Bio-Filter-Lid for Bio Wheelie Bins

Organic Waste Storage without any Problems

A Scientific Research from:

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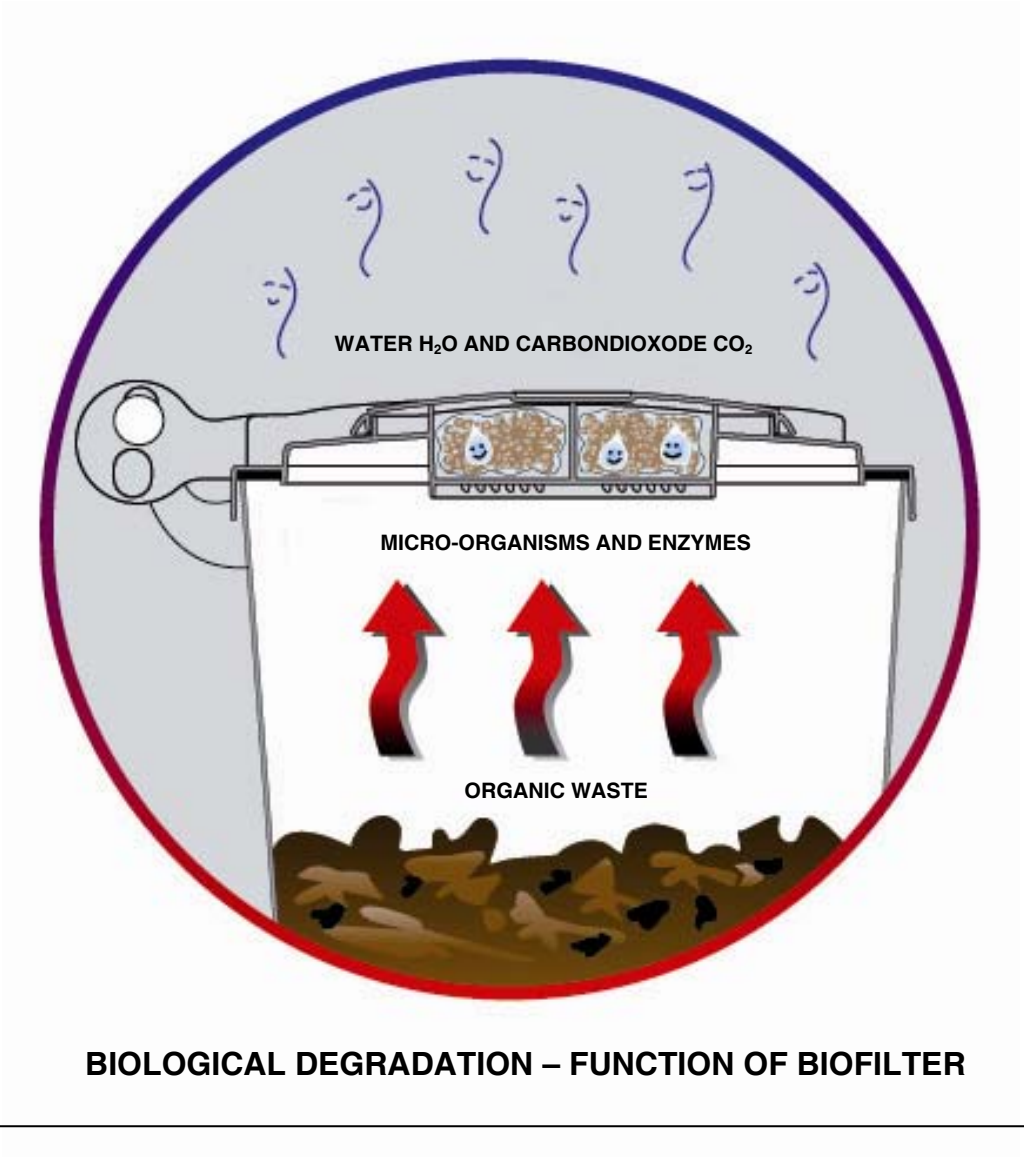
With the aid of biotechnology, a waste-bin can be turned into a problem-free bio-bin. Maggots and offensive smells become a thing of the past. A fortnightly collection cycle is recommended. The project is being funded by the German environmental foundation "Deutsche Bundesstiftung Umwelt".

