which consist of rearranging collecting trays (for fecal matters) as they are being filled and proceeding to the waste disposal process whether it is burning (faeces) or just emptying the tank (urine).

3.2 Specifications of the Truck model (size, performance, etc.)

- Locations: worldwide, military camp, health organization, temporary situations
- External dimensions: 6.058 x 2.591 x 2.438 mm (L x H x W)
- Capacity: Four cabins
- Autonomy: Approx. 1.000 visits (eg. 100 uses per day / 2 months)
- Power consumption: Less than 500 W
- Waste: Liquid inert waste (urine); Solid waste (ashes) and Smoke

3.3 Advantages of the Truck model

The Truck model therefore offers a number of compelling value propositions in comparison with the two competing product types. The Truck model does not require any water input or regular maintenance meaning that it has a distinct logistical advantage over both products.

In addition, the Truck model is an environmentally friendly alternative to the water and energy intensive solutions on the market. The Truck model can also be installed without the need to hire qualified personnel. Moreover, the rising costs of transportation and chemicals, waste disposable as well as toilet paper have created a downward pressure on margins for market players, meaning that the Truck model is an increasingly competitive solution.

III. Massive model

1 Background and first results

The emergence of Massive model does not come from an idea but from a progressive process of contacts with a new market, rest areas.

Sanisphere equipped small rest areas located on small French roads. One thing leading to another, it equipped bigger and bigger rest areas till highways (first experience on highway was in 2011). This evolution led Sanisphere to improve its products in order to resist and to work with very high rate of frequentation. But, the difference of the rates of frequentation from national roads to highways was tremendous; from 10 000 utilisations per year to more than 40 000 utilisations per year. This gap of frequentation has generated, in a first phase, several dysfunctions leading to frequent Sanisphere's interventions to deal with the situation.

So, Sanisphere had a deep reflection on how adapt its technical product to answer easily and automatically to high rates of frequentation issue. The Massive model developed and experimented in Drycloset demo project is the completion of this reflection.

2 The Need

As mentioned in the section above for the Kit and the truck models, there are some situations that typically create a need for a dry toilet solution (please refer to sections dedicated in kit and truck parts). During the 20 years that Sanisphere has been in the industry, another need, more specific, has also been seen which is the following:

Highway rest areas are pretty often located into the wild, far away from inhabited areas. Therefore, they are far away from water, sanitation and electric networks as well. It results that it is very difficult to set up traditional flush toilets. Water and waste water could be transported by truck but it is a very expensive solution. For this latter, the cost is estimated at 50 000 € per year and per rest area.



Landgraben rest area: Flushing toilet (left) before Sanimassive (right)

There are other reasons to prefer dry closets from flush toilets to equip rest areas. For example, highways or frequented roads of the North-East of France are managed by an organism called DIR (Interdepartmental Roads Direction). DIR used to equip rest areas of these roads with flush toilets but they faced several problems:

- Frequent clogging because of stuffs thrown into the toilet bowl
- Freeze in winter
- Difficult management of waste water during peaks of frequentation (like summer holidays) because sanitation infrastructures are not designed for those peaks
- Difficult cleaning. In that case, water is more inconvenient than advantageous

3 Our solution

3.1 Product description of the Massive model

The Massive model is a dry toilet with high capacity. It is designed to work for up from 20 000 to 30 000 utilizations per year.

Composition

Sanisphere's public dry toilets are made from technological bricks that are explained in Kit part. Nevertheless, Sanimassive is designed with additional technologies.

The scraper chain

The scraper chain is linked with the conveyor. Its aim is to avoid the accumulation of solid wastes just under the conveyor belt and so the blockage of this one. The scraper chain also facilitates vermicomposting process.

Self cleaning urine tray

It is linked with the conveyor and clean automatically urine tray in case of solids would fall in this latter. It is a very good tool to avoid pipes clogging

Biofilter

The Massive model is fitted with a biofilter to minimize odour emissions outside the toilet and to prevent unpleasant smells inside.

Urinals

In order to improve the frequency of utilization (for men), urinals are installed. They are dry urinals to limit consumption of water.



Pictures of the Massive model

How to use it

Everyday use

Two different uses can be distinguished for Sanisphere's toilets:

- User part: he just has to push the pedal after utilization
- Manager part: The toilet cabin has to be cleaned on a regular basis (the frequency depending on the actual use). The maintenance of the toilet mechanism and technical area is done once a year. It could be done by Sanisphere (see below).

Maintenance

The dry toilet needs very little maintenance, only once a year, but Sanisphere has developed a new service few years ago, the free maintenance process. This service is included in the selling price and clients can have this service during 5 years. Beyond these years, they can subscribe for a charged maintenance once a year.

