In-market trial to prove recycling process for black CPET trays

Background

Approximately 1.3 billion black crystallised polyethylene terephthalate (CPET) trays are used in ready meal packaging in the UK every year. Whilst they are recyclable, the black colour of the trays makes them invisible to optical sorting equipment at plastic recovery and sorting facilities and they are usually missed and end up in landfill or being processed into energy.

In late 2013, WRAP initiated a call for projects to Courtauld Commitment 3 (CC3) signatories to provide funding and support in developing evidence to aid the delivery of the packaging target. This project aimed to test whether black CPET trays that use alternative colourant previously shown to be successfully detected and separated automatically*, could potentially be recycled back into packaging.

M&S, Sainsbury's and leading industry organisations worked together to demonstrate the ability to manufacture, distribute and recover detectable black CPET trays through household recycling collections. Once recovered at the material recovery facility (MRF), the trays were flaked and assessed for their suitability for remanufacturing into food grade black CPET trays.

It is expected that these findings are relevant to all involved in the supply, collection and recovery of plastics.

Key findings

- The premium British ready meal sector is growing year on year, and the use of black CPET is increasing both in the market and the waste stream. An estimated 30,000 tonnes of black CPET packaging from the household ended up in landfill or energy recovery in 2013.
- Feasibility studies proved that CPET trays using an alternative colourant to black could be detected by sorting equipment.
- This project demonstrated it is possible to incorporate detectable black pigments into ready meals products, recover the trays, sort and recycle these back into food grade trays.
- The availability and recovery of enough detectable black CPET material is paramount for the recycling process to work. This requires investment and support to prove its operational and economic viability in full scale commercial conditions.

* http://www.wrap.org.uk/content/recyclability-black-plastic-packaging-0

Trial Description

The trial involved the following key stages:

1. Quantifying and producing detectable black CPET ready meal trays and placing them onto the market

The number of trays needed for the trial was based on trays that would be sold in M&S and Sainsbury's stores within the regions that were served by the waste management provider whose MRF was used in the trial. M&S and Sainsbury's each required 2 million ready meal trays and sold these in stores in south east of England.

2. Ordering, manufacturing and testing of the detectable black CPET tray

Qualification tests were undertaken at the food suppliers' to trial the new detectable black CPET trays through a full production and usage cycle. This was to ensure that the new dye had no effect on technical or mechanical performance and on consumer perception. No changes were made as a result of these tests and the remaining trays were manufactured, filled, packed and distributed.

Consideration:

In advance of the ready meal products being distributed, and to prevent MRFs and Plastics Recovery Facilities (PRFs) from having detectable black CPET trays potentially contaminating their PET streams, a press release was sent out to advise notice of a technical adjustment which could be made to most optical sorters to prevent this. The information sheet is available on WRAP's website.

3. Planning for the capture and sorting of the detectable black CPET trays at the MRF

Although the sorting and detection of the new black CPET tray had been proven in previous laboratory trials, a test run was conducted at the MRF before the in-market trial. This tested the sorting process which involved a plastic separation stage with two optical sorting units, and an operative manually removing the detectable CPET from the clear PET in the resulting stream.

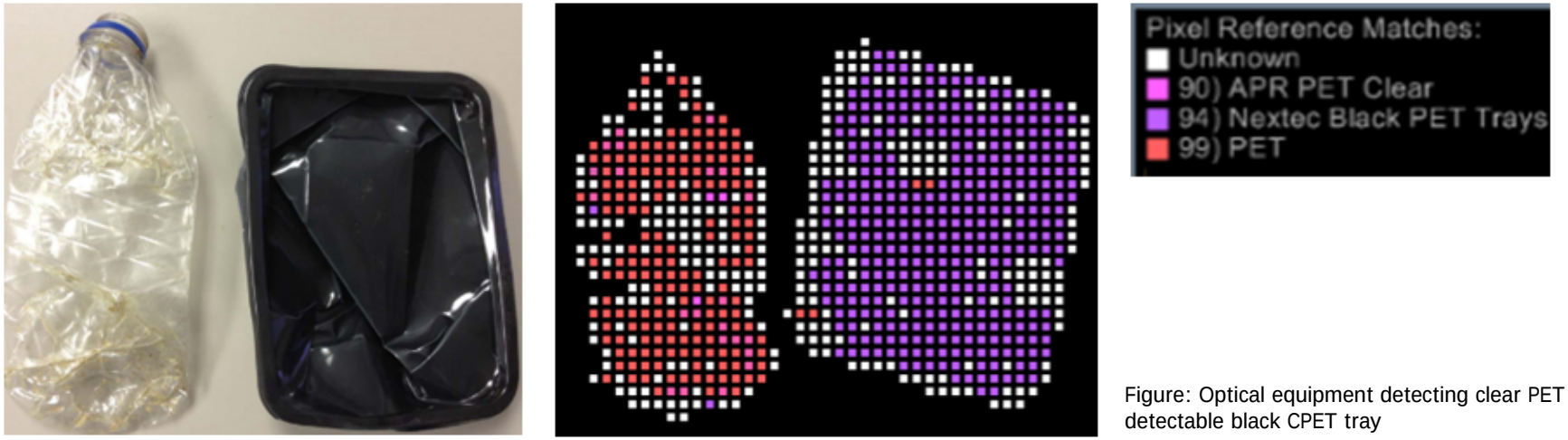

Figure: Optical equipment detecting clear PET bottle and detectable black CPET tray

Trial adjustment – more trays needed

Commercial changes took place during the project which affected the number of contracts held by the MRF.

