Disposal of Biodegradable Plastics

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Abstract

These days there are a lot of technological developments in the field of biodegradable plastics both in industrial and in public research. Not only renewable but also petrochemical raw materials are used for synthesis of these biodegradable plastics because the ability to decompose does primary not depend from the raw material but rather from the chemical structure of the plastics. The success of these inventions is mainly influenced by the rules of the environment and the market. Therefore, it is necessary to evaluate the company external boundary conditions. In this content, the Fraunhofer Institute for Factory Operation and Automation conducted a study of technological, legal, economical, and sociodemographic company boundary conditions about the exploitation and disposal of biodegradable plastics. The results of this investigation support the marketing activities of companies that produce or deal with biodegradable plastics.

1 Data Collection

Within the scope of this study the institute conducted a survey. An important aspect of the questionnaire made by the project team of Fraunhofer Institute were technological, legal, economical, and sociodemographic company boundary conditions about the exploitation and disposal of biodegradable plastics which are the subject matter of this paper. These questionnaires – all in all five hundred – were sent to experts in the following fields:

- research,
- enterprises,
- politics and
- interest groups.

The theme of the study turned out to be of great public interest. Figure 1 shows the specific fields of those experts who answered the questionnaire.

Figure 1: Fields of Expertise

2 Results

It is the goal of this paper to present connections between technically feasible ways of disposal on the one hand and the political / legal, economical and sociodemographic boundary conditions on the other hand.

There are currently four different options for the reuse or disposal of biodegradable plastics and plastic waste:

- landfill,
- mechanical / biological waste treatment,
- thermal waste treatment, and
- recycling.

A precondition for all of these ways is a system for the collection of the biodegradable plastic, e.g. the in Germany currently working DSD (*Duales System Deutschland*) for wrapping waste. Plastic waste that does not belong into this category can be collected by other systems.

The introduction of the decomposable yoghurt beaker made from polylactic acids (PLA) by Danone in January 1998 led to discussions about the collection of biodegradable wrappings by the DSD. While it was the initial intention of Danone to organise the disposal of the decomposable beaker by a system designed for biological waste (*Biotonne*), the company finally chose the disposal via the DSD [5]. From the point of view of Danone this way has the following advantages [5]:

- no change for customers,
- DSD detaches the aluminium covers from the PLA-beakers before decomposing.

Above all, the legal situation at product launching time made it impossible for Danone to depose the biodegradable plastic beakers by a system designed for biological waste. Manufacturers or product launching companies have to prove an overall disposal in order to liberate themselves from the duty to take the packaging back. Otherwise manufacturers or launching companies have to guarantee by use of the brand of DSD - presently the only system which guarantees an overall disposal. In Germany, the law *Technische Anleitung Siedlungsabfall (TASi)* provides that not until 2005 the *Biotonne*-system designed for biological waste must have overall coverage too. This legislation would mean a dead end for biodegradable packaging. Therefore the recently passed amendment of packaging decree includes the following special arrangements [4]: "In case of an application for the establishment of a system exclusively for plastic packagings predominantly made out of biodegradable plastics made from renewable raw materials with each component being entirely decomposable, the competent authority is allowed to grant the establishment irrespective of the requirement of area coverage until 30 June 2002 according to §6, section 3, clause 11, if the system running company sets up an appropriate set of measures ensuring that a big part of the packagings brought into the system will be decomposed."

With regard to the term "decomposable" the decree refers to DIN¹ V 54900 [1].

The decomposable yoghurt beakers by Danone are not the first biodegradable plastics which are collected by DSD. After a warning from the Federal Cartel Court DSD is licenser also for manufacturer of biodegradable packagings. However, it could not guarantee a mechanical / biological waste treatment so far. One example was the '*Biopol*' bottle of the *Wella* hair shampoo '*Sanara*'. It got the '*Grüne Punkt*'² from the DSD with the comment that they are allowed to bring these biodegradable plastics to landfill or thermal waste treatment because of the comparably small amount. This

led to an unsatisfying situation regarding ecological policy: when a sort of biodegradable plastics obtained the '*Grüne Punkt*', their manufacturers had to pay for its utilization which does not occur and also the plastics got to where they were never intended to get by their developers – on the landfill or the thermal treatment [8].

According to the DSD and Danone this situation has changed at least insofar that the yoghurt beaker from PLA is transferred to the mechanical / biological waste treatment – in this case decomposition – via the DSD. The sorting out process is made possible by marking the beakers with a green ring and a good sorting quota is supposed to be obtained by the following actions [5]:

- concentration on the most significant sorting installations,
- direct information and technical support of the personnel at the sorting installations by Danone-DSD experts.