SYSTEM BIOLOGIC



BIOLOGICAL DEGRADATION – FUNCTION OF BIOFILTER

Bio-Filter-Lid for Organic Waste Storage – A Scientific Research

1. Introduction

The separate collection of organic waste and its conversion into compost has been given a new status by the German laws relating to domestic waste. Accordingly, organic rubbish, which makes up about a third of normal domestic waste, may in future no longer be deposited on rubbish dumps intended for domestic waste.

Fig. 1: Bio-bin with Bio-Filter-Lid

Separate collection and treatment of organic waste requires separate storage in special "bio-bins". In many towns and other communities, the bio-bin has already been introduced in recent years - frequently only in individual collection districts - and the associated composting plants have been built.

Within the context of an increase in environmental awareness, the separate collection of organic waste enjoys great acceptance and support from most members of the public. However, with the usual fortnightly collection intervals, these same people are really put to the test in summer: an intolerable smell and intense insect activity inside and outside the bins mean that, for many an environmentally aware citizen, a visit to the bio-bin is a highly unpleasant experience. In the summer months, this often leads to protests and headlines in the daily press. In particular, the most serious nuisance occurs when - in addition to garden rubbish and vegetable remains - meat, fish and left-overs from meals are put into the bio-bin. According to the German laws relating to domestic waste, these types of rubbish too should be composted via the bio-bin without any health risk.

To store organic waste, containers of the same kind as those employed for domestic and residual (i.e. non-compostable and non-recyclable) waste, but coloured differently for identification, were used initially. These containers still make up a large proportion of bio-bins.

To minimise anaerobic conditions in the storage of organic waste, thus reducing smell, "ventilated" containers were introduced later. Air entry and air circulation are promoted by various holes in the lower and upper parts of the containers. The same purpose is served by holes in the lid or spacers at the edge of the lid. With regard to composting and to the bulk reduction caused by loss of water, ventilation is certainly beneficial. However, the desired reduction of the smell nuisance was not achieved, and the emergence of percolating water attracts flies and habitation vermin to an increased extent. At the same time, hygiene problems occur here which are not immediately perceptible, with the result that, to avoid danger to health, collection intervals exceeding one week are not acceptable.

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From the point of view of community hygiene, the unhindered vermin cycle plays a key role; this is especially true of flies and maggots, with their particular preference for everything that smells unpleasant, for example faeces and carrion from vermin and from domestic animals. The pathogens which naturally occur here in large concentrations are taken to the organic waste by flies. There, they find optimum conditions for growth and reproduction. Later, these germs emerge in turn from the bin with the flies or - more particularly - with the migrating maggots, and are thus transported further into the environment and onto human foodstuffs.

The requirement stipulated by the German laws relating to domestic waste that "collection systems for organic waste should be designed so that nuisance, especially that caused by smell, insects and rodents, is avoided" cannot be fulfilled in summer by the existing collection systems unless the bins are emptied weekly, and then only with certain restrictions.

The former Federal German Health Office ("BGA") reacted to this problem and, in press releases and other statements, announced that, from the point of view of hygiene, collection intervals of more than seven days for organic waste could not be recommended.

Because, for logistical reasons, the collection of organic waste mainly takes place alternately with the collection of residual (non-compostable and non-recyclable) waste in a fortnightly cycle, a collection system cannot survive in the long term unless fortnightly collection intervals can be assured without any hygiene risks.

After several years of development work, the company "Biologic" has presented a patented container system which permits aesthetic and hygienic storage of organic waste with fornightly collection intervals, even in hot summer months. The heart of the new system, which is outstanding in its simplicity of construction and its functional reliability, is a modified lid design. It consists of a bio-filter installed in the lid, and of an all-round rubber seal at the edge of the lid (Fig. 1). In this way, it is possible to utilise the advantages of ventilated containers without having to put up with health problems or nuisance caused by smell, flies and maggots.

