



PIONERING DIGITAL MATERMARKS FOR SMART PACKAGING RECYCLING IN THE EU

Digital Watermarks Initiative HolyGrail 2.0

CIRCULAR ECONOMY

FOR PACKAGING



FACING THE NEW CIRCULAR REALITY

> Eliminate problematic or unnecessary single-use plastics



BY 2030 100%

of plastic packaging to be reusable, easily recyclable,

of plastic packaging to be **effectively**

average recycled content across all plastic beverage bottles

CIRCULAR ECONOMY

How can we achieve a Circular Economy for Packaging in the EU?

FOR PACKAGING



One of the biggest challenges is how to **maximize our resources** through optimal sorting and recycling

We need to **better sort our post-consumer waste in the EU waste management systems** by accurately identifying (plastics) packaging, resulting in more efficient and higher-quality recycling



CIRCULAR ECONOMY FOR PACKAGING

Digital watermarks for smart packaging to **revolutionise the way packaging is sorted**

Opens **new possibilities** currently not feasible with existing technologies



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CIRCULAR ECONOMY FOR PACKAGING

September 2020: Under the auspices of AIM, European Brands Association, companies and organisations from the complete packaging value chain have joined forces

Objective: Prove the viability of digital watermarking technologies for accurate sorting and the business case at large scale

Website: www.digitalwatermarks.eu

Digital Watermarks Initiative "HolyGrail 2.0"



CIRCULAR ECONOMY FOR PACKAGING

1st iteration of the **Pioneering Project HolyGrail 1.0** was led by the Ellen MacArthur Foundation 2016-2019

HolyGrail 1.0 investigated different innovations to improve post-consumer recycling (digital watermarks & chemical tracers)



Background

Digital watermarks were found to be **the most promising technology**, gathering support among the majority of stakeholders and passing a basic proof of concept on a test sorting line





Digital Watermarks Initiative HolyGrail 2.0

Driven by AIM – European Brands Association Powered by AEPW – Alliance to End Plastic Waste













Welcome to the world of DIGITAL WATERMARKS



HOLYGRAIL 2.0 Membership





HolyGrail 2.0 Objective

Prove the viability of digital watermarking technologies for accurate sorting and the business case at large scale.

Proving the <u>TECHNICAL</u> viability of digital watermarking technologies (WP 1-3), through e.g.:

- Validating of the prototype in three stages: 1° in an R&D centre (Phase 1 and Phase 2.1), 2° at a test facility on a semi-industrial scale (Phase 2.2), and 3° rolled out on a wider scale during real-time test runs in a commercial sorting and/or recycling facility (Phase 3)
- Ensuring the readability of the digital watermark embedded in print or in plastic, whilst taking into account esthetical and haptic aspects (e.g. shelf apeal)

Proving the <u>ECONOMIC</u> viability of digital watermarking technologies (WP 4), through e.g.:

- Reviewing existing and new business models, in different stages, building on key learnings from each test phase
- Addressing main market barriers, and assessing similar state-of-the-art technologies
- Examining cost improvement potential of DW detection systems, as add-on, by retrofitting or new equipment
- Perform a full techno-economic analysis, incl. cost breakdown structure for the entire packaging value chain

- Imperceptible codes, the size of a postage stamp, covering the surface of a consumer goods packaging
- Able to carry a wide range of attributes

 (e.g. manufacturer, SKU, type of plastics
 used and composition for multilayer objects, food
 vs. non-food usage)

ALLIANCE TO END

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WHAT ARE **Digital** Watermarks?





- Imperceptible codes, the size of a postage stamp, covering the surface of a consumer goods packaging
- Able to carry a wide range of attributes (e.g. manufacturer, SKU, type of plastics used and composition for multilayer objects, food vs. non-food usage)



WHAT ARE **Digital** Watermarks?

BEHAVES

14



Digital Watermarks @work FOR PRINT





Digital Watermarks @work FOR MOLDS



HOW DO DIGITAL WATERMARKS WORK ON A SORTING LINE?