3.2 Specifications of the Massive model (size, performance, etc.)

- Location: France, boarder countries, rest areas
- High rate of frequentation, 20 000 to 30 000 utilizations per year
- Size: 2.85 X 5 m or 4 X 5 m
- Main materials: wood class 4, compact
- Highly resistant cabin (fitted equipment, steel)
- Waste: Liquid inert waste (urine); Solid waste (vermicompost)

3.3 Advantages of the Massive model

Massive model was designed to answer to all the specifications described for highway's rest areas. Nowadays, it is the unique product including answer to all the constraints.

- No clogging or blockage
- Easy cleaning
- Little maintenance
- No sensible to peaks of frequentation
- No networks connection

Potential impact and main dissemination activities and exploitation of results

Dry closets are environmentally-friendly products. They have good impact in term of water saving and decreasing of water treatment needs. Moreover, their easy and cheap maintenance and their acceptable investment cost make them economically viable. Nevertheless, they are mainly unknown by general audience as well as targeted customers. Thus, the project Drycloset permit to let them becomes a little more famous and used.

The 3 products can be settled in numerous environment and offer services for both users (by limiting human impacts on the environment like wild disposal) and manager (services provided). The results of the dry closet project are dedicated to public relief!

Here, we show on a first hand, the customers per product and then the main dissemination activities that have been carried out to promote dry closets and to raise awareness among customers.

I. A drycloset solution adapted to your need

1 The Kit model

The Saniter model looks like a little chalet in wood. With its universal shape and size, it can be proposed for several kinds of markets. As examples, kit model fits perfectly for the following sites:

- **National parks:** most of toilet's installations are in remote areas far away from the different networks (water, sanitation and electricity).
- **Municipalities:** most of Sanisphere's clients in France are municipalities so Sanisphere has already the tools and a good approach for this kind of project.

2 The Truck model

Truck model is dedicated to Portal Toilet market:

- **Construction and Commercial** : This market segment tends to utilize the most basic Portable Toilets as cost is the main purchasing criteria. Nevertheless, the truck model is cleaner and necessitates less maintenance than traditional toilet.
- **Special Events and Recreation: For events like** concerts, music festivals, fairs as well as beaches, parks, sporting events, etc. Truck model is a durable and ecological solution with easy transportation and implantation (nothing to do).
- **Military**: temporary military bases or military camps. “Luxury” Mobile Toilets tend to be the preferred portable option.
- **Emergency Services** demand Portable Toilets to provide temporary relief to disaster stricken areas. The Truck model gains a competitive advantage over other conventional Portable Toilets because of its ability to go approximately 2 months without emptying.

3 The Massive model

The Massive model was primarily developed for the specific market of rest areas of public highways in France which are managed by the DIRs (Interdepartmental Roads Direction). The DIRs are local organisms in charge of managing the roads of a part of France (DIR Est, DIR Nord, DIR Méditerranée...).

Nevertheless; private companies exploiting highways networks or very frequented places can also use Massive model.

II. Drycloset in the media

An overview of dissemination actions led during Drycloset Demo project is shown. If you are interested in drycloset's products, different ways of meeting Sanisphere and TecnoVe are presented.

1 Presence in fairs and conferences

SETT Montpellier, France

Sanisphere has participated to the SETT to begin to be known in the domain of camping sites and tourism activities like equestrian centers. Sanisphere has participated at the 2014 edition and we will participate to the next edition in Montpellier on November 4th and 5th 2015.

Salon des Maires, Paris, France



This fair is dedicated to services for French collectivities and municipalities. Sanisphere participated to the edition 2014 and will participate again in November 2015.

Presence in Arab Health 2015

TECNOVE booked a stand in Arab Health in order to promote mainly its health products, including the Truck model.



Arab Health Fair: TecnoVe stand

They look forward to 2016 edition, with more information and pictures to present.

Sustainable summit, Golden, Colorado, USA



Sanisphere has given a presentation. Technologies and different models were presented. Demo project and especially the kit model has been shown during the talk.

International audience of professionals comes to this event to propose and look for new solutions to treat human waste in mountain areas.

2 Web news

Find us on the following links:

- Find Drycloset project on: www.drycloset-project.eu
- Follow Sanisphere on its website: www.sanispheer-fr.com and social networks (facebook and twitter)
- Follow Tecnove on its website: www.tecnove.com

Two videos showing the different models developed in the drycloset demo project can be seen on youtube (they are also accessible by drycloset website)

<https://www.youtube.com/watch?v=taMFLpfzETw&feature=youtu.be>

<https://www.youtube.com/watch?v=1pEi9Kmxvzg&feature=youtu.be>