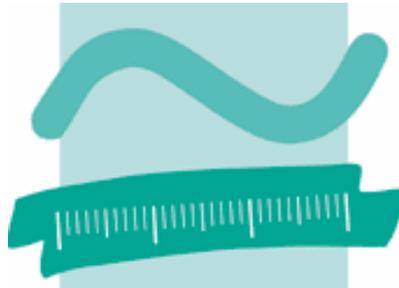


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Biodegradable Packaging



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1. Introduction

This essay deals with the omnipresent problem of waste arising from packaging and especially from plastic. To find new ways of delving into that challenge by developing new materials and alternative disposal methods in a responsible way of treating our resources has to be mankind's main focus.

That packaging waste should be avoided in the first instance is abundantly clear and regulated in the Ordinance on the avoidance and recovery of packaging wastes¹. Regulated continuative as well is the reuse of packaging, recycling and other forms of recovery which should then take priority over the disposal of packaging waste. The Packaging Ordinance has proved to be an effective instrument as you will see in the following figure. Since its entry into force, the annual consumption of packaging has decreased by 1.3 million tonnes.

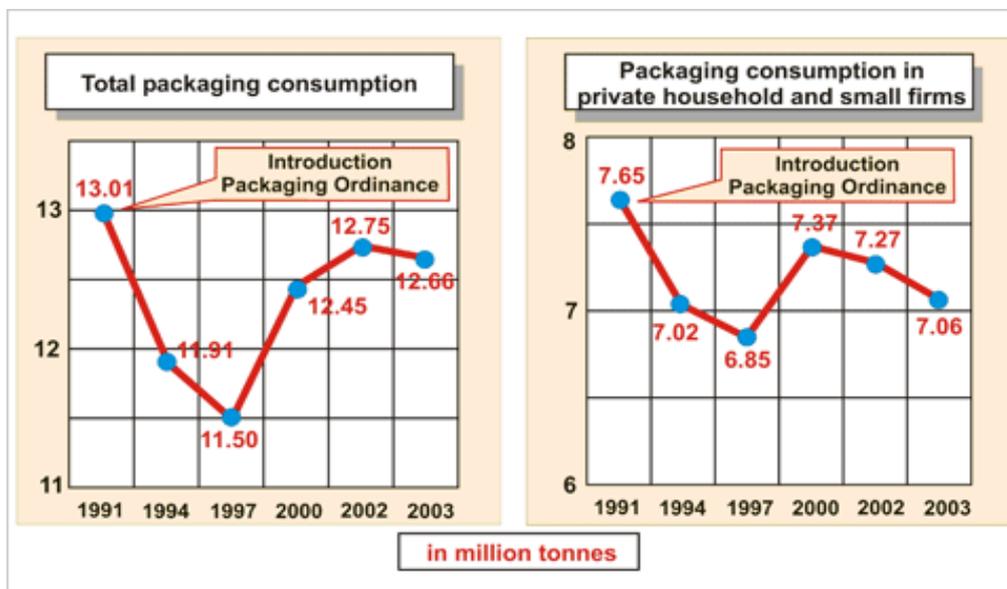


Figure 1: Packaging Consumption²

This should encourage all of us. We need to work in a more dedicated way in the field of research and development and we should never be satisfied until finding a solution which will be best for our environment.

The development of biodegradable packaging seems to be a great beginning and this will be the topic of my essay. I will give an overview of plastic as a packaging material, Bioplastics and how their certification regulations are.

¹ www.gesetze-im-internet.de

² www.bmu.de

2. Plastic as a packaging material

Packaging is part of our everyday life. It serves the customer for a variety of purposes. It safely delivers products, it encloses, protects and presents products. Packaging consists mainly of glass, paper, paperboard and cardboard, plastics, tinsplate, aluminum and wood. The reuse of the material or its recycling helps to conserve natural sources of raw materials.

Plastics are one of the most important packaging materials and have a very high significance in the packaging industry. Of the 14 million tons of packaging material that are produced in Germany every year, about 40% consist of plastic. Around 1.8 million tons of that are perishable or single-use plastic packaging materials³. A lot of these products could easily be substituted by Bioplastics and it should be the goal to achieve that.

Due to the various features of plastics there are broad ranges of application. Plastics have a brilliant printability and they are transparent, which is a major sales argument for a product. Some sorts of plastics give an excellent barrier which prevents for example the leaking of aroma and taste. Plastics convince with their light weight and they are still not easily breakable. As you can see, there are a lot of reasons why the industry reverts to that material. Plastic covers a variety of synthetic or semisynthetic polymerization products. They are composed of organic condensation or addition polymers and may contain other substances to improve performance or economics⁴. Plastic is gained from petroleum which is first of all a very expensive product as shown in the afterimage. So it is not only a matter of finding an environmentally friendly solution but also a question of cost saving.

