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Deliverable report

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Project Website:	www.creatorproject.eu

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ABBREVIATIONS

ABS	Acrylonitrile butadiene styrene
B2B	Business to business
B2C	Business to consumer
B&C	Building and construction
ISO	International standardization organization
LCA/LCC	Life cycle assessment/ Life cycle cost
QR	Quick Response
SLS	Smart labelling system

PROJECT ABSTRACT

CREAToR is focused on process development and demonstration to sort and remove hazardous, already banned bromine containing flame-retardants from waste streams using continuous sorting and purification technologies: LIBS technology for sorting and supercritical CO_2 and natural deep eutectic solvents (NADES) for continuous extraction in twin-screw extruders.

CREAToR will cover the whole value chain, starting from collecting thermoplastic waste streams from building and construction and from waste electrical and electronic equipment. The project will implement ways to collect secondary raw materials, identify the presence of hazardous flame retardants, remove these contaminants from the materials and finally reuse the materials. As case studies they will be reused as valuable secondary raw materials for new B&C insulation panels, closing the circle of economy, for automotive interior application, and for producing 3D printed parts for aerospace applications.

For further increasing the economic feasibility of the approach an optimised logistic concept and a harmonized material quality classification scheme will be developed and applied. CREAToR will create a circular economy solution, transforming waste streams that are currently incinerated into value-bringing secondary raw materials. The economic viability of CREAToR will be validated through material benchmarking and LCA/LCC assessment for the whole value chain resulting in next generation products.

Moreover, CREAToR is developing a label for recycling materials. It will represent a statement that the recyclers maintain a quality and safety system throughout their processes. The recyclers' output materials will be labelled with a code that will contain a list of their properties, to simplify the end-users' manufacturing processes.

DOCUMENT HISTORY

Table 1: Version management

VERSION NR	REVISER	CONTENT
V0	Christina Dalla, Rocco Lagioia (ITB)	Deliverable template (V0)
V1	Francisca Gaona (ITB)	First draft (V1)
V2	Irma Mikonsaari, Carolyn Fisher (ICT)	Review
V3	Tom Caris (CLR)	Review
V4	Francisca Gaona (ITB)	Final draft

CONTRIBUTION OF THE PARTNERS

Table 2: Partners' contribution to the deliverable

PARTNER	SHORT NAME	ROLE IN THE WP	CONTRIBUTION TO THE DELIVERABLE
ITRB Group	ITB	Leader Task 1.3	Author of deliverable
Coolrec BV	CLR	Contributor and reviewer	Print and label's implementation. The photos contained in this deliverable.
Fundacion Gaiker	GKR	Leader of WP	Deliverable 1.3 (information on material characteristics)
Maier, S. Coop.	MAI	Labelled recycled plastic end-users and contributors	Information of compounds' characteristics
Centexbel	CTB		
Transfercenter für Kunststofftechnik GmbH	TCK		
Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung e.V.	ICT	Reviewer	Review of the deliverable.

1 INTRODUCTION AND OBJECTIVES

Summarizing, ***two initial types of smart labels have been proposed within the consortium***, one for the entry of waste into the sorting facilities that could help with the classification of the input stream, and a second label for the materials that were sorted as the output stream for a second application.

The first (material label for the input into sorting) was discarded after holding several meetings with recycling companies that are part of CREAToR's consortium and after conversations within the stakeholder event held at Kuhne Logistics University under the name "Plastics recycling workshop" in March 2020 with external parties.

The second label, for output materials exiting the recycling process, was the type of label selected to be developed in the project. The CREAToR consortium believes that the introduction of a label for recycled materials is of utmost benefit for their commercialization, for their use in high end applications and for their social acceptance.

The label will contain a list of properties of the recycled materials. The description of the composition and characteristics of recycled materials by end-users simplifies their tasks in manufacturing and producing their final product. Moreover, it increases the confidence of producers to expand the use of recycled materials to the detriment of virgin materials.

The labelling should combine only key parameters to facilitate its use by polymer converters. This selection of parameters was made according to a series of conversations between the partners ITRB Group, Fundacion Gaiker, Coolrec and the information collected in the workshop (see Table 3).

Table 3: End-user specifications for labelling

TECHNICAL SPECIFICATIONS	TEST METHOD
Density	ISO 1183-1A
Melt -flow rate	ISO 1133-B
Charpy impact strength	ISO 179-1eA
Tensile modulus	ISO 527-2
Tensile strain at break	ISO 527-2
Flexural modulus	ISO 178
Flexural strength	ISO178
Flame rating	UL 94
Flame retardant content	GC-MS

In order to minimize any impact on the final cost of material recycling, the label has to be viable in terms of cost, time and resources for its implementation. The consortium identified and selected QR codes as they are a low-cost technology.