The system is characterised by the following features:

- Existing systems can be converted simply by exchanging the lid; the bin remains compliant with official ("EN 840-1") standards. At the same time, this ensures that factory-made containers and those produced by retrofitting are of identical construction.
- Gas exchange can only take place via the biofilter, in which micro-organisms and enzymes ensure maximum decomposition of smell-producing substances.
- A filter material developed specially for this purpose and having a useful life of two years permits practically resistance-free gas exchange with the external air, so that there is an adequate supply of oxygen in the interior of the containers.
- The design and additives in the filter material ensure a good water-balance in the bio-filter; this is a necessary prerequisite for proper functioning.
- The bio-bin, having little or no smell, no longer attracts flies, other insects, rats or mice.
- Flies are additionally prevented mechanically from laying their eggs into the bio-bin.

- Maggots can no longer occur unless flies have already laid their eggs on the organic waste within the household or if dead flies with eggs already fertilised are thrown into the organic waste. With a bit of care, both of these events can easily be avoided.
- The micro-organisms which are put into the bio-filter in the form of a defined mixed culture also act as a self-reproducing starter culture for the interior of the bio-bin. With the falling droplets of condensed water, they find their way onto the stored waste. There, they can specifically prevent the growth of undesirable mould fungi and pathogens by natural competition.

2. Laboratory Trials

The smell reduction in the bio-filter has been proven in trials conducted on the laboratory scale. At the same time, a filter material was developed which provides the organisms used with uniformly ideal living conditions for at least two years. Here, particular importance was attached to the water balance of the material, which must maintain its moisture by means of the gases passing through it. What is needed is a constantly high pore-volume; material which readily turns into soil-like humus (compost, peat etc.), such as is used in some large-area bio-filters, is therefore not suitable in bio-filters for bio-bins.

3. Practical Test

A tough practical test began in a field trial in Havixbeck, a town in the Münsterland district. The field trial, which was scientifically evaluated by the Institute of Hygiene at the Wilhelms University of Westphalia in Münster in the course of a dissertation, was carried out with the help of about a hundred volunteer test households. Because the collecting of organic rubbish had already been taking place in Havixbeck for about four years using conventional waste-bins, the test participants were able to form a clear judgement of the changes brought about by the biofilter-lid. Technical and logistical support was provided by the waste disposal firm concerned, namely the Rethmann Company (today Remondis) based in Selm.

The investigations involved two main subjects:

- Smell formation, flies and maggots.
- Reduction of fungus spores.

4. Smell Formation, Flies and Maggots

Smell formation and infestation by flies, maggots and vermin are things that can be perceived by anybody and are also the main cause of annoyance inflicted on the public by the storage and collection of organic waste. To determine these parameters in comparison with conventional bio-bins, the Biologic Company questioned all test households several times. Independently of this, some of the test containers were assessed at regular intervals by employees of the Institute of Hygiene.

In Figs 2 and 3, the results of the questioning are presented graphically.

Fig. 2 shows the smell nuisance emanating from closed bio-bins as assessed by the test households. The large reduction of smell found here in the environment and in the interior of the bin due to the effect of the biofilter-lid was confirmed by the investigations performed by the Institute of Hygiene.