HOLY GRAIL 2.0

3 FOCUS AREAS





Consumer Engagement

HOLY GRAIL 2.0

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PLASTIC

WASTE (@)

WORK PACKAGES

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BRANDS

Intelligent Sorting



















POTENTIAL BENEFITS OF DIGITAL WATERMARKS across the package life

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PLASTIC

WASTE (1)

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BRANDS

ASSOCIATION

Intelligent Sorting



HOLYGRAIL 2.0



- Focus on functional add-on module for the detection sorting unit – combined with existing NIR sorters – developed by the machine vendors Pellenc ST and Tomra, in combination with Digimarc (digital watermarks technology provider).
- Success criteria: unit's ability to detect and sort digitally watermarked packaging of various sizes.
 The Technical Project Manager overlooks and validates the prototypes.
- The prototypes will be used for the (semi-)industrial testing phase.
- Successful completion of Phase 1 will bring the Technical Readiness Level (TRL) to TRL 6 – technology demonstrated in relevant environment.

Phase I

Prototype Development Q1 2021 – Q1 2022







Digital Watermarks Initiative HolyGrail 2.0 reaches milestone with the validation of its first prototype detection sorting unit

Press release for immediate release – Brussels, 13 September 2021 – Following last week's partnership <u>announcement</u>, the Digital Watermarks Initiative HolyGrail 2.0 has reached its first milestone with the successful validation of the project's first prototype detection sorting unit.

Developed by the machine vendor Pellenc ST and the digital watermarks technology provider Digimarc, the prototype, which combines the digital watermarks technology and NIR/VIS infrared for sorting of packaging waste, achieved a >95% ejection rate. This sorter is now ready to be installed in the Amager Resource Centre (ARC) in Copenhagen to start the semi-industrial test phase. Over the next four months, trials and demonstrations with around 125.000 pieces of packaging representing up to 260 different stock-keeping units (SKUS), all prepared by HolyGrail 2.0 members, will be held in Copenhagen. Engineers will test for several parameters including the speed and accuracy of the system, to ensure its ability to withstand the pressures of full-scale industrial operations.

If successful, digitally watermarked products could be introduced to store shelves in Denmark, France and Germany by the first half of 2022 for in-market demonstrations and industrial-scale trials.







PHASE I

1st VALIDATED PROTOTYPE ADD-ON MODULE BY PELLENC ST, IN COOPERATION WITH DIGIMARC



1ST DETECTION ADD-ON MODULE





- Software model & identification parameters are developed and tested for sorting based on digital watermarks detection.
- System is tested for speed, accuracy, and detection efficiency.
- 2 test locations for semi-industrial trials of the detection sorting units:
 - Pellenc ST/Digimarc module: Sep - Dec 2021 at the Amager Resource Centre, Copenhagen with 125.000 packaging samples coded with DW (around 260 SKUs)
 - Tomra/Digimarc module: Q1 2022 in Germany
- Successful completion of Phase 2 will bring the Technical Readiness Level (TRL) to TRL 7 – system prototype demonstration in operational environment and TRL 8 – system complete and qualified.

Phase II

Semi-industrial testing July 2021 – Q1 2022





AIM - European Brands Association and City of Copenhagen

INVITE TO

Open Houses

for a semi-industrial test demonstration of the Digital Watermarks Initiative HolyGrail 2.0

Amager Resource Centre, Copenhagen
 19 October and 18 November 2021

Virtual tours for all interested stakeholders and on-site visits for HolyGrail 2.0 members only





PHASE II

SEMI-INDUSTRIAL TEST DEMONSTRATION AT AMAGER RESOURCE CENTRE IN COPENHAGEN

Consistent high results across all tested categories of plastic packaging material of on average:

- 99% detection rates
- 95% ejection rates
- 95% purity rates demonstrated an impressive performance of the prototype.

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PHASE II

SEMI-INDUSTRIAL TEST VALIDATION RESULTS OF PELLENC ST/DIGIMARC PROTOTYPE DETECTION SORTING UNIT

Results per packaging material

Category	<u>Detection Rate[1]</u> (Estimate)	<u>Ejection Rate[2]</u> (By weight)	<u>Purity[3]</u> (By weight)
Rigid PP	99%	95%	96%
Rigid PE	98%	96%	99%
Rigid PET	99%	98%	95%
Flexibles	99%	91%	90%
Average across packaging materials	99%	95%	95%

Table 1: Average single sort results from mixed packaging waste streams (watermarked samples + contamination (non-watermarked samples + other pack material classes)). Typical industrial process conditions have been used in these trials (belt speed of 3m/s; Loading: Rigids running at ~2.5 tonnes/hr; Flexibles at ~0.5 tonnes/hr). Success criteria (after 1st sort) for detection efficiency/ejection efficiency/purity are 95%/95%/92% for rigid packaging, 95%/87%/90% respectively for film packaging (in line with industrial specifications).

