Bauhaus – Universität Weimar

Department of Waste Management

Model Project Kassel

Application of Biodegradable Packaging Items in a Real Test Market And Their Recovery Via the Municipal Organic Waste Collection

Summary - Interim Report

by order of

Lichtl Beratung für Umweltkommunikation

Eschborner Landstraße 41-51

60489 Frankfurt a.M.

Project Management

Prof. Dr.-Ing. habil. W. Bidlingmaier

Weimar, June 2002

1 Introduction

A model project with biodegradable plastic packaging items (biopolymers - BP) was launched May 2001 in the German city of Kassel, that was prolonged until December 2002. The model project was conducted to promote and increase the use of biodegradable packaging and to scrutinise the recycling paths of these explicitly labelled packaging products via the municipal organic waste collection. The experiments should clarify if the consumer sorts such explicitly labelled BP products in the adequate collection system without an increase of disturbing contents, i.e. conventional plastic packaging, that complicate recycling processes. This topic was considered as an essential question, as separate collection systems for packaging and organic waste are existing in Germany as in most of the industrialised countries. Next emphasis was set on the recycling procedure, in that case an composting process. Examination related to the processability of BP packaging items in a technical composting site were carried out in the composting plant. The quality of produced composts made from BP packaging containing organic waste was continuously monitored according to German standards. Las focal point was the possible and safe application of these composts in the agriculture. This topic was investigated with a pilot-scale agricultural application test. All findings are interim results since the pilot project in Kassel is still a project in progress and will be finished at the end of December 2002.

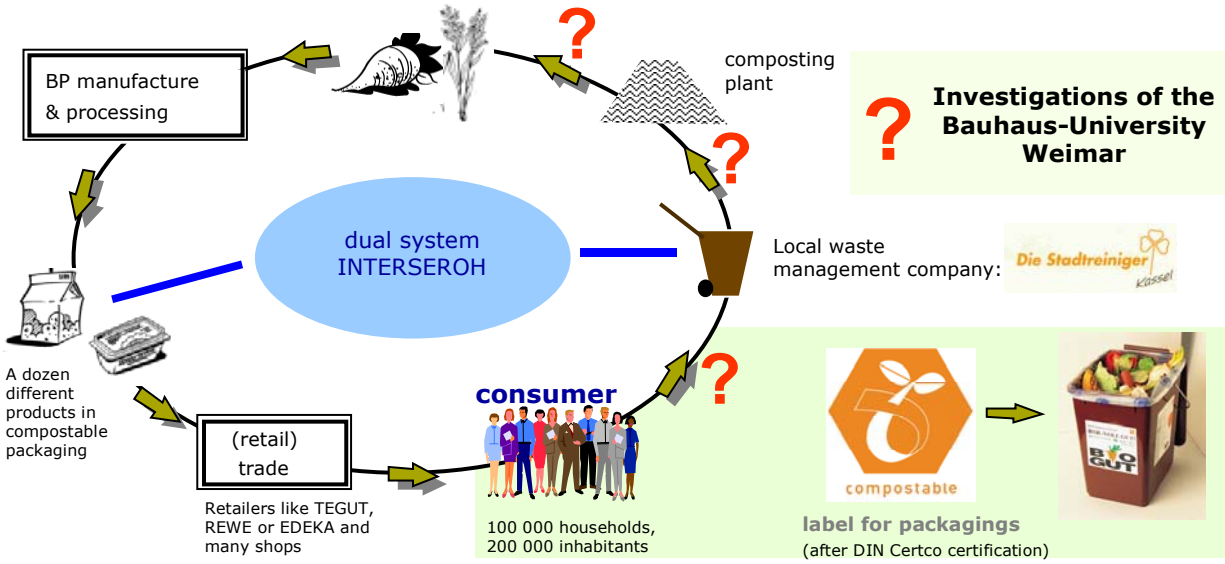

Fig 1: Scheme for the Kassel project: a new approach for closing substance cycles - like nature does

2 Waste Analysis Campaigns

Main aim of the waste analysis campaigns consisted in a scrutiny, if the collection of the BP packaging items caused any change of the amounts of disturbing contents in the organic waste (“biowaste bin”). . Up to now six waste analysis campaigns were executed. The campaigns were conducted in the selected, typical area structures of the city of Kassel, because the composition of the waste differs considerably in these structures. The received results were compared with the results of a campaign conducted before the start of the pilot trial (August 2000) to get basic data.