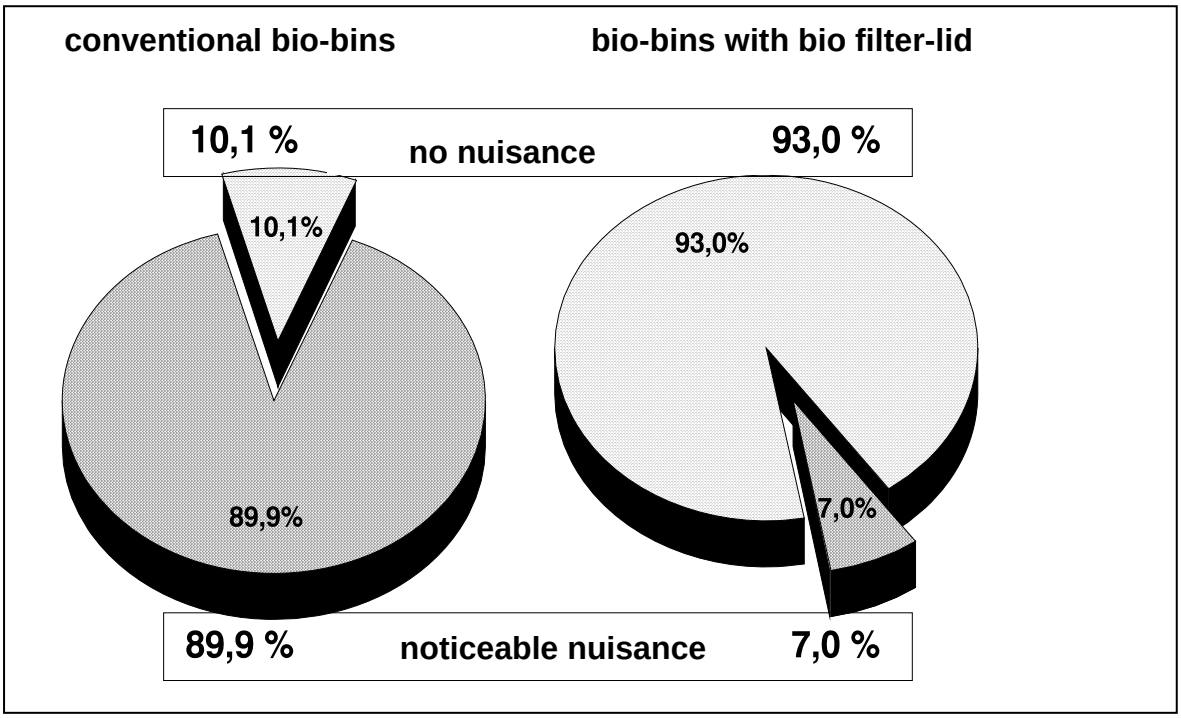

Fig. 2: Smell nuisance caused by closed bio-bins

Fig. 3 shows the occurrence of maggots and flies in the bio-bin. Whereas, when the conventional waste-bins were used, about 75% of them were regularly infested by flies and maggots in the summer months, this figure was reduced to less than 2% by the biofilter-lid. These values too were determined by questioning the trial participants, and at the same time reproduce the data determined independently by the Institute of Hygiene.