- Functional prototypes now deployed in commercial sorting and recycling facilities under normal operational conditions on a large-scale.
 - **5 locations in France and Germany**, includ. MRFs, PRF, recycling plants. Partners include e.g. SUEZ, PreZero, Indorama, Tomra/Borealis/Zimmermann, Paprec.
- Brand owners and retailers bring their enhanced products commercially to market in Denmark, France and Germany.
- Consumers can buy on-shelf products with digitally watermarked packaging, which will enter the waste stream after consumption.
- Objective: test system's reliability to ensure optimum performance.
- Successful completion of Phase 3 will bring the TRL to TRL 9 – actual system proven in operational environment.

Phase III

Industrial tests 2022





HolyGrail 2.0 Partners



More information in our press release <u>here</u>





HolyGrail 2.0 Structure

HG2.0 STRUCTURE BASED ON HOLYGRAIL 2.0 CHARTER UNDER THE AUSPICES OF AIM, EUROPEAN BRANDS ASSOCIATION:



MEMBERSHIP

HG2.0 Membership Associate & Full Initiative Members

Technical Work Packages:

Involvement of all members based on expertise and knowledge

WG leaders appointed

Under supervision of Technical Project Management

Leadership Team:

= Core members representing each of the sectors engaged in the initiative

Leads, coordinates and manages the activities of the initiative

Ensures effective use of membership fees and involvement of member companies

Overlooks the activities and decides on the set-up of technical work packages





HOLY GRAIL 2.0

LEADERSHIP TEAM



LT Chair: Gian de Belder, P&G



HolyGrail 2.0 Structure

HG2.0 STRUCTURE BASED ON HOLYGRAIL 2.0 CHARTER UNDER THE AUSPICES OF AIM, EUROPEAN BRANDS ASSOCIATION:

MANAGEMENT

Secretariat – AIM as Initiative Facilitator:

Overall management of initiative

Contact point for members & external stakeholders

Ensuring regular updates / information flow to all HG2.0 members

Technical Project Management:

Drafting a technical test plan

Coordinating the different technical working groups

Overseeing the work on the test sorting line

Supporting members with technical expertise & in their work with technology suppliers

Legal Counsel:

Present at all meetings of leadership team and HG2.0 members

AIM R EUROPEAN REANDS ASSOCIATION Intelligent Sorting ALLIANCE TO END PLASTIC WASTE

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HolyGrail 2.0 Structure

HG2.0 ADVISORY GROUP STRUCTURE BASED ON HOLYGRAIL 2.0 ADVISORY GROUP CHARTER:

ADVICE

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Advisory Group:

Panel for dialogue, exchange and input into both the operational implementation of key activities and the overall strategy of HG2.0.

Provides advice to HG2.0 Leadership Team, constituting the public and policy complement to the cross-value chain initiative HolyGrail 2.0.

Comprised of key stakeholders in the Circular Economy debate, including representatives from NGOs, Media, European and national public agencies, European and national policy-makers, other key stakeholders









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Innovation, sustainability and digital are the 3 key ingredients we are combining with smart packaging through digital watermarks to achieve the objective of the Green Deal towards a clean, circular and climate neutral economy.

MICHELLE GIBBONS DIRECTOR GENERAL, AIM

Digital Watermarks Initiative HolyGrail 2.0



The Digital Watermarks Initiative HolyGrail 2.0 – driven by AIM, the **European Brands Association** and powered by the Alliance to End Plastic Waste – is a pilot project with the objective to prove the **technical viability** of digital watermarks for accurate sorting of packaging waste as well as the **economic viability** of the business case at large scale.



Digital watermarks are **imperceptible codes**, the size of a **postage stamp**, covering the surface of a consumer goods **packaging** and carrying a wide range of attributes. The aim is that once the packaging has entered into a **waste sorting facility**, the digital watermark can be detected and decoded by a **standard high resolution camera** on the sorting line, which then – based on the transferred attributes (e.g. food vs. non-food) – is able to sort the packaging in corresponding streams. This would result in better and more accurate sorting streams, thus consequently in **higherquality recyclates benefiting the complete packaging value chain**.





CONTACT

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