



## **Launch of Biodegradable PLA Bottles: a Sociological Survey on Packaging Material Awareness in the Czech Republic**

*Romana Topiarzová, Vladimír Čablík,*

*Lucie Nezvalová, Peter Fečko*

*VŠB – Technical University of Ostrava, Czech Republic*

*Barbara Tora*

*AGH – University of Science and Technology, Kraków, Poland*

### **1. Introduction**

Recently, no other municipal waste constituent quantity has grown so radically as it has been in case of packaging materials. Both their quantity and quality are changing. Nowadays, there is an emphasis on economical products which should also be eco-friendly, though. Scientists had dealt with the issue of reducing environmental load for years when they invented a new material of PLA, which is a polyester on a cornflour base called polylactid acid, which due to its biodegradable characteristics and manufacturing method making use of renewable resources has started a great environmental “boom” on the packaging material market. For the time being, its disadvantage is its higher cost which

should, however, decrease through expanding outputs and having more competition on the market [1].

PLA has already been used in the sphere of medicine as well as in the food-processing industry where it asserts itself in the production of plastic foils, trays, disposable cutlery, cups and yoghurt packaging. Own PLA bottles predominantly assert themselves as a packaging material for food and drinks with short-term durability, e.g. still water. Not only the disposal but also the production of PLA is more environmentally friendly as about 65% less of fossil fuels gets used in its production than it is in case of other plastics. Objectors oppose that the production of PLA from corn can deteriorate the situation in the food market despite the fact PLA producers use low quality corn only [2].

The bottle has an excellent transparency and its oxygen barrier properties are equivalent to polypropylene. The bottle degrades in the course of 75 to 80 days in the conditions of commercial composting [2]. The feedstock for PLA production are plants producing starch, most frequently corn. Starch is extracted from plants and is broken into its structural units – molecules of glucose. Glucose is then converted into lactic acid by lactic acid fermentation bacteria. Chemical polymerization of lactic acid follows under the formation of a desired polymer [3]. Next, a granulation product is made, from which, similarly to a PET (Polyethylenterephthalate) bottle production, preforms are manufactured resulting into the final product of PLA bottles [4]. The final PLA bottle production step may be implemented using the already existing facilities used for PET, PP (Polypropylene) and PE (Polyethylene) production [18].

However, in case of PLA material there is a problem in the moment of having consumed the contents of a bottle, for example, and the consumer is forced to decide what to do with the used packaging. How and where should the refuse be disposed of? The crucial aspect is a necessity of precise separation of this waste as mixing PET and PLA devalues the final recycled material when recycling PET bottles. It is apparent that reaching a desired percentage of separation requires sufficient public awareness of the existence of such a material and how it should be sorted.

The interest of the sociological survey, on the grounds of the above mentioned, was to find out what the current public awareness of packaging materials is. The questions contained in the sociological sur-

vey were directed towards the knowledge of types of packaging materials, for example, whether consumers would prefer a product according to the type of material from which the packaging is made, whether the respondents sort waste and last, but not least, what is the public opinion on deposits for PET containers.

In the Czech Republic a system of deposits, which would separate 100% of PET and PLA bottles in the process of separation, has not been adopted yet. There is no law which would regulate the issue of biodegradable bottles, either. As a result, PLA material is ineffectively mixed with other types of plastics, the public is not informed about the issue, the costs are thus higher and the PLA bottles become low economically attractive. The Czech legal system only regulates biowaste, namely in Act on Waste **185/2001 Coll.** [13], **which apart others deals with the duties in handling of waste**, waste utilization methods and waste disposal, etc., in Act on Packaging 477/2001 Coll. [19], and in Regulation 341/2008 on details on handling biologically degradable wastes [20].

Nevertheless, there is no mention of PLA bottles in the Act on Waste (Act **185/2001 Coll., on waste as amended**) [4]. The reason for this is unawareness, unfulfilled expectations, cost and insufficient economic attractiveness of PLA bottles.

Legislation in the sphere of biodegradable plastics (BDP) started to gradually develop at the beginning of the 1990s on the national levels, predominantly in the USA (ASTM – American Society for Testing and Materials) and in Germany (DIN – Deutsche Industrie-Norm) [14]. In 1999 ISO international standards were adopted and in 2000 a fundamental European Union norm on compostable and biodegradable packaging EN 13 432 was passed (CSN EN 13 432) [14, 21].

