

# Results in the Use and Practise of Composting Toilets in Multi Story Houses in Bielefeld and Rostock, Germany

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## 1. Abstract

Two projects are reported, using composting toilets as single solution for treating human waste.

An ecological settlement in Bielefeld with 270 inhabitants now was started in 1994. More than 100 flats up to four stories high and a public Kindergarden were established since then. Problems with building codes and planning details are described as well as the different experiences in maintaining the biological process. The results after 8 years of practise led into different product improvements.

In 1995, an old villa in the middle of the town of Rostock was reconstructed for use as offices, shops and a restaurant, supplied with composting toilets. For five years research was done together with the University of Rostock, proving health aspects in use and experiences in the maintenance of the system. Beside the realization of product improvements, the training of the staff, which is responsible for the function of the system, was determining for a successful process and the high motivation of the project members.

## 2. Composting Toilets in the ecological settlement Bielefeld-Waldquelle

### 2.1. Pioneer projects in Germany

In Germany composting toilets (Clivus Multrum and similar systems) are offered since 1980 and are mainly installed in family houses. In 1986, the first ecological settlement was established to demonstrate decentralized solutions using composting toilets and constructed wetlands for cleaning grey water (Hamburg-Allermöhe). Others followed in Kiel, Berlin, Bielefeld and Hamburg-Braamfeld, while the ecological settlement in Bielefeld even seems to be the largest one in Europe (70 containers). At the moment there are about 500 composting toilet systems (mainly TerraNova systems) installed.

## 2.2. Concept and realization

In 1988, a group of ecologically interested families and the architectural office Bültmann started planning a peri-urban settlement in Bielefeld-Quelle. Different social groups should participate and additionally the consequent realization of ecological standards be performed. From 1994 until 1999 family houses, multi story houses and a public Kindergarden, planned by different architectural offices, were established, all provided with composting toilets. Grey water should be treated by constructed wetlands, but are not built yet because of the lack of financial means. Grey water is therefore connected to the sewer system up to now. One characteristic of the settlement is the installation of composting toilets for houses up to four stories, which seems to be the first project of this kind in Europe.



Figure 1: Four story building with public Kindergarden

### 2.3. The TerraNova composting toilet system

Developed from the Swedish Clivus Multrum system, the TerraNova system is provided with an insulated composting container which is connected to each toilet by a vertical pipe (300 mm diameter). The container is permanently ventilated and connected with an air pipe leading above the roof (150 mm diameter). An electrical and a wind powered fan supply oxygen for the composting process and ensure negative pressure as a seal against smell. Up to four toilets can be installed. They close tightly and are provided with an insert, which can be removed for cleaning. Before starting, a filter bed is installed inside the container, which helps the biological decomposition of organic material within two years, including organic kitchen waste (Lorenz-Ladener, 1992).

### 2.4. Approval and hygiene

In Germany, all flats and houses have to be provided with water flushed toilets, except in the city of Hamburg. There, toilets without water can be permitted, if hygienic considerations and public interests are not opposed. There is no general approval yet, so single approvals had to be applied for each flat in the settlement of Bielefeld. Special problems had to be solved, concerning the protection against fire and resonance of noise within the four story buildings, but also the ventilation of inside toilet rooms without windows. Further the inhabitants had to sign contracts with each other to ensure their acceptance of using composting toilets.



**Figure 2:** TerraNova composting container with improved maintenance area

Beside operating terms, given by us as the producer of the toilet system, the disposal and utilization of the final product (about 40 Litres per person per year) was solved. The inhabitants decide, if they use the compost on their private ground or dispose it on a fixed area within the settlement. Bacterial tests in other settlements showed, that the compost as well as the infiltrated fluid and the exhaust air were free of pathogenic agents. The quality of the final product, however, is much dependent from the function and the maintenance of the system. To be safe as much as possible, the compost should be treated in another extern composting box for one year, before using it as garden soil. In any case, the finished compost should not be given to useful plants, to avoid closing the loop for food. In this case the final product has not to be sterile.

### 2.5. Operation and maintenance

Each owner of a compost toilet system is advised, to take one hour time per month for maintaining the composting system. If there are several flats connected to one container, one of the users has to be responsible for the proper function. For several years, a group of interested and trained inhabitants gives advice to their neighbours. If there is no regular maintenance possible, it can be ordered as a service within the settlement or from the producer.

Monthly maintenance includes levelling and breaking up raw material by means of a special tool and bringing in structural and compensating aids, depending from humidity and biological activity of the process. Part of the work, as personal experiences since 1977 show, can be done by earth worms and other digging compost organisms, provided that conditions are suitable for them (Berger, 1977). This way, expense can be reduced but conditions still have to be controlled regularly. Excess fluid, if not connected to the grey water system, has to be emptied for garden use. The amount is dependent on the number of users, air temperature and biochemical activities in the process.

After two to three years, the wastes are reduced up to 10 % of its original volume and all decomposed material can be removed for the first time. Partly emptying should follow once a year then.

The toilet stool, the seat and the insert are designed in a way that cleaning once a week is sufficient, using little water and soft soap. Fly control is also no problem, as long as the process is kept in a good condition.

## 2.6. Experiences and developments

Composting toilet systems were developed in many ways and for many purposes. All of them need maintenance more or less. Regular maintaining takes time and sometimes muscle power. This way, the amount of effort for maintaining the system is often decisive for the acceptance of the special system by the user.