On the basis of these analysis campaigns, a simultaneous dimension check-up of the collecting system “biowaste bin” was executed. The dimension check-up was carried out because a higher volume demand of the collection bins was assumed due to the low pouring density of biopolymers compared to organic waste. The determination of the waste composition of MSW, organic and the packing waste was done by the analysis of random samples in three different, representative urban area structures (AS) of the city: AS 2 - multi-storey with more than 3 floors or more than 6 dept., AS 3 - multi-family houses with up to 3 floors or max. 6 departments and AS 4 - detached and two-family houses. These areas were chosen to examine three different urban structures, thus receiving

representative data of different structures that could be extrapolated to gain data about the entire city of Kassel.

BP product availability: General availability of BP products in the trade varied strongly in assortment and quantity for different reasons, so that the Kassel citizen had in parts only limited access to the BP products. Offered packaging items were mainly bags (shopping bags, bags for fruits and vegetables etc.) that could be used as a collection bag in the household. The sorting of these bags filled with organic waste is relatively obvious and logical. Beside this BP flowerpots with herbs were distributed within the scope of product promotion activities. A quantity of approx. 25 tons of biopolymer packaging (source DIN CERTCO) was delivered to the retail trade of Kassel within 5 months. This amount correspondents to a total quantity of approx. 25 000 tons projected to the complete area of Germany The highest proportion of BP in the organic waste, which was found during the analysis campaigns, was 0,47 % (w/w) of the examined organic waste. Related to a total amount of organic waste of approx. 6 million Mg (Mega gramme = ton) in Germany this quantity is equivalent to 28 000 million Mg of biopolymers in the organic waste. Since it was not possible to sell BP packaging items only in the Kassel city area due to the structure of the involved retailers; a certain part of the BP products were bought by citizens of surrounding towns and villages. This fact led to a lost of a certain part of the BP products that was not found during the analysis campaigns in the city of Kassel, that should be considered assessing these figures. Intense product promotions took place during May until October, then the product range decreased considerably. Due to the relatively small spectrum of products - mostly bags were sold - it should been investigated precisely in the prolongation of the project how the sorting behaviour is influenced by products without a possible use as pre-collection container for kitchen wastes.

Disturbing contents in the collected organic waste: The amounts of disturbing contents in the biowaste in the examined city structures did not change significantly compared with the analysis campaign before the test (August 2000) up to the analysis campaign carried out in October 2001. Compared with the basic data a slight reduction of the disturbing content percentage was recognised. That can be caused by the intensive communication during the project phase thus causing a better sorting behaviour. However, in the temporarily last analysis campaign (January 2002) in all structures a slightly increased percentage of disturbing contents was determined. No explicit reason for these finding could be detected, Seasonal influences (Christmas Holidays), that are known for causing higher amounts of waste, and, in addition, climatic influences (winter), reducing the absolute amount of organic waste by the absence of green wastes, can be responsible for these findings.

Volume demand for the collection containers: No significant changes of volume demand of the collection bins were detected due to the simultaneous collection of BP packing items since seasonally influences possess substantially larger effects on this demand.

Recovery of BP products in the biowaste collection system "biowaste bin": The recovery rate is the part of the total organic waste in all collection systems that is collected via the appropriate collection system ("biowaste bin"). To calculate the recovery rates for the entire city the produced amounts of organic waste per person in each waste fraction were determined. The city was divided in area structures with assigned number of inhabitants. With these figures it was possible to calculate the to determinate the total amount of the organic waste in all fractions of the entire city. The recovery rate of BP items projected on the entire city of Kassel differed considerably in different urban areas. Three representative urban residential area structures (AS) were analysed. The highest recovery rates were achieved in AS 3. They started with 95 to 90 % (w/w) and decreased to values of approx. 80% (w/w) of the total amount of BP items in the tree analysed waste streams (packing wastes, MSW, and biowaste) in the course of the project. In AS 2 the recovery rates were lower, approx. 60% (w/w) of the total amount. Almost no BP items were found in the waste streams of areas with detached and two-family houses (AS 4). It is assumed that by the availability of gardens and the explicit labelling as "compostable" the BP items were deposed on backyard or home composting sites. This was confirmed by market research with personal interviews. 25 % of the interviewees declared that they are running a private home composting site. Another reason was the fact, that the density of biopolymer packaging selling retailers was very low thus causing a bad access of the citizens living in the examined area.

Only small amounts of biodegradable polymers were found in the MSW; however, the quantity collected biopolymer packaging via this collection system was considerable. Even a small percentage of biopolymers in the MSW implies a relatively high amount due to the higher total mass and the more frequent collection compared

with the biowaste. In the packaging fraction (“yellow bag”) similarly only small quantities of biopolymer products were regained.

3 Composting Plant

These investigations were conducted to test the system compatibility of the biopolymer products in a commercial composting system; i.e. whether these products have any influence on the process of the composting. The general compostability was not subject of these investigations, since exclusively products, which were certified by the DIN CERTCO as compostable were used in these trials. In addition pre-treatment tests were executed, which should clarify, to what extent the BP products influence the manual source separation in the composting plant.