Compostable plastics belong into the group of biodegradable plastics. The third article of German Directive 94/62/ES [15] for packaging created a privileged status for compostable plastic packaging. According to the directive, compostable and certified packagings are exempt from the provision of § 6 of the directive till 2012. In simple terms, they are exempt from the legal provisions of “der Grüne Punkt”. The international association for bioplastics and biodegradable polymers of IBAW (Indian Business Alliance on Water) expects that this provision shall have a positive influence on the launch of packaging from bioplastics onto the German market. Its material characteristics must comply with biodegradabil-

ity conditions in accordance with CSN EN 13 432 [21]. In 2006 the European countries of Germany, Netherlands, Poland, Switzerland and Great Britain agreed on the biodegradability usage and condition fulfilment. Complying with the relevant norm requirements compostable plastics are utilizable in composting. Compostable plastics made from starch derivatives have an optimal life cycle. Widely available renewable resources such as corn, grain, rice or potatoes are used for their production [5].

## **2. Statistical Computing Methods**

The sociological survey was carried out questioning 4 principal target groups, particularly drink producers, store chains, consumers and packaging waste disposal companies. The evaluation was conducted in the form of testing hypotheses using a non-parametric method. Dependence of two variables was identified in the interest groups, except for the store chains. In their case only a verbal evaluation was carried out due to a low representativeness of the sample.

Drawing up the sociological survey the methodology of Briš, Litschmannová, etc. was used [6÷8]. Wording the questions, both the analytical (basic data on the respondent) as well as priority ones were used. The respondents could choose answers to questions of a closed-ended type, alternative, semi-closed or open-ended. There were seven questions concerning the issue of the packaging material. The initial questions focused on the basic data about the respondent, which were followed by hypotheses of two variables based on the parameters.

The total number of respondents was 173. In the target group of consumers it was 113 respondents, which is a sufficient sample for such type of a sociological survey. Data were acquired using the technique of a “snowball sampling”, through emails or trained questioners [9].

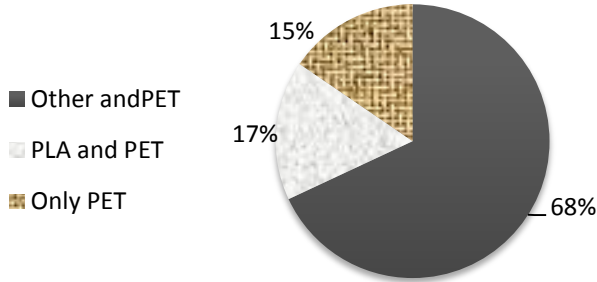
The addressed representatives of waste disposal companies and packaging material producers (27 answered questionnaires), store chains (7 answered questionnaires), mineral water companies, dairies and others (26 answered questionnaires) were selected in a company database of “ALBERTINA – COMPANY MONITOR” of Creditinfo company, and by means of web sites. Both the companies as well as consumers came from all ends of the Czech Republic to ensure as most effective representativeness of the sociological survey as possible.

### **3. Results and Discussion**

One of the first questions was aimed at the knowledge of packaging material types. Launching PLA bottles it is necessary to put emphasis on the fact they are recognized and sorted correspondingly. In the group of consumers the question of “What of the stated types of packaging materials do you know?” had few positive answers in case of PLA bottles representing the biodegradable material awareness, i.e. mere 21 out of the total 113 respondents (approx. 19%), whereas everybody knew PET bottles (See Figure 1). Producers and packaging material processors were asked whether they are aware of a PLA bottle notion and the answers imply that 56% of companies have already come across this type of packaging (See Figure 2).

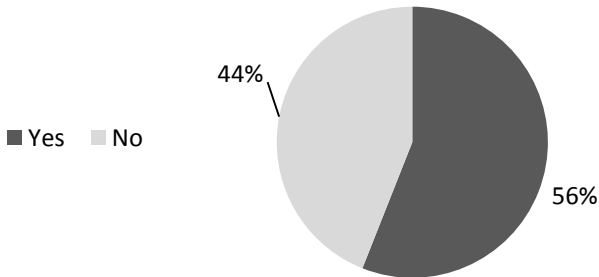
It is apparent on the grounds of the above mentioned that the first step to launch PLA bottles should be a sufficient promotion of the own material among consumers. So far, PLA bottles have not been distributed in the CR and thus consumers do not know this new packaging material. Companies dealing with packaging come across this type of product quite frequently and it is only a matter of time when also consumers have the chance to encounter PLA bottles.