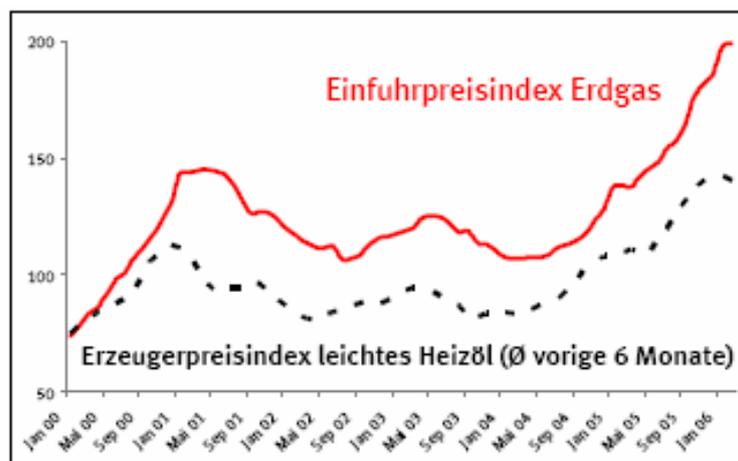


Figure 2: Price development of Petroleum in Germany⁵

³ www.wikipedia.de

⁴ Ebenda

⁵ www.destatis.de

Although plastics are very durable they degrade very slowly and the recycling of plastic is still a big problem. One of the main difficulties are to “automate the sorting of plastic waste”⁶.

To approach the problem of landfilling, disposal and recycling of plastics the Closed Substance Cycle and Waste Management (KrW-/AbfG) take advantage of packaging made from renewable resources, biodegradable packaging and a more gentle way of production processes.

3. Bioplastics

Starch and sugar plants such as potatoes, cane sugar and sugar beets are the ideal resources for the production of Bioplastics. Most of the Bioplastic raw materials can be processed in traditional machines and depending on the desired sort be transformed into different polymers.

The term biodegradable means that a substance is able to be broken down into simpler substances by the activities of living organisms and therefore is unlikely to persist in the environment⁷. Biodegradable plastics or so called Bioplastics are capable to break down. Traditional plastics have very long polymer molecules and they are too large and tightly bonded together to be broken apart and that is the reason why they are not biodegradable.

Due to the positive characteristics of Bioplastics they are a persuasive alternative to traditional plastics made out of fossil resources. The two following figures will show that Bioplastics have an outstanding consumer acceptance and that they are willing to pay more for an environmentally friendly packaging.