No direct influences on the composting process and technical components of the composting plant were detected by the treatment of organic waste mixed with BP. Manual source separation is affected by higher amounts of BP items at simultaneously high amounts of conventional disturbing contents. The efficiency of the manual source separation decreased with increasing BP content in the organic waste during the executed experiments The quality of the manual source separation was not impaired in tests with organic waste including a small proportion of BP products (0,125 % (w/w)) of BP products. However, organic wastes with a content of 0,25% (w/w) caused already a clear quantity reduction of the separated disturbing contents. Already small BP additions to strongly contaminated organic waste (more than 5% (w/w)) deteriorated considerably the manual source separation performance. Samples without BP addition were cleared of disturbing contents most effectively in both investigation campaigns although they possessed the highest pollution rate from all used organic waste samples. These facts indicate that the process of source separation is affected negatively with that type of source separation practised in this composting plant. however, no general predicates can be derived because the source separation is carried out in other compost plants with differing methods, e.g. an input stream sieving without manual sorting process or without any pre-treatment with a subsequent sieving of the composts. However, it can be assumed that systems with a manual source separation including a mechanical pre-treatment of the input stream and a smaller throughput, achieve better performance of the source separation. These pre-treatment processes make sure, that BP products get into the rotting mass and avoids that the BP product are sorted out in relevant amounts in the course eof the source separation. The mechanical pre-treatment could be a sieving process and the throughput should not exceed 4 to 5 Mg (= tons) per hour. Personnel interviews resulted in the finding that BP products with used process of source separation in that composting plant were only very heavily distinguishable from "normal" disturbing contents. This was caused by a frequently only one-side and small formatted labelling. That leads to the conclusion that it must be guaranteed that the BP products are labelled on both sides and generally as big as possible.

A principal reason for the not selective source separation ,i.e. the insufficient differentiation between BP products and conventional disturbing contents, was the high operating speed and the high working load resulting from it. Analyses of separated disturbing contents showed that primarily large and remarkable BP products were sorted out.

Actually the best labelled bags for organic waste were sorted out in considerable amounts. . They, like other bag-looking products, were likewise separated probably due to their good palpability. Small seized products, which looked optical like organic mass as trays and butter wrapping, achieved the smallest separation ratio. The inconspicuously labelled PLA cups (logo punched transparently into the lid) were separated as a function of the working load, i.e. they are separated in higher amounts when the working load decreased.

Altogether the manual source separation led only in the first test (1.1 % (w/w) content of disturbing materials in the input) to a satisfying result related to the material pre-treatment. The input material of the second investigation course was mixed with an average content of disturbing materials of 4,1 % (w/w). These inputs materials are problematic related to the standards for compost given in the Biowaste Ordinance. The low glass contents in the input organic waste were considered as positive as the remaining disturbing contents can be separated by an afterward sieving.

4 Compost analysis

The results of compost quality analysis campaigns were compared with the data of a analysis campaigns of the compost made from biowaste without BP that were conducted before the start of the experiment. During the testing phase monthly conducted campaigns observed the quality parameters of produces composts. No changes in compost quality parameters were detected. Composts made from biowaste mixed with certified biopolymers had the same quality as conventional composts. The limits given in several standards (RAL GZ 251, Biowaste Ordinance) were met. Only very low heavy metal contents were detected.

5 Agricultural Application Test

In a agricultural application test was carried out to investigate the suitability of matured compost, which were made from organic waste that contained 1 % (w/w) of biologically degradable polymers. Accompanying tests were carried out without fertilisation, with a mineral fertiliser and with normal compost.

The compost addition to the soil corresponded to an amount of 30 tons dry mass per hectare, that is the maximum admissible load according the German Biowaste Ordinance (1998) for quality composts. All tests were executed four times to obtain statistically secured results from June to August 2001 with Chinese leaves on a Loess soil.

Chinese leaves, which were fertilised with matured compost made from biowaste containing BP had fresh mass yields of 1.3 tons per hectare (total product) or 0.83 tons per hectare marketable product (Fig. 6), that is considered as a normal yield level. The obtained yields corresponded to the yields obtained from fertilisation with conventional matured compost as well as with mineral fertiliser. Vitamin and nitrite contents as well as the plant quality were identical in all fertilised versions. Soil parameter were tested before and after the end of the trials. No modification of soil characteristics could be determined due to the use of compost made from BP containing biowaste. The test demonstrated convincingly that an utilisation of BP by municipal organic waste collection with the following composting is possible in the agriculture without problems.

More information available on: www.modellprojekt-kassel.de