An important factor affecting the use of PLA bottles as a packaging material on the market is the fact whether this packaging shall be interesting for consumers for being biodegradable or whether the price shall be decisive. Consumers were asked a question – “Would you choose goods according to their packaging material?” (See Figure 3) and store chains and drink producers were asked a question – “Do you think consumers would choose a product according to its packaging material?” Depending on the addressed group there were significant differences in the answers. Store chains with 100% and drink producers with 77% suppose that their customers would choose goods according to the packaging material, but only 47% respondents from the consumer group would really decide according to the packaging material. The remaining majority (53%) did not care what the packaging material is.



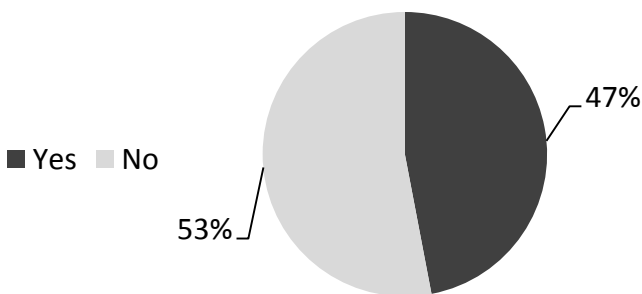
**Fig. 1.** Evaluation of respondents' knowledge of packaging materials

**Rys. 1.** Ocena znajomości materiałów opakowaniowych przez respondentów



**Fig. 2.** Evaluation of producers and packaging material processors' answers whether they are aware of PLA bottles

**Rys. 2.** Ocena odpowiedzi producentów I przetwórców materiałów opakowaniowych na pytanie czy znają butelki z PLA

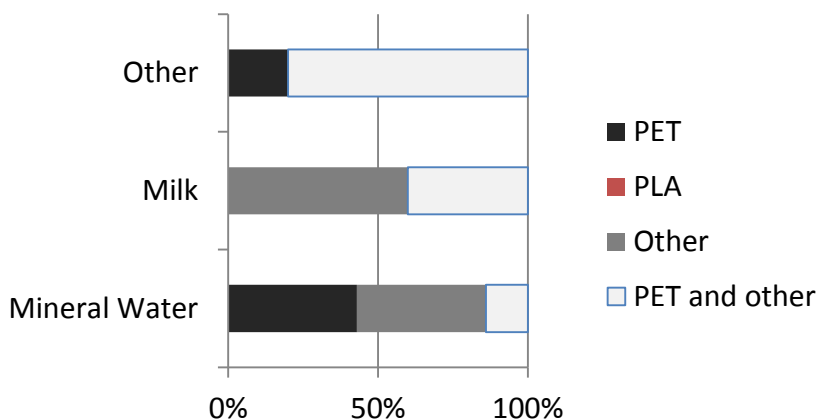


**Fig. 3.** Evaluation of respondents' answers to: "Would you choose goods according to their type of packaging material?"

**Rys. 3.** Odpowiedzi respondentów na pytanie: „Czy wybierałbyś produkty ze względu na typ ich opakowania?”

This demonstrates the public attitude to the fact that customers shall not appreciate products packed into “more eco-friendly” PLA bottles and they shall choose goods according to their popularity or their price. It is then left on the producers’ consideration what materials they should fill into.

The questionnaire survey showed that most frequently the observed products are filled into PET bottles and other category labelled as “others” (glass, Tetrapac, LACPET, PP). To date, no company fills their products into PLA bottles in the CR (See Figure 4). The problem here is the cost of PLA bottles which is, so far, much higher than the cost of PET bottles [1]. This way, products filled into PLA bottles would become more expensive and would not be competitive.