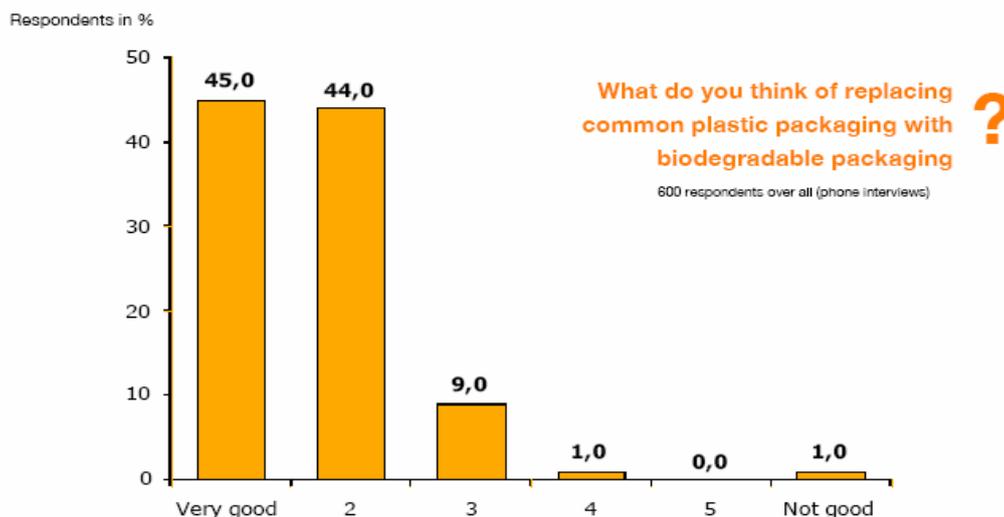


Figure 3.1: Market research in Kassel 2002⁸

⁶ www.wikipedia.de

⁷ www.science.org

⁸ www.ModellprojektKassel.de/Markt

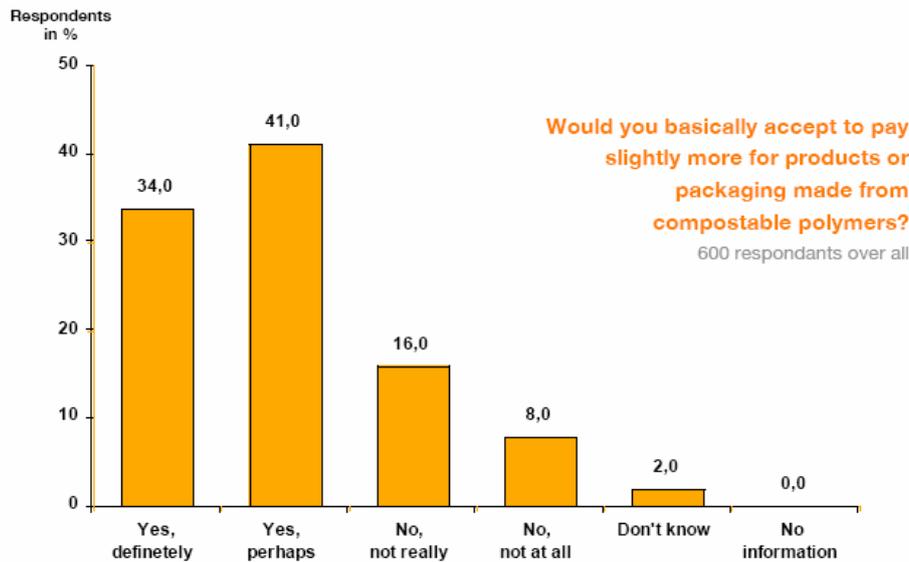


Figure 3.2: Market research in Kassel 2002⁹

The only conclusion you can draw from this is that you will find a ready market for Bioplastics and that the industry simply has to accept that and take further steps.

3.1 Starch

“Starch is a complex carbohydrate which is insoluble in water (...) biochemically it is a combination of two polymeric carbohydrates (polysaccharides) called amylose and amylopectin.”¹⁰ Products made from starch will swell and deform upon exposure to moisture. To improve some of the properties starch is blended with hydrophobic polymers to increase biodegradability. That starch can biodegrade is the “result of enzymatic attack at the glucosidic linkages between the sugar groups leading to a reduction in chain length and the splitting off of sugar units”¹¹.

Starch is not only available everywhere but also has it a suasive price-performance ratio. In Europe, USA and South Africa Corn, crop and potatoes are the most important plants containing starch. In Asia they revert to Tapioka to extract starch.

Starch is the most interesting resource for the development and manufacturing of Bioplastics. The present market share is 80%. Worldwide there is an annual industrial production of 45 Mio tonnes, 10 Mio tonnes in Europe and almost 2 Mio tonnes in Germany.¹²

⁹ www.ModellprojektKassel.de/Markt

¹⁰ www.wikipedia.de

¹¹ www.deh.gov.au

¹² www.bioplastics24.com

There is a wide range of products made out of Bioplastics, manufactured out of starch such as bags, eating utensils and often foils and trays. Some are shown in the following pictures.



Picture 1: cookie trays out of starch¹³



Picture 2: chocolate tray out of starch¹⁴



Picture 3: extrudes net out of starch¹⁵



Picture 4: shopping bag out of starch¹⁶

3.2 PLA

Poly lactid Acid is a polymer with lactid acid as its basic module and is thus manufactured out of renewable resources and is fully degradable. PLA has already been used in the medical sector for surgical stitches for a long time but not in the field of packaging industry. In the beginning, production cost had been prohibitive in relation to traditional plastics but due to the newest developments scientist found comparable and marketable Poly lactid Acid¹⁷.

PLA has a lot of advantages. It is of course, as mentioned above, biodegradable and manufactured out of renewable resources, but it has also a good printability, thermoplasticity and high transparency almost as good as PET

¹³ www.plantic.com.au

¹⁴ www.european-bioplastics.org

¹⁵ Ebenda

¹⁶ Ebenda

¹⁷ [www.http://www.sukano.ch/downloads/newsletter/deutsch/11_Sukano_Newsletter-Deutsch_2005.pdf#search=%22sukano%20pla%20deutsch%22](http://www.sukano.ch/downloads/newsletter/deutsch/11_Sukano_Newsletter-Deutsch_2005.pdf#search=%22sukano%20pla%20deutsch%22)

(Polyethylenterephtalat) or PS (Polystyrol). The disadvantages are that it already starts to melt at 60 C° and the biopolymer starts to stick to the roller during the manufacturing process.

Just like starch PLA has a broad product range. It is used as agrarian foils, trays for fruits and vegetables, cups et cetera. Some examples are shown in the pictures below.