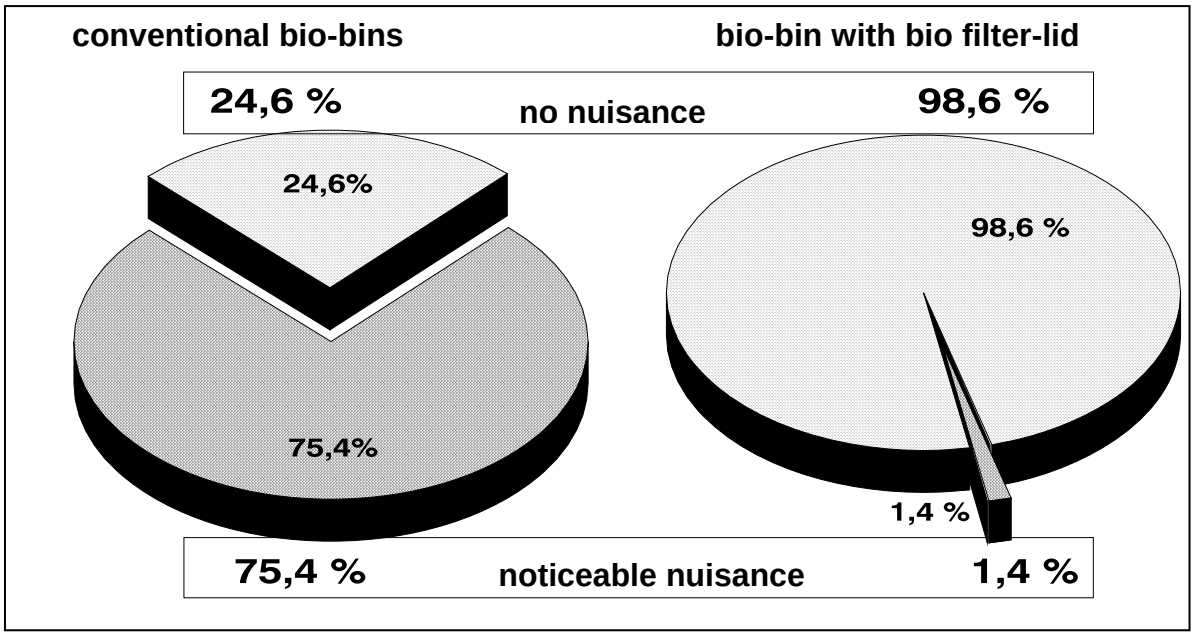

Fig. 3: Infestation by flies and maggots in the bio-bin

5. Olfactometric Measurements

To be able to describe with scientific exactness the smell reduction produced by the bio-filter-lid, a further series of trials was conducted by Münster Polytechnic (Immission Protection Laboratory) within the framework of two degree-studies. In this series of trials, a ventilated bio-bin, a conventional waste-bin and a bio-bin with a bio-filter-lid were compared under standardised conditions and with exactly identical contents. To determine representative measurement values, the 120-litre bins were placed inside closed, uniformly ventilated 240-litre enclosing bins, from which the samples for the olfactometric measurements were taken. The olfactory units (OU) measured after 14 days with the initial filling are shown in Fig. 4. The effectiveness of the bio-filter-lid can be clearly seen.

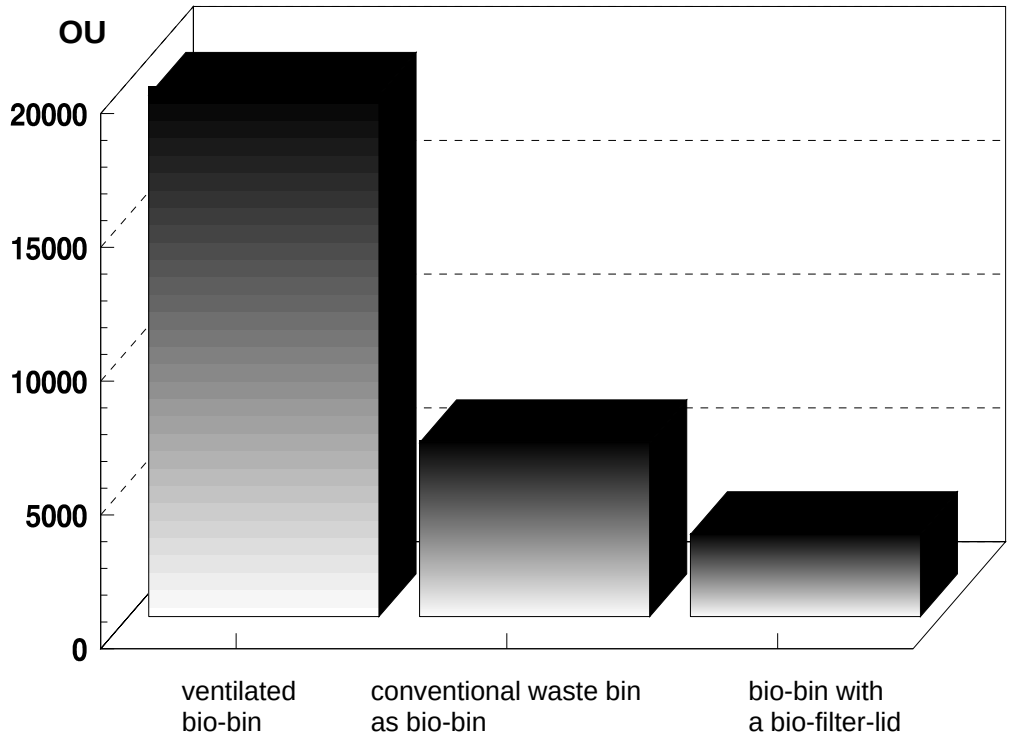

Fig. 4: Smell emissions from the various types of bio-bin

6. Reduction of Fungus Spores

In the trials, not only the smell reduction in the bio-filter but also the mould fungus inhibiting effect of the cultures used were proven. Fig. 5 shows a Petri dish on the left with the mould fungus *Aspergillus niger* on a fungus culture medium (Kimmig agar); the growth of the mould fungus is inhibited by the micro-organisms situated at the centre.

Fig.: 5 Inhibition test with *Aspergillus niger*

On the right-hand Petri dish, the unaffected growth of the fungus is shown as a control for comparison. Because the fungus growth is not completely suppressed but only inhibited, the mould fungi can reproduce again later during composting, and can perform their task there in the rotting process.