Moreover, the project is developing a quality assurance system for CREAToR's purification technology using extractive extrusion. The idea is to merge the definition of the label with the quality assurance system to create a certification for materials that have passed through the purification technology developed.

In the public deliverable 1.3 "Smart labelling system methodology report", information is provided about the methodology behind the decision to use a QR code, and in the public deliverable 1.4 "Analysis of recycling agents' conceptions & beliefs on SLS methodology", detailed information is given about the different certifications/labels used in plastic recycling, the draft of CREAToR's quality assurance system and the key factors affecting the implementation and certification of the label. Both deliverables can be accessed via the project's homepage **https://creatorproject.eu/publications/** .

This deliverable presents the implementation of the labelling in the value chain.

2 LABELLING DRAFT

Partner Coolrec (responsible for WEEE recycling) implemented the label in their supply chain, specifically to the material exiting the treatment and to be sold for reuse to part manufacturers.

It was decided that two labels would be used for different compounds produced within the project. The first compound is used to manufacture a 3D filament, used for 3D printing of aeronautical components at Cyclefibre. The second compound is used to manufacture automotive interior components at Maier.

Table 4 shows the characteristics of the two compounds:

Table 4: Recycled plastic compounds characteristics

CHARACTERISTICS	TEST METHOD	FILAMENT COMPOUND	AUTOMOTIVE COMPOUND
Plastic composition	-	Recycled ABS	Recycled ABS
Colour	-	White	Black
Density	ISO 1183-1A	-	1,065 g/cm^3
Melt-flow rate	ISO 1133-B	24 ± 0,1g/10min	30,15 g/10min
Charpy impact strength	ISO 179-1eA	14 ± 0,4 kJ/m^2	10,08 kJ/m^2
Tensile modulus	ISO 527-2	2530 ± 22 MPa	2419 MPa
Tensile strain at break	ISO 527-2	19 ± 3,5 %	2,17 %
Flexural modulus	ISO 178	-	-
Flexural strength	ISO178	-	-
Flame rating	UL 94	-	-
Flame retardant content	GC-MS	-	-

The next step was the creation of QR codes containing the information to be transmitted to the end-users. The creation of QR codes is a simple task, which can be carried out by any employee. There are web pages[1] that create a code for free and there are also multiple free QR code reading applications for mobile devices.

[1] https://www.qrcode-monkey.com/#ur

The diagrams below show the generated QR codes and the information behind the codes (see Figure 1 and Figure 2).

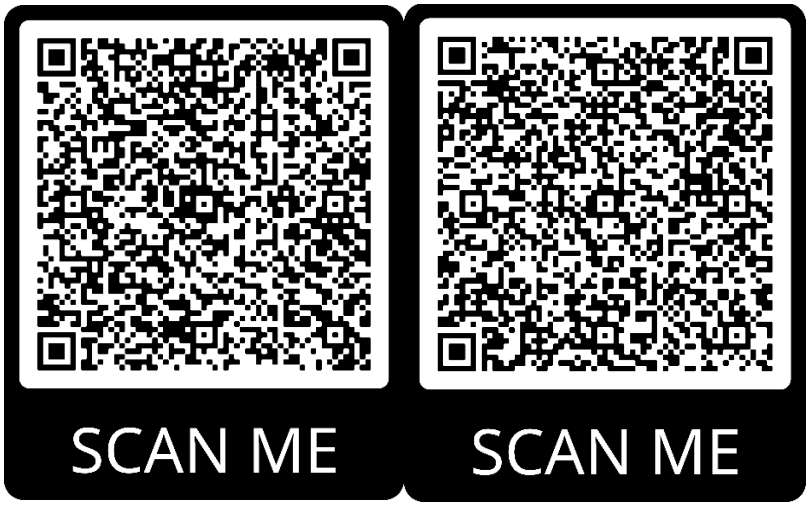

Figure 1: Recycled plastic label code for 3D-filament and for automotive components

Detalles del código QR:

CREAToR Project

Material: Recycled ABS
Colour: White
Density : -
Melt -flow rate : 24 ± 0.1 g/10min
Charpy impact strength: 14 ± 0.4 kJ/m2
Tensile modulus: 2530 ± 22 MPa
Tensile strain at break : 19 ± 3.5 %
Flexural modulus: -
Flexural strength: -
Flame rating : -

Detalles del código QR:

CREAToR project

Material: 100% recycled ABS
Colour: Black
Density: 1,065 g/cm3
Melt-flow rate: 30,15 g/10 min
Charpy impact strength: 10,08 kJ/m2
Tensile modulus: 2419 MPa
Tensile strain at break: 2,17%
Flexural modulus: -
Flexural strength: -
Flame rating: -

Figure 2: Image of the codes' reading with the camera of a mobile phone.