Picture 5: Examples for products out of PLA¹⁸

3.3 PHB

Polyhydroxybutyrate or short called PHB is a thermoplastic polyester synthesized by bacteria. The supply is almost limitless, there are 600 different kind of bacteria which can produce PHB¹⁹. They are simply grown in culture and the plastic is then harvested. The advantages of Polyhydroxybutyrate is its very low permeability to oxygen, carbon dioxide and water and it has a high melting point. The problem with PHB is its high price and its brittleness. Scientists are already working on substances to add to avoid or reduce the brittleness but that will need some time and investment. PHB can be used for producing bottles, films and fibers. The Shampoo bottle shown below is used in Europe and is allowed to decompose in soil.

¹⁸ www.sukano.ch

¹⁹ www.mtholyoke.edu/offices/comm/csj/970124/bacteria.html



Picture 6 : Example for a product out of PHB²⁰

4. Certification regulation

To guarantee compliance with waste management requirements experts responsible for waste management recycling and compost quality assurance have developed an Europe-wide unified DIN standard certification for compostable products. It is the DIN EN 13423 regulating the identification and proper handling of compostable plastic products. In Germany the DIN CERTCO is responsible for the certification and if the product meets the necessary requirements it may be placed on the market. To facilitate the identification of compostable products for the consumers they are equipped with the seedling logo (Figure 5). With that everyone knows into which bin it belongs after usage. The certification and therefore the logo ensure that the product can be composted. It guarantees that not only the plastic is compostable but also all other components of the product such as colors, glues, labels et cetera. The logo is not only be used in Germany but also in Switzerland, the Netherlands, the UK and Poland.²¹



Figure 4: Seedling logo for compostable products²²

5. Résumé

It is taken for granted that plastics are made from mineral oil but that is not true and cannot be the solution for the future. Conventional plastics are as well known a serious environmental concern. We need to overcome the problem due to plastic

²⁰ www.ccmr.cornell.edu/education/ask/?quid=140

²¹ www.dincertco.de

²² Ebenda

wastes. More research is still needed on all plastics particularly in relation to their toxicity and fate within the environment. There are many products out of non degradable petroleum based polymers which can be substituted by biodegradable plastics as mentioned in this essay. In some cases, quality and price already allow Bioplastics to successfully compete with petroleum based plastics. In other cases a significant effort is required to achieve production of useful and economic materials. Bioplastics lower the greenhouse gas production and reduce waste production as well as energy and raw material consumption.

The market researches in Figures 3 and 4 show a high consumer acceptance and willingness to pay more for Bioplastic products. They offer a good alternative for many applications but they need to be introduced to the market by industry.

Let's go from this

To this!

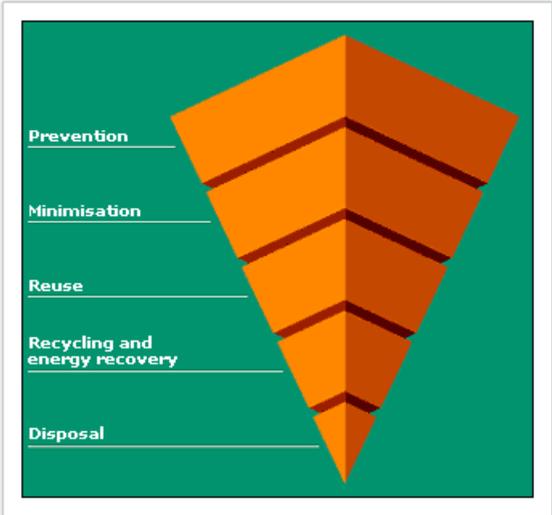
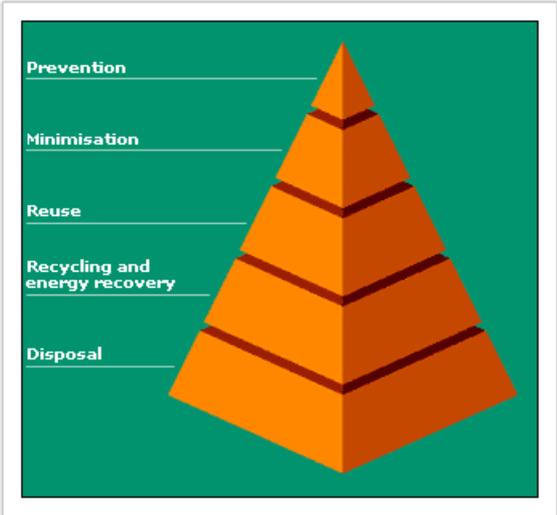


Figure 5: Waste Pyramid ²³

²³ www_rbk.gov_uk-EnvironmentalServices-rubbishrecyclinglitter-waste_pyramid_02_gif.htm

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