Progress of the HolyGrail Initiative

Jennye Scott, VP Global Creative Services
Nov 1, 2022

Introduction

One of plastics' greatest strengths is its versatility. With a variety of polymers available, each offering various performance criteria, plastic provides the ideal flexibility and adaptability for many different products and applications.

While many plastic polymers are recyclable, a lack of efficient sorting can limit the use for blends of recycled materials. And as the world continues to move towards a circular economy, the ability to easily sort and separate plastic polymers will be critical to delivering high-quality, consistent recyclate that is suitable for use in a wide variety of products.

To help overcome this challenge, we are partnering with Digital Watermarks to support their HolyGrail initiative.

The Project

The Digital Watermarks Initiative, HolyGrail, is coordinated by AIM, the European Brands Association, and the Alliance to End Plastic Waste. The pilot project aims to prove the technical viability of digital watermarks for the accurate sorting of packaging waste, along with its wider economic suitability.

Digital watermarks are imperceptible codes, the size of a postage stamp, that can cover the surface of a package. They can be embedded into graphics or into the packaging mould itself. For the sorting of plastic waste, the objective is that once a pack has entered into a waste sorting facility, the digital watermark can be detected and decoded by a high-resolution camera, which is able to sort packaging into the different categories required, such as food and non-food.

This would result in better and more accurate sorting streams, which will deliver higher quality recyclate that benefits the entire packaging value chain.

History and Progress

The HolyGrail Pioneer Project was established to speed up the transition to a circular economy for plastics by focusing on ways to increase recycling rates, in particular through improved sorting of post-consumer packaging.

The digital watermarks initiative originated as part of the wider HolyGrail 1.0 project, which took place between 2016 and 2019. This was facilitated by the Ellen MacArthur Foundation and brought together various stakeholders from the packaging value chain to investigate possibilities for improving post-consumer recycling through the use of chemical tracers and digital watermarks for better sorting.

From this initial project, digital watermarks were found to be the most promising technology, gaining support among the large majority of stakeholders.

As well as its potential for effective sorting, through the creation of smart packaging, the technology also has the potential to be used in other areas. These include enhanced consumer engagement (i.e., providing additional product information), linking to a website or promoting a competition, supply chain visibility, and retail operations.

HolyGrail 1.0 provided a basic proof-of-concept for digital watermarks. This led to the establishment of HolyGrail 2.0 as a cross-value-chain initiative to assess how this digital technology can enable better sorting and higher-quality recycling rates as part of a circular economy.

Digital Watermarks Initiative HolyGrail 2.0

The second stage of the project involved semi-industrial testing that mimicked real-life conditions of the prototype detection unit for digital watermarks. The tests were carried out on around 125,000 pieces of packaging from 260 stock-keeping units (SKUs). The packs included soiled and crushed examples and were handled at a belt speed of 3m per second to represent routine industrial operations. Additional testing of packs with severe soiling and crushing were performed at a higher belt speed of 4.5 m/s and showed no loss of performance.
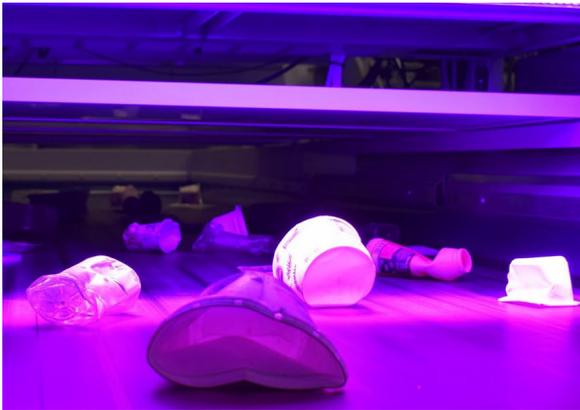
Success criteria for the tests included detection efficiency, ejection efficiency, purity, prototype stability and routine function, ease of programming the sorting operation, and counting capabilities of the prototype.

The ejection operation comprised a software combination of digital watermark detection and near-infrared (NIR) detection to identify both watermarked and non-watermarked items, as would occur in a typical industrial sorting or recycling facility. Based on initial findings, the combined signal of NIR/digital watermarks detection was refined to further improve the purity of the sorted output.

Berry
INNOVATION FOR THE WORLD
SOLUTIONS FOR YOU

Page 2 of 3

Progress of the HolyGrail Initiative
Nov 1, 2022

The Results

The results showed that the digital watermark technology can achieve more granular packaging waste at scale. Consistently high rates were achieved across all the tested categories of plastic packaging, with on average 99% detection, 95% ejection, and 95% purity rates.

Due to Berry's extensive product portfolio, we were able to make an important contribution to the project, providing a number of different drinking cups, lids, tubs, and tubes to test the sorting technology. These items covered a variety of properties, ranging from material makeup (polypropylene and polyethylene), design technology (thermoformed and injection moulded), color (transparent, white, and printed), and finish (laminated, gloss, matte, and satin). We also provided products that were either printed or moulded with the watermark to enable full testing of the technology.

A particularly significant finding was the ability of the system to identify and sort the soiled and crushed items, even in instances where only part of the code was visible.

The success of the project opens up potential opportunities, such as developing separate food and new PCR streams for items such as cosmetics or household chemicals. This could provide new recycling steams, help to overcome the limitations of current NIR sorting technologies, and help move towards a true circular economy for packaging.

Moving Forward

The project has proved that digital watermarks can increase intelligent sorting of packaging waste at scale. It also demonstrates how collaboration among businesses who are engaged and committed to a clear goal can help to accelerate the development of new solutions.

The next step will be industrial-scale pilots and in-market tests to assess the technology on an even larger basis. We will keep our customers updated on the progress of the project. And with the ability to embed the watermark into both graphics and moulds, we will be able to advise customers on the appropriate next steps for their requirements.