A more effective and cost-sensitive sorting is expected from new technological advances for the sorting plants (i.e. infrared detectors).

However, the use of this system of disposal is at least questionable. Not only did it have problems with acceptance in the past, it does also not allow the financing of the higher costs of the plastics via the disposal. Currently developments are undergoing that aim to create alternative systems on the basis of the *Biotonne*, which is currently accessible to about 60% of all German households [2]. While no such system is established today – the gradual introduction will start approximately Summer 1999³ – a program for the certification of products from decomposable plastics for this system on basis of DIN V 54900 already exists [3].

The norm DIN V 54900 requires not only the proof of the biological degradability in laboratory experiments but also a test in practically relevant conditions – in large decomposition plants. This leads to a commitment of the treatment for waste of such plastics to mechanical / biological waste treatment.

The draft of DIN V 54900 caused positive as well as negative reactions from the experts questioned by Fraunhofer IFF. On the one hand the norm seems basically practical and is already in use by some of the questioned companies for certification of their products. Critics, on the other hand, complain that the process the norm is requiring is too lavish and expensive, which would raise a barrier especially for smaller companies. Figure 2 shows what the experts thought of the practical usability of DIN V 54900. As can be seen in the figure, to 46% of the participants the draft was not known, which indicates a high information demand.

1 DIN: German Institute for Standardisation

2 'Grüne Punkt': green point, a sign for packaging supposed to be disposed by the DSD

3 informations from the 'Interessengemeinschaft Biologisch Abbaubarer Werkstoffe, IBAW e.V.', Rosenheim

Figure 2: Practical usability of DIN V 54900

Even if, as in the case of the Danone yoghurt beaker, the decomposing, as one possible method of mechanical / biological waste treatment, is used, there are still boundaries to take into account. These are caused mainly by political company boundary conditions. So the *TASi* indirectly states that from June 2005 on (compare *TASi*, transitional rule 12.1) commercialisation of the compost must be completed because after this date it will only be allowed to deposit waste if the organic share of residue on ignition amounts to not more than 5% of the overall weight (this follows from point 4.2.1 *TASi* in connection with Appendix C *TASi*).

These criteria of landfill are not obtainable – with the present level of knowledge - by using mechanical / biological waste treatment (cold methods). Goals of these cold methods are by means of mechanical treatment:

- to separate scrap,
- to separate inert materials,
- to enrich the organic fraction for biological treatment and / or
- to mince and homogenize

and by means of biological treatment:

- the conversion of biologically degradable organic residual waste components,
- reduction of the necessary volume on the landfill,
- reduction of gas emission on the landfill,
- reduction of the load of organic leakage water,
- reduction of heat emission in the landfill as well as
- production of compost or secondary raw materials [6].

For the biological treatment basically the decomposition (aerobic) and fermentation (anaerobic) are possible.

After decomposition the residue on ignition is still between 10 and 40 % [6], an ecologically sensible deposition according to *TASi* would, therefore, not be possible. This means, that after June 2005, when the option of landfill of the compost runs out, other ways have to be found. One contribution to this was made in

the *BioAbfV*⁴, which tries to open up new fields of use for compost.

During fermentation the carbon is only degraded to approximately 50 % [6]; the residue can therefore by no means be put on a landfill. The in the case of waste relevant methan fermentation produces biogas, which can be used as energy source.

The strict criteria for landfill in the *TASi* can, therefore, only be met by thermal methods. There are quite a number of methods for thermal waste treatment known, which can be put into three groups:

- combustion,
- gasification and
- a combination of both.

All thermal treatments are technically suited to meet the requirements of *TASi* (and also the emission limits), but are considerably more expensive than biological and mechanical methods. Experts currently consider the combination of these two solutions.

To the above mentioned way of recycling should be added that the experience with classical plastics shows, that the price for collecting and sorting of mixed and dirty wrappings is comparatively high. Mass plastics like polyethylen, polystyrol, polyvinylchlorid and polypropylen do cost considerably less than 2 DM [7], when bought as new raw material, while the cost for the recycled material is between 2 and 3 DM [7]. Since the economical incentive to use recycled mass plastics is missing they have to be subsidised to stay on the market.

3 Concluding Remarks

Today the range of product sectors where biodegradable plastics can play a role is growing. Research and technological development results must be used to help shape policies, which make the production, commercialization but also the disposal of biodegradable plastics more attractive. The biodegradable properties should be integrated in disposal systems and should provide a competitive advantage for instance because of lower costs of disposal.

4 References

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