The plan for feeding particular food depots, that then supplied retailer shops in particular regions therefore had to change to one involving a wider distribution of products still leading to the MRF. The seeding of the products was therefore less controlled.

The project team ensured that extra pallets of detectable black CPET trays were available at the MRF in case the recovery of the trays from kerbside collection was too low for the material's onward processing.

These virgin trays were known as "Plan B" trays and would be introduced in the sorting system in a controlled manner and contextualised in the resulting recovery figures.

4. Recovering the material at the MRF

Under commercial conditions, the MRF experienced high volumes of material on the belt which allowed for a high quantity of non-requested black plastics material carried over from the 1st optical sorter. Gravimetric tests were showing that only 2% of the black materials was estimated to be detectable black CPET and this could not be sorted efficiently by the sorting equipment and resources available.

The mixed material stream was instead captured and sent to a PRF which would separate out the detectable black CPET from the rest of the plastics. This stream constituted 8 bales and weighed around 2 tonnes.

Consideration:

The issue of carryover material affecting the detection of the trial trays was not foreseen and was problematic for a manual separation of the trays. Taking normal business conditions into consideration for future work to separate detectable black CPET, it might be more realistic to plan for a less efficient separation of plastics at a MRF before onward plastics sorting at a PRF.

Figure: Mixed stream containing trial CPET trays after sorting at the MRF (on right, the 8 bales)

5. Further sorting of the material at the PRF

At the PRF, the bales of mixed plastics were sorted and approximately 100kg of detectable CPET material was recovered.

Figure: Automatic sorting for trial CPET trays at the PRF (on right, the recovered trays)

Trial adjustment – limited recovered material for testing

Due to the low amount of material recovered from the trial, it was not possible to provide the plastics recycler with the material for granulating and washing. The project team decided instead to focus on doing laboratory-scale tests involving flaking, washing and decontamination tests to prove the suitability and quality of the recovered material for reprocessing into trays.

6. The flaking, washing and decontamination of the material

2kg of detectable CPET tray material consisting of 1kg post-consumer and 1kg virgin tray material was ground to 15-20 mm flakes for washing and then decontamination analysis. Results were kept separately for the differently sourced materials.

Figure: Flaked trial tray material for washing and decontamination analysis

The flaked material was washed, rinsed and dried at the PRF.

It was then tested for residual contamination by full extraction before and after decontamination in a lab scale setup mimicking standard production recycling conditions.

Figure: Post consumer CPET flake after washing and decontamination

7. Interpreting the decontamination results

The suitability of the decontaminated flake for reuse in food grade trays was based on the evaluation of the results by the tray manufacturer, and builds upon guidelines provided by the European Food Standard Agency (EFSA). Test results on the post-consumer material after decontamination showed no traces of any contaminants and easily complied with the limits set for recovered amorphous polyethylene terephthalate (APET) going to food grade trays.

Results from the trial showed that the properties of the recovered detectable black CPET material did not show any significant property change due to the recycling. This provides sufficient assurance that the inclusion of the recovered material back into food trays is food safe and technically feasible*.

As the recycling infrastructure extends to accept CPET trays, it will be possible to safely incorporate increasing levels of recycled CPET back into new trays without technical constraints.

Conclusion

Although the trial encountered a number of logistical and operational issues, it provided clear examples of how the process for recovering post-consumer material currently works in practice and the day-to-day difficulties that can be encountered. The project has been successful in providing insight and results to demonstrate that there is potential for a closed loop solution for detectable black CPET trays.

As an indication of impact, if all black CPET trays were collected for recycling this would amount to approximately 30k tonnes of plastic being diverted from landfill or energy recovery, thereby helping the UK in delivering against its plastic packaging recycling target. The estimated potential savings of disposal costs for local authorities of between £2.2-£2.8 million per year.

Learnings & considerations

Full in-market trials in a commercial environment provide a number of challenges and considerations. This includes:

- difficulty in capturing the test material if this is not a targeted material for the majority of local authority kerbside collections;
- dependency on stable partnership contractual arrangements to carry out the trial as intended;
- potential impact that normal commercial conditions have on the efficacy of recovering test material; and
- the importance of communication across all project partners and their employees to ensure awareness of any trials taking place.

* A technical supplement explaining the process and tests used is available to download on WRAP's website

Next steps

Data analysis on the recovered detectable black CPET flake confirm the material would satisfy the requirements for manufacture into new food grade trays.

The theoretical suitability of the recovered material CPET material should be analysed further to establish the upper threshold of CPET recyclate that can be used in the manufacture of new trays.

The viability of recycling detectable black CPET depends on a number of factors including the:

- widespread availability of detectable black CPET trays on the market;
- technical capabilities of current MRFs and PRFs to recover the trays;
- location and number of MRFs and PRFs that can recover the trays; and
- financial conditions in the polymer market to make the use of detectable CPET materials economically viable and attractive.

Investment and support is now needed to prove its operational and commercial viability for both retailers and recyclers in full scale commercial conditions. It is also recommended that a lifecycle analysis is completed to better understand and establish the environmental credentials of using detectable CPET material.

It is hoped that the key findings, learnings and considerations from this in-market trial will inform the establishment of a closed loop process for detectable black CPET.

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