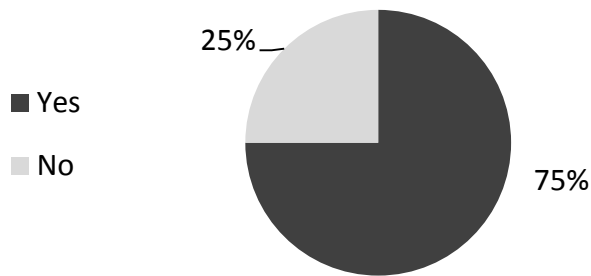


**Fig. 4.** Types of used packaging material for mineral water, milk, etc.

**Rys. 4.** Typy zastosowanych materiałów opakowaniowych do wody mineralnej, mleka itp.

After all, if products from PLA asserted themselves on the market, there would be another issue of how consumers should handle this packaging material subsequently. Neither the existing legal regulations in the Czech Republic nor the waste collection system take biodegradable PLA bottles into consideration. The established sorting process takes into account only plastics, glass, paper and compostable material (however, this does not get into composting plants suitable for PLA degradation).

The sociological survey implies that over 75% of the addressed public sort waste (See Figure 5), and therefore, a theoretical solution for PLA bottles separation would be an introduction of one more constituent into the sorting process. The existing container sites could include another container type for biodegradable materials.



**Fig. 5.** Evaluation of respondents' answers to: "Do you sort waste?"

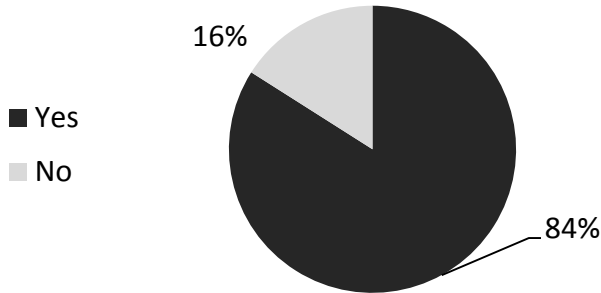
**Rys. 5.** Odpowiedzi respondentów na pytanie: „Czy sortujesz odpady?”

In the CR one food-processing company tried to launch the PLA material in 1998 in the form of new bioyoghurt filled into PLA cups [10]. It must be said that the novelty came off quite badly. Soon, the packaging material was withdrawn from the market due to an unresolved collection system and subsequent utilization of the material. Even ecologically-minded consumers did not know how to dispose of this type of waste. The failure was then caused by an insufficient promotion and failure of the collection system [10]. Another bioplastics producer is, for example, the company of NatureWorks LLC (USA) [17] which uses PLA bottles for still mineral water called BIOTA [11] or Earthpure Organics™ LLC, which also started to fill into this material, i.e. their product called Eco-Water™. More and more companies begin to use packaging made from bioplastics for their products and it is only a matter of time when such products shall appear on the Czech market and there will then be a necessity to deal with the situation [12].

A certain possibility how to motivate the society towards a higher productivity of waste sorting, especially in case of the monitored PET and PLA containers could be deposits [16]. This method of collection was approved by 84% of respondents from the ranks of the public, i.e. consumers (See Figure 6). Producers of dairy drinks, 70% of the ad-

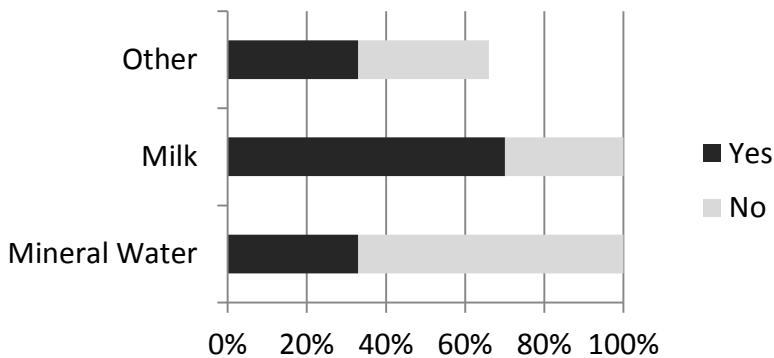


dressed ones, were also in favour of deposits, but only 33% of producers of mineral water and other drinks agreed with deposits (See Figure 7).



**Fig. 6.** Evaluation of respondents' answers to: "Do you agree with deposits on packaging material?"

**Rys. 6.** Odpowiedzi respondentów na pytanie: „Czy zgadzasz się na kaucję za opakowania?”



**Fig. 7.** Evaluation of mineral water producers and dairy's answers to: "Do you agree with deposits on packaging material?"