Bacteria and mould fungi are important in the biological cycle, and therefore occur naturally even at non-contaminated places.

7. Fungus Spore Emissions

- During the filling process -

To obtain useful information on fungus spore emission from the bio-bins, it was necessary first of all to develop a suitable method of measurement. It turned out to be inappropriate simply to catch the fungus spores inside the bio-bins with the aid of collecting dishes (malt agar) and to count these spores after suitable incubation in an incubator (30 and 45°C). Therefore, it was necessary first to standardise a method of measurement with which the spore emissions from the bio-bin could be measured during the filling process.

In the measurement method used, the work was done with an airborne-germ collecting device at head height and, at the same time, with three collecting dishes to the right, to the left and in front of the bio-bin. Before the measurement, the containers were moved to the street. To be able to determine the pure emission, an empty value was determined first with the bio-bin still closed; this value was then subtracted from the measurement made during the filling process. The filling process was standardised by means of a kilogram of peat wrapped in newspaper, which was thrown into the containers from the same height. Because of the season of the year and the high cost involved, only one series of measurements (five bio-bins with biofilter-lids and five bio-bins without biofilter-lids) has been conducted so far with this method. The results are shown in Fig. 6 as the sum of the CFU's (1 CFU = 1 colony-forming unit = 1 fungus spore) from the collecting dishes and airborne-germ collecting device. Although the number of bio-bins tested is very small, the correlation with the inhibition tests on agar can be seen.