CREAToR's consortium has considered the GDPR and that data security has to be considered by the implementing partners as well later on. The main problem is that the information used to generate the QR code is saved on the servers of the code generator. The generator that CREATOR has used ensures that the only ones who have access to this information are the person who generates the code and the person who reads it[2].

[2] www.qr-code-generator.com/blog/qr-code-security/

3 LABELLING IMPLEMENTATION

The first idea for the implementation of these tags is to place them in a point where they can be easily read by the end-users. For this reason, labels are stuck on the containers that are used to send the recycled material from the recyclers to the end-users (buyers).

Coolrec uses three types of containers/bags to send the recycled material to the end-users. There are two types of bags that are used to send samples to the customers and another bigger package to send the sold material. The sample bags contain 5 kg and 25 kg. Figure 3 and Figure 4 below show the labelled bags with the recycled material.

Figure 3: 5 kg and 25 kg bags.

Figure 4: Packaging for sold material

In Figure 5 below, the two types of compounds inside the labelled bags are shown. The compound used by the project partner Centexbel to produce the 3D filament is pictured on the left, while the compound used by project partner Maier for the production of car interior components is shown on the right.

Figure 5: 5 kg bags containing CREAToR's compounds.

The QR code size must be large enough to be scanned using most available smartphones. For most smartphone cameras to read a QR code, its size should be at least 2.5 x 2.5 cm or 115 x 115 pixels (in width and height). From the dimensions of the packaging, it is clear that the size of the codes will not be a problem to implement in the recycling plants.

The QR code can be easily read, by following these steps:

1. Open the QR code reader on a mobile phone.

2. Hold the device over a QR code so that it's clearly visible within the smartphone's screen.

Two things can happen when a smartphone is held correctly over a QR code.

1. The phone automatically scans the code.

2. On some readers it is necessary to press a button to take a picture, not unlike the button on the smartphone camera.

If necessary, the button should be pressed. The smartphone reads the code and navigates to the intended destination, which doesn't happen instantly. It may take a few seconds on most devices.

In Figure 6 below an operator is shown reading the labels.

Figure 6: Code reading by an operator.

Finally, there would be the possibility to place the code inside the material bags. This would ensure that the code would only be readable by the receiver of the package. It would only be visible when the package was opened and the information would be confidential (s. Figure 7).

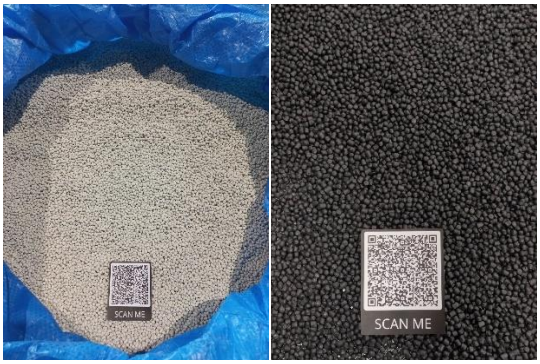

Figure 7: Codes inside the bags.

4 CONCLUSION

The purpose of the labelling is to certify that the recyclers maintain a quality and safety system throughout their processes. Moreover, the QR code on the label contains information on the characteristics of the recycled material.

CREAToR is also developing a quality assurance system for CREAToR's purification technology. The idea is to merge the definition of the label with the quality assurance system to create a certification for materials that have passed through the purification technology developed.

For this alone, the label creates an added value, since its sole purpose is to give end-users confidence in the quality of the product they are buying, knowing in advance some characteristics that are important for the manufacture of final products.

Labelling & certification are one way for a company to try to improve its competitive position in the market. The incentives that can stimulate a company to improve its environmental and social performance will also depend on various forms of societal pressure, resulting from the interests of different stakeholders (i.e. government agencies, shareholders, customers). A good marketing and communication strategy with recyclers and end-users is therefore the best way to strengthen the image of a label. For this reason, ITRB has created a first video to present the label to the general public: **https://app.wideo.co/en/view/3543340163423496256 7**

The next actions regarding CREAToR's label will be:

- Finalise the quality assurance system for CREAToR's purification technology. The final draft will be presented in deliverable 3.8 Qualification of CREAToR purification technology (III) at the end of the project in March 2023.
- Develop a communication strategy B2B and B2C. A good strategy is necessary so users (recyclers) and consumers know and trust the information on the label. This strategy will be presented at the end of the project in the deliverable D7.7 Business Model (II) in March 2023.

Interviews and impressions regarding CREAToR's label will be collected at the stakeholder event included in task 6.6 Framework, industry- and policy recommendation. This event will take place in 2022 and its results will be collected in deliverable 6.7 Report about the industry recommendations in March 2023.