All inhabitants of the ecological settlement in Bielefeld-Waldquelle were asked about their experiences with the composting toilet system after having used it for several years, initiated by the members of the compost group. Many of the inhabitants complained about the heavy conditions, maintaining and emptying the compost and asked for better design solutions. Some of them wanted automatically operating systems, because they did not want to spend time with toilet maintenance. We worked out a solution, which is more practical and which can be reconstructed in existing containers (Berger, 2001). Also the function of the container and the process itself were improved. We also developed a half automatic system, which is under construction. Our close contact to the user and his demands often gives the impulse for changes and developments, especially in such an intimate area, users do not want to speak about. This way, reservations against composting toilet systems can be reduced and their function be improved.

## 3. Composting toilets in the public institution Ökohaus in Rostock

### 3.1. Pioneer projects in Germany

While composting toilets in public areas are one of the main selling fields in countries like USA, Kanada, Australia and South Africa, only about 50 projects are realized in Germany (mountain huts, seminar houses, Kindergartens and public toilets in recreation areas). One of the reasons for this is that building and health codes are more rigid than in private households. The following project is the first one, which is open to everybody in the middle of a town.

### 3.2. Concept and realization

Shortly after the political changes in the GDR, a group of 15 people established an association for supporting ecology, basic democracy and solidarity. They found an old villa, which was reconstructed to establish shops, offices and a restaurant. All building activities had to fulfil ecological standards, so composting toilets became a main project, supported by Deutsche Stiftung Umwelt. From the beginning of the project in 1995, scientific research was started by members of the Ökohaus together with the University of Rostock and the Landeshygieneinstitut was started. Research should find out possibilities for approval, concerning building codes and hygienic aspects (Kacan, 2000).

### 3.3. The TerraNova composting toilet system in combination with the Aquatron separator

All public toilets were realized as dry toilets and connected to four composting containers. The waiters in the restaurant, according to the regulations, had to use a water flushed toilet. The solution was to combine a 4-litre water saving flush toilet together with a separator that separates the flushed water from the excreta, so the solid parts could be led into the composting container. The containers are provided with an overflow connected to the sewer system. There are water flushed urinals in the toilet rooms for men. Each two containers are connected to one exhaust pipe, which is led outside along the side wall above the roof.



Figure 3: Final compost ready for use in garden areas with ornamental plants

### 3.4. Approval and hygiene

A limited approval of 7 years was given by the authorities, depending from further results of the research project. In 2002 finished compost was emptied from all containers for the first time and bacterial tests were taken. All tests accorded to the hygienic standards so the authorities gave another 15 years approval. The compost material was deposited for further tests outside in separated composting boxes. In this way, comparisons can show after one year, if a second composting has any effect on hygiene and use as a fertilizer for plants. The research also showed that excess fluid and final compost include relatively high contents of salts and nutrients and should be diluted before using them as garden fertilizers (Eckstädt, 1999). Further tests will be made for proving quality for plants in another research project.

Another part of the research programme was to evaluate possible bacterial effects on the air inside the toilet rooms and out of the exhaust pipes, possible contaminations with pathogens on the toilet seats and the valuation of the hygienic conditions in general. Parallel tests were done in a toilet room of the Landeshygieneinstitut, using water flushed toilets. The results were attested as good enough to continue further approval and some recommendations were given (extract):

- The operating staff of a composting toilet system should be trained and be connected to consulting partners, in case there are any problems;
- For two years inspections should be under contract;
- A responsible person and his substitute should be named for maintaining and controlling the process (Schöttler, 1999);

### 3.5. Operation and maintenance

According to the recommendations, a training of the staff together with us was carried out, as the former staff had changed. The training was both theoretic and practical. After half a day of basic information about composting, processes and function, the regular maintenance was demonstrated and the final compost was emptied together. Before, the containers were reconstructed for easier handling (see description above). Both actions helped to convince all project members and everybody was astonished about the good smell of the compost.

### 3.6. Experiences and development

Users must know, what happens in a toilet without water flushing. When understanding the process, they are open and responsible for using and handling. Therefore, different possibilities of information and training are necessary in theory and practice. Operators and users must see the benefit of being responsible. Of course, the work that has to be done, must be convenient and acceptable. Experiences in this project showed that more simple solutions have to be offered to control and influence the composting process, so maintenance can be reduced on a minimum level. Conditions in the compost must be most favourable, so earthworms are able to overtake a part of the work that has to be done by the operator. They work 24 hours a day, increasing their population. Earth worms are a steady part of the delivery programme of our company since 1985.



Figure 4: Toilet stool with black removable insert and sealing



**Figure 5:** Successful emptying of final compost after 7 years use (NNN, 29.04.2002)

#### **4. Conclusions**

Composting is not the only way of treating excreta without water, but it is the only way to transform human waste into earth. Humidity is necessary and therefore the significance of composting toilet systems is more suitable to humid than to dry climates. The described projects give important results for operating and maintaining and what can be improved to make composting toilet systems more acceptable, even for both climates. The separation and collection of urine make drying of faeces possible. Only small changes are necessary, to transform a composting toilet system into a drying toilet system. The problem is, to develop systems on a low cost level with a high standard of hygiene and function.

Therefore, it is necessary to have projects like this in so called developed countries like Germany, because they give orientation and experiences for users, research institutes and authorities for further development, before these solutions are recommended for other countries with fewer opportunities. Nevertheless, there are still a lot of situations in the developed countries, where hygienic conditions have to be improved or water flushed toilet systems have to be replaced. This gives a chance and a benefit for both.

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