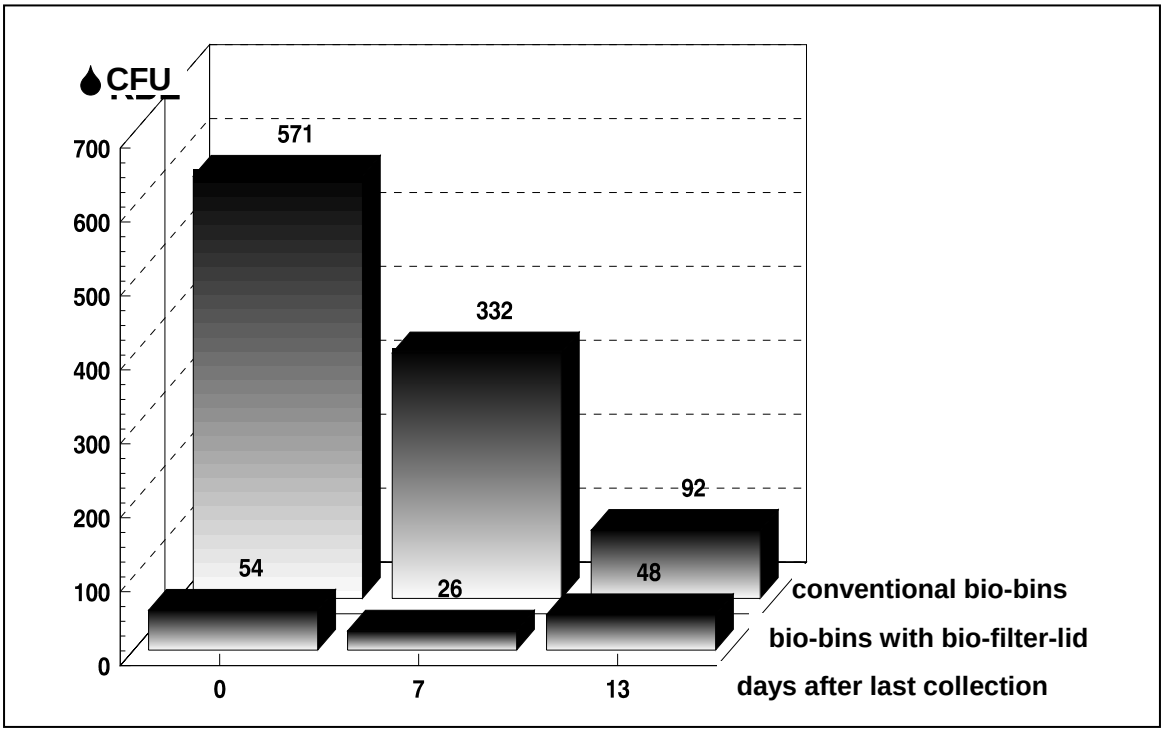

Fig. 6: Spore emissions with filling performed in standardised manner

- From closed containers -

To compare the fungus spore emissions from various container systems, the experimental set-up for the olfactometric measurements described above was also used for a series of measurements performed by the Institute of Hygiene. Here, the fungus spore concentrations in the enclosing bins and in the organic waste were determined. Fig. 7 shows the fungus spore concentration measured in the enclosing bins, after subtraction of the fungus spore concentration in the external air.

Clearly evident are the high emission of spores from the ventilated bin and the fact that the spore content of the bio-bin with biofilter-lid is only slightly higher than that of the surrounding air.

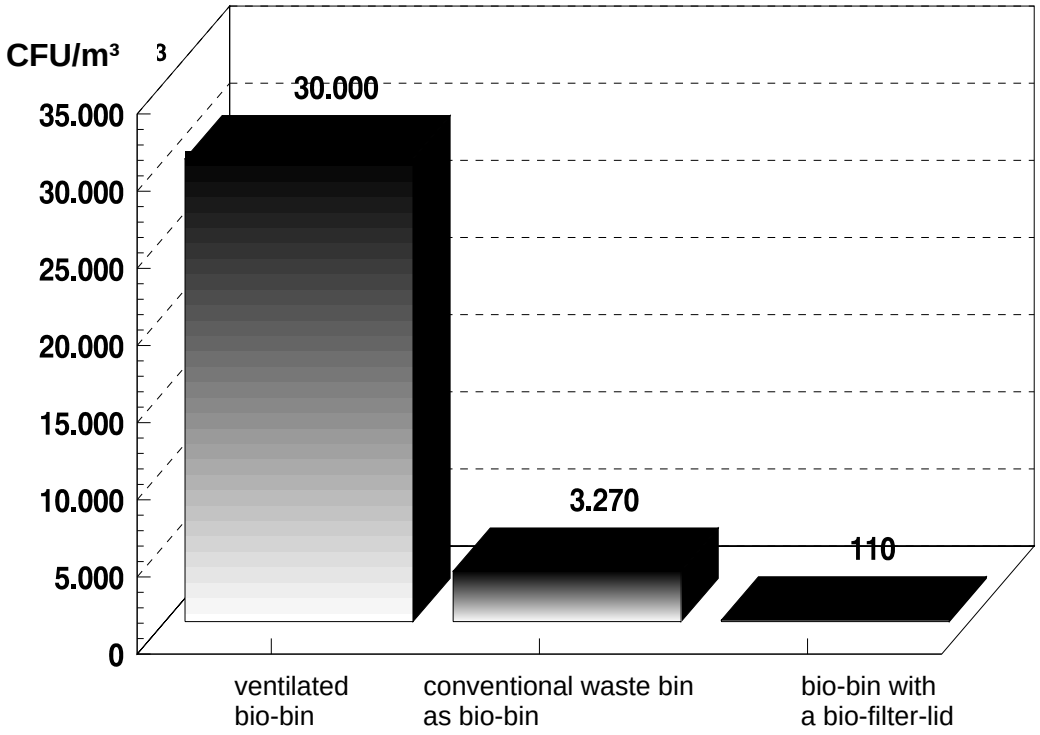

Fig. 7: Fungus spore emissions from various container types under standardised conditions

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8. Summary

Containers which are open and attract vermin by the emission of smells lead automatically to the spreading of germs. This is risky, because not only harmless environmental micro-organisms get into the bio-bins, but also various pathogens such as Salmonellas via flies, habitation vermin, eggshells, left-overs from meals, cat litter, and many other sources.

The storage system with bio-filter and all-round lid seal permits highly aesthetic storage of organic waste with virtually no risk to health, and offers the advantages of ventilated bins without having to put up with their disadvantages.

Furthermore, an economically important aspect is the considerable cost saving achieved by extending the collection intervals from a week to a fortnight. This saving exceeds the extra cost of the new system.

Result after 6 days organic waste storage

conventional bio bin

bio-bin with
a bio-filter-lid

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