**Rys. 7.** Odpowiedzi producentów mleka i wody mineralnej na pytanie: „Czy zgadzasz się na kaucję za opakowania?”

This begs the question whether it would be suitable to take into account deposits on PET as well as PLA in the future, when the majority of the addressed consumers, whom the issue concerns the most, agree with the given method of collection [9]. There is no doubt that the transfer to a deposit system for PET as well as PLA bottles would cause a number of changes. Apart from legislative and consumers' habits the

change would also concern producers' methods and established distributors' mechanisms. In addition, it may have an influence on product price fixing. Naturally, the collected bottles against a deposit would not be refilled, but the material would be recycled or composted.

#### **4. Conclusion**

On the grounds of the above stated facts it may be concluded that PLA as a packaging material, both for drinks or other products, is prospective for the future, not only thanks to its properties of a biologically degradable material, but also thanks to the fact it comes from renewable resources. However, it must be pointed out that the whole system of production, distribution, collection and follow-up processing of biodegradable materials still has lots of restrictions and issues to be dealt with, which will have to be solved before the products appear on the Czech market.

Not only in the Czech Republic, PLA is not distributed on a mass basis so far and before this happens it is necessary to prepare adequate conditions, both legislative and practical ones. As a consumer is not able to distinguish these two types of plastics with the naked eye, these could get mixed up, which represents a problem for recycling of both the packagings. PLA impurities in PET worsen its quality during repeated production. On the other hand, PET cannot be composted whatever the efforts may be. Therefore, it is necessary to prepare and introduce a separate system of collection and inform the public in a similar way how they got familiarized with waste sorting into paper, plastics and glass. If deposits on packaging are considered, collection machines must be prepared for this possibility or collection site personnel must be trained, and last but not least, industrial composting plants must be set up.

The implemented sociological survey showed that the target group of the general public favours PLA as an environmentally more friendly material. The contemporary society is not indifferent to the environment and despite an increase in the consumerist way of life they are interested in being environmentally friendly, e.g. by sorting waste. A more than half of the consumers sort waste and 47% of consumers use recycled and ecological materials. On the other hand, producers of packaging and companies that fill their products in the materials are naturally

sceptical to the materials as a launch of new plastics would require certain changes in their plants, especially introducing the system of deposits and related considerable investments

To launch PLA bottles on the market it is vital to:

- pass legislative measures,
- to work out a collection system for such packaging,
- to sufficiently promote PLA bottles,
- to mark the bottles to better distinguish among other packaging materials,
- to prepare commercial composting plants for biodegradable PLA bottles.

### Acknowledgement

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## **Wprowadzenie biodegradowalnych butelek PLA: badania socjologiczne świadomości materiałów opakowaniowych w Republice Czeskiej**

### **Streszczenie**

W artykule omówiono aktualne zagadnienie coraz większych ilości opakowań z tworzyw sztucznych. Przeprowadzono badanie socjologiczne, dotyczące tego zagadnienia, na temat „Świadomość dotycząca opakowań”. Jego celem było wskazanie problemów przy wprowadzaniu nowych biodegradowal-

nych butelek z polilaktydu (PLA). Kolejnym celem była identyfikacja i udokumentowanie świadomości społecznej podmiotów, których sprawa dotyczy, a więc sprawdzić, jak są one postrzegane przez odbiorców oraz, czy zdaniem respondentów, warto śledzić rozwój opakowań biodegradowalnych w przyszłości. Badania przeprowadzono wśród konsumentów, producentów opakowań, firm, które używają tych opakowań, sieci sklepów oraz firm zajmujących się utylizacją odpadów. Wyniki badania socjologicznego pokazują, że społeczeństwo ma pozytywny stosunek do wprowadzenia opakowań biodegradowalnych, natomiast producenci opakowań i firmy, które je wykorzystują są raczej sceptycznie nastawieni do tych materiałów. Nacisk położono także na stosunek konsumentów do sortowania odpadów i pytanie o wprowadzenie kaucji za opakowania. Ponad połowa respondentów sortuje odpady i są za kaucją na opakowania. Były jednak różne opinie w firmach, używają opakowań: odpowiedzi dotyczące systemu kaucji całkowicie różniły się w zależności od typu napoju.