



Unveiling a recycling-sourced of heavy metal-based solids component and organic effluent for use in the ceramic industry



PROJECT INFORMATION



Project reference: LIFE20 ENV/ES/000115
 Duration: 01 October 2021 – 30 September 2025
 Total budget: 1,290,675 €
 LIFE Program contribution: 709,871 €

PROJECT FUNDING

This Project is financed by the LIFE Programme
 2014-2020 of the European Union for the
 Environment and Climate Action

LIFE REPLAY CONSORTIUM

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Project beneficiaries:



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**AKCOAT Recubrimientos
 Químicos Especializados S.L.U.**
www.akcoat.com/es



**Centro de Tratamiento de Residuos
 del Mediterráneo SL (CTR)**
www.ctrmediterraneo.com



NEPTURY TECHNOLOGIES S.L.
www.neptury.com



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1. WHAT IS THE LIFE PROGRAMME OF THE EUROPEAN UNION?

LIFE programme is the EU's funding instrument for environment and climate action, which has co-financed more than 5,000 projects helping Europe to become greener. As of 2021, the LIFE programme includes the new Clean Energy Transition sub-programme.

The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value.

2. WHAT IS THE MAIN PURPOSE OF LIFE REPLAY?

The main goal of the project is to demonstrate the technical feasibility of using ceramic inkjet ink wastes as a raw material for the ceramic industry, prior separation of those, resulting in a solid component based on heavy-metal inorganic pigment and in a liquid component based on an organic solvent.

In 2024, 1,928 tons/year of waste were generated from the ceramic inkjet inks at European level without being re-used nor recycled. Their treatment and disposal induce costs of about 12.5 M€ year at European level. The two leading countries at EU level in terms of production waste generation are Spain (514 tons/year) and Italy (411 tons/year), representing a total cost of above 3 M€/year.



Thanks to LIFE REPLAY, ceramic inkjet ink wastes will be reintroduced in the industrial process by using a specific separation procedure which fulfils the industrial requirements for quality management.

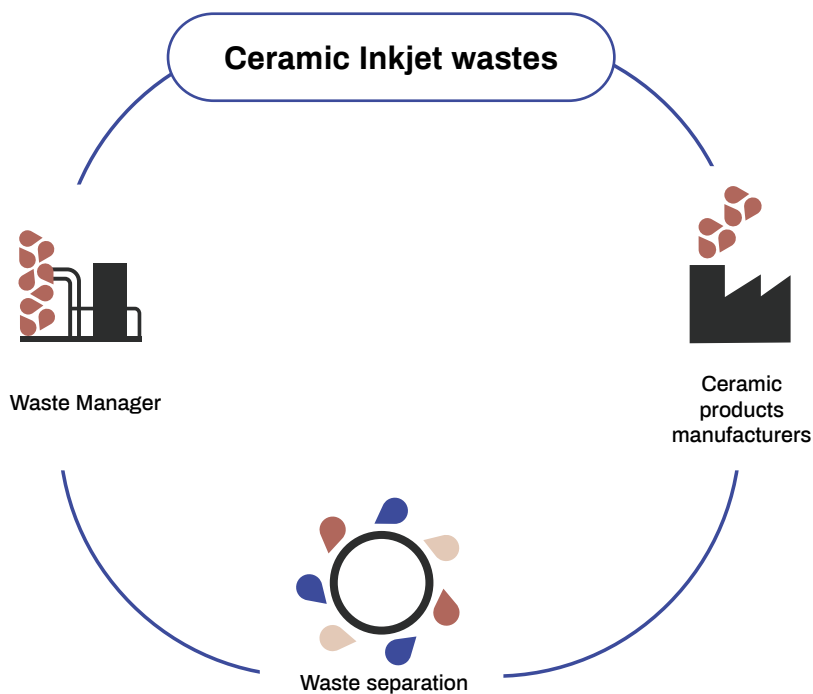
Ceramic inkjet inks are made up of complex mixtures consisting mainly of a heavy metal-based solid component organic solvents and various additives. The presence of heavy metals in the solid component and the organic nature of the solvents lead to significant environmental problems that increase environmental risks (including soil and water contamination).

The hazardous nature of the waste generated, and the economic cost of waste treatment and disposal oblige the ceramic industry to take measures to prevent and/or minimise waste generation and increase resource efficiency to mitigate negative impacts.

This proposal also demonstrates the feasibility of using inkjet ink waste as a new raw material for the ceramic industry, transforming it into an environmentally friendly and cost-effective alternative source of pigment and solvent.

The specific objectives have been:

- To **demonstrate in real environment** the valorisation of inkjet ink wastes in the ceramic SMEs.
- To **implement a value chain pilot** based on **circular economy** pillars through collaboration and resource sharing among SMEs.
- To **demonstrate** the competitive edge of the **business model** and measure the **economic benefits** for all SMEs, especially related to the ceramic, decorative glass and cathodic/anodic application industries.
- To **develop a prototype for the separation** procedure of the inkjet ink wastes in a simple and low-cost process.
- To **deploy the new business** model for transformation of the inkjet ink wastes as a new resource for the ceramic industry.
- To assess the **environmental impact** on the production of brand-new ceramic products reusing and recycling inkjet ink wastes as well as on the ceramic tile and inkjet ink production.
- To **replicate the solution** of the innovative valorisation scheme in other SMEs (not only the consortium).
- To **foster social awareness** related to the environmental problem caused by inkjet ink wastes nowadays and the new situation after this project.



3. WHAT HAVE WE DONE AT LIFE REPLAY?

The project ensures the technical feasibility of employing ceramic inkjet ink waste as a source of new materials (by-products) for the ceramic industry, and these products have been integrated in the ceramic compositions.

The project includes actions at laboratory and industrial level to put into practice, demonstrate and disseminate a solution for introducing part of by-products obtained in the production of inks, pigments and tiles.

Actions developed are shown in the following chart:

B. Implementation actions		C. Monitoring of the impact of the project	D. Public awareness and dissemination of results	E. Project management
B1. Mapping and analysis of LIFE REPLAY B1.1. Legal analysis and mapping in the ceramic industry B1.2. Legal analysis and mapping in other industries (decorative glass and metal-based batteries)		C1. Environmental analysis and legal requirements C1.1. Environmental, social and circular assessment C1.2. Self-declared environmental claiming C1.3. Legal implications for the use of treated ceramic inkjet ink wastes	D1. Dissemination planning and execution D1.1. Dissemination plan D1.2. Networking D1.3. Awareness raising campaign D1.4. Review of CER BREF	E1. Project management by ITC-AICE E1.1. Overall Project management E1.2. After-LIFE Plan
	 			
	B3. Pre-industrial scale tests with separated wastes B3.1. Designing ceramic tiles using the separated products B3.2. Validation of ceramic tile demonstrators B3.3. Designing inorganic pigment compositions and ceramic inkjet inks using the separated products B3.4. Validation of pigment and ceramic inkjet ink demonstrators	 		
	B4. Industrial trials in real environment B4.1. Separation process of ceramic inkjet ink wastes in real environment B4.2. Designing industrial ceramic tile demonstrators using the separated products B4.3. Designing industrial inorganic pigment and ceramic inkjet ink demonstrator using the separated products	  		
	B5. Replicability and transferability B5.1. Business Plan B5.2. Replicability and Transfer Plan			

The implementation actions (B1 to B5) are the core of the project. They include a) **to determine the environmental and administrative legislation** that can affect the project realisation and implementation and all data related to the European producers of ceramic inkjet ink wastes (action B1), b) the **construction of the prototype for the separation** to obtain heavy-metal solids and an organic effluent, which is installed in CTR facilities (action B2), b) the **pre-industrial scale tests with separated wastes** with the by-products obtained, where is demonstrated the valorisation of the resulting treated products obtained at pilot scale (action B3), c) **industrial trials in real environment** to demonstrate the industrial adequacy of the prototype built and the industrial valorisation of the resulting treated products obtained in an industrial environment (action B4) and finally d) two **business plans** for CTR and NEPTURY were developed **and a replication strategy** towards other companies in Europe has been developed (action B5).

The monitoring actions (C1 and C2) have allowed to measure the performance indicators. Within the framework of action C1, a **Life Cycle Assessment (LCA)** to quantify the environmental impacts of the new products and calculate the environmental benefits in comparison with the conventional existing products and **self-declared environmental claims** of these by-products have been developed. In addition, a study of **legal implications for the use of treated ceramic inkjet ink wastes** has been carried out with the aim of ensuring the implementation and commercialization of this new two products for the ceramic sector.

Action C2 encompassed the following up of the LIFE KPI's and progress indicators as well as the monitoring of socioeconomic impact of the project.

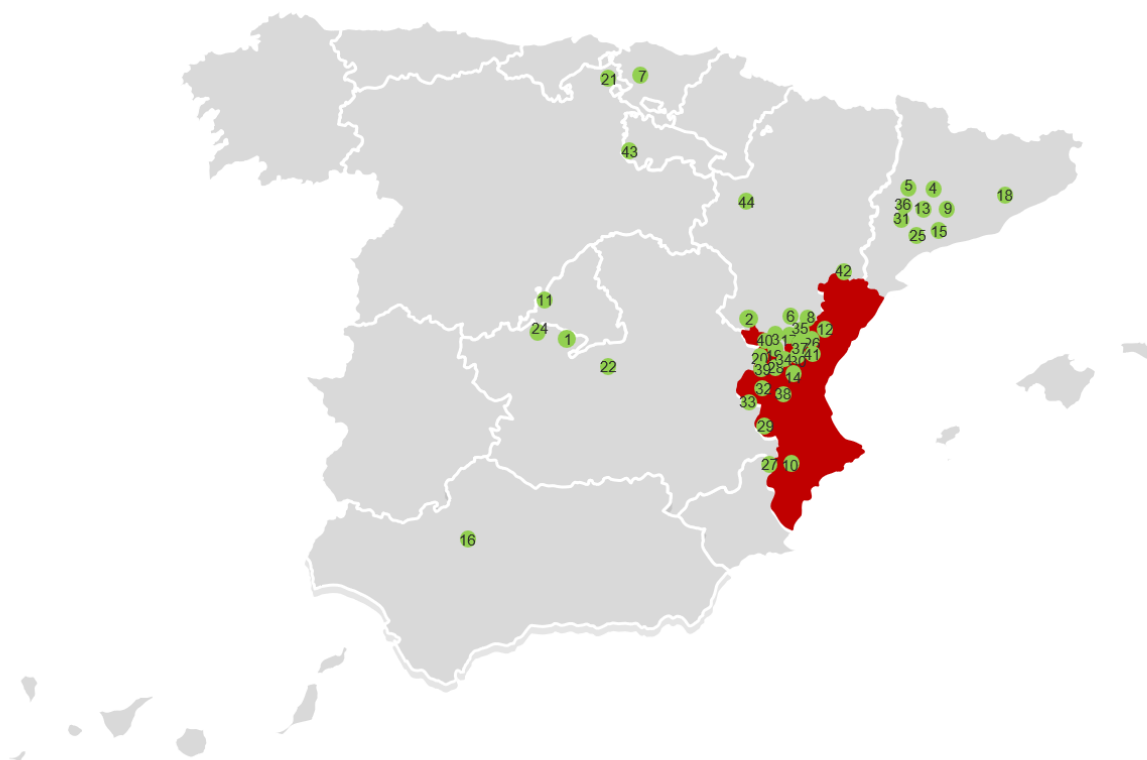
Other key actions that are essential for the implementation the project results are those related to its **communication and dissemination (Action D1)**. A **communication plan** has been developed, which encompasses all activities aimed at effectively transmitting the benefits of the new alternative raw material to industries, citizens, decision-makers and planners. The main communication channel through which the information has been collected and transmitted is the project website: <https://lifereplay.eu/> where information related to both the development of the project and its results is available through videos, documents, press releases, etc...The website design, the corporate image of the project and the awareness raising campaign are crucial for implementation and engage a high number of stakeholders.

There is a clear commitment reflected in the **After Life Plan (Action E2)** that the website will be kept up to date to keep users informed of all project activities and impacts and for ensuring the sustainability the project beyond its end.

4. MAIN RESULTS

4.1. MAP OF POTENTIAL GENERATORS OF CERAMIC INKJET INK WASTES IN SPAIN AND REVIEW OF LEGAL BARRIERS IN EUROPE

The Spanish ceramic tile manufacturing industry is known for being one of the most innovative and dynamic in the world, occupying a consolidated position at the forefront of the international market not only in terms of technological development, but also for the design and quality of its materials and services. A list of this potential generators of ceramic inkjet ink wastes from Spain has been obtained and several maps including these companies have been built.



*Figure 1 Potential generators of ceramic inkjet ink wastes in Spain (2020).
Source ASCER, ANFFECC and ITC-AICE.*

4.2. DEVELOPING A PROTOTYPE FOR THE SEPARATION

- A prototype has been developed by NEPTURY TECHNOLOGIES for the separation of the inkjet ink wastes.
- The prototype is installed in CTR facilities and has a continuous processing capacity of up to 0.5 t/hour, comprising all modules of the prototype.
- Two by-products are obtained: heavy-metal solids (“cake”) and organic effluent.



Figure 2. Prototype built and installed in CTR.

4.3. BY-PRODUCTS OBTAINED

After drying, the characterization of several “**cake**” batches confirms that it has similar components to those that an industrial pigment or ink might have, so we can use it for this purpose.



Figure 3 Image of dried cake

The **clarified liquid** obtained from the centrifugation process demonstrates considerable versatility. Although the wide variety of inkjet inks available on the market has posed challenges for its direct use in digital printing, significant progress has been made in developing inks suitable for screen printing processes. This presents a valuable opportunity to reintroduce the liquid into the graphic sector, supporting circular economy principles and significantly reducing waste generation.



Figure 4 Image of clarified liquid

4.4. INDUSTRIAL TESTS WITH SEPARATED WASTES IN CONSORTIUM COMPANIES

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After “cake” treatment (drying, grinding and sieving) for its subsequent introduction into the process (mixing with industrial spray-dried and later on pressing), industrial tiles have been obtained, incorporating 0.45% of cake into the process.

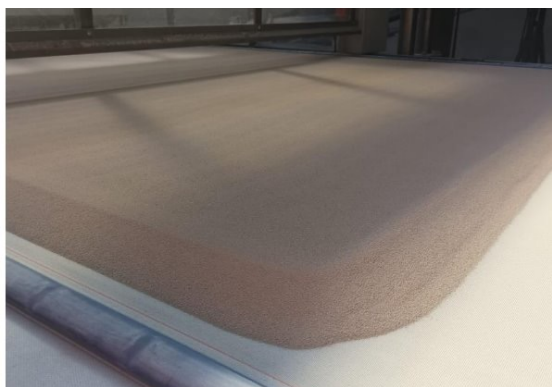


Figure 5 Mixture before pressing process

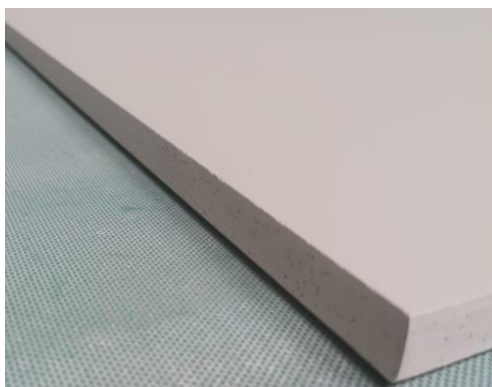


