EnTRESS Case Study

Simbrix Limited

Simbrix Ltd is a manufacturer of plastic arts and crafts toys which encourages boys and girls to be creative. Simbrix colourful pieces connect together without needing to be ironed, glued or sprayed with water and with very few instructions.

EnTRESS intervention

- Literature review of past research relating to chemical leaching from PET water bottles.
- Proposed experimental methodology for further research.

Background to the support provided

Simbrix products are made from high quality plastic, designed to last through a good deal of play but plastics have a bad reputation. The company wanted to commission some research which aligns with their ethos. They were looking for an opportunity to raise their profile through promoting responsible plastic use. They asked EnTRESS to explore whether single use plastic water bottles can safely be used more than once.

Simbrix aimed to disseminate the information through a joint press release and social media campaign with the University, in order to educate the public about plastic bottle reuse. In addition, it was hoped that the literature review could be used as a starting point for university students and or researchers to develop and undertake laboratory based experimental work on plastic bottles in the future in order to expand upon the research that had already been completed.

European Union
European Regional Development Fund

UNIVERSITY OF WOLVERHAMPTON

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What was accomplished?
The Knowledge Transfer Process

Dr Kate Nixon (Senior Lecturer in Physical Chemistry, University of Wolverhampton) conducted a literature review on the topic of chemical leaching from single-use water bottles made of polyethylene terephthalate (PET) . The review of previous research aimed to understand whether chemicals leach into water to dangerous levels and the effect of environmental conditions like heat and light on the level of contamination in water.

Findings

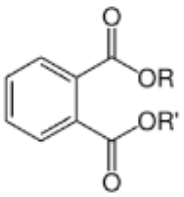
Currently there is conflicting advice regarding the reuse of polyethylene terephthalate (PET) plastic water bottles as there is concern about the migration of potentially harmful chemicals into the water they contain. The scientific literature regarding chemical migration from PET is concerned with two main contaminants:

1. Antimony.

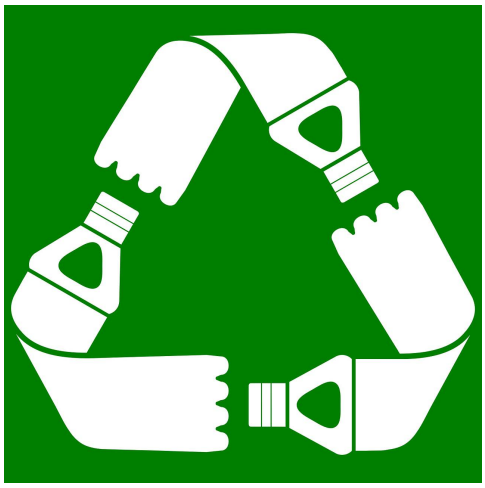
Antimony trioxide is used as a catalyst during PET production to speed up the manufacturing process. It is suspected of causing cancer. The maximum acceptable level of antimony in drinking water in the EU is 5 µg / L.

2. Phthalate acid esters (PAEs).

PAEs are a class of chemical used as plasticisers to increase the useful physical properties of pure plastics. Diethylhexyl phthalate (DEHP) is the most commonly used. PAEs mimic hormones in the body and disrupt normal function. The US Environmental Protection Agency give a maximum contamination level of 6 µg/ L for DEHP.



The general structure of a phthalic acid ester. The R groups can be replaced by other organic groups to produce a family of similar chemicals.



What's available from EnTRESS?

- Fully-funded, one-to-one mentoring and business support, for the development and / or adoption of environmental technologies, processes and improvements.
- Access to, and collaboration with, leading research provided through the University of Wolverhampton.
- Fully-funded, in-house resource efficiency audits for SMEs.
- Technical review workshops providing assessments on current products and associated R&D opportunities.
- Environmental impact challenges set by large commercial and public organisations, providing SMEs with business opportunities.
- Technology showcases promoting the uptake of environmental innovations developed by SMEs.

Antinomy

A number of studies have investigated the migration of antinomy from PET into water. Storage temperature is the dominating factor; much more leaching occurs at temperatures of 60Á°C and above. Sunlight also increases the leaching of antimony, but to a lesser extent than temperature. pH in the range typically found for water (6-8) has no effect on the migration of antimony.

The storage time has a negative effect on the migration of antimony into water from PET; there is an initial burst of antimony into the water, after which, the concentration remains constant or decreases. *Overall the research has shown the level of antinomy found in water bottled in PET was well below the WHO guidelines (5 og/L) when stored below 50°C, regardless of storage time.*

Phthalate Acid Esters (PAEs)

Various PAEs have been identified as contaminants of water bottled in PET bottles, the five most studied are dimethyl phthalate, diethyl phthalate, di-n-butyl phalate, benzyl butyl phthalate and diethylhexyl phthalate (DEHP).

Dr Nixon focused on investigations of DEHP levels found in still water stored in PET bottles only. The studies originate from a range of countries and have investigated the PAE concentration in bottled water for a range of brands, storage lengths, temperatures and exposure to sunlight. *With only two exceptions, the DEHP level was found to be below that set by the US Environmental Protection Agency and is less than one quarter of the acceptable limit in the majority of cases.*

The effect of storage time, temperature and exposure to sunlight were investigated. Unfortunately, there is little correlation between investigations, with often contradictory results being reported. Two studies mentioned as a discussion point that the quality of the bottle affected the amount of migration, as did the nature of the plastic (virgin or recycled).

Simbrix

Simbrix is a small company with only two full time employees. Their product was inspired by the inventor's children to be a toy free from frustration that is suitable for all genders. Simbrix offer a wide range of their unique brick toys for children to design and create their own pictures, with the bricks joining and sticking together through friction alone.

Plastics

Increasing attention has been given to how we can recycle and reuse plastics. Plastics, in particular single use plastics, have recently come under criticism as a material that does not biodegrade. This has led many manufacturers to look at their products and think about how their materials can be recycled or look for other sustainable/biodegradable materials.

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Outcomes

None of the studies found by Dr Nixon investigated the re-use of single-use plastic water bottles and none were focused on the UK. The majority focused on water storage time (days to months and even years) and conditions including temperature and sunlight. Interestingly, the levels of antimony and DEHP were rarely found to exceed the recommended limits.

Another area of concern is microbial growth in single-use bottles which are used repeatedly but not washed well or often enough.

The migration of chemicals from PET into water as a single-use bottle is re-used has not been reported. To determine if re-using single-use bottles is unsafe, due to leaching of chemicals, experimental work will need to be undertaken. Suggested methods for experimental work examining the chemical contamination risks of re-using water bottles has been outlined to Simbrix.

There are many factors to consider with experimental work on this topic. Should the bottle be shaken to simulate use? How many reuses should be simulated? How often should the water be refreshed? The University of Wolverhampton has laboratories equipped to perform appropriate research and will be offering projects to undergraduate and masters students on this topic.

What is EnTRESS?

EnTRESS is an environmental innovation project drawing on University of Wolverhampton expertise, part funded by the European Regional Development Fund (ERDF).

What we do?

Support for SMEs who want to modify their practices for increased sustainability.

Eligibility criteria

Open to Small to Medium Size Enterprises (SMEs).

Definition of an SME

'The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million' - Extract of Article 2 of the annex to Recommendation 2003/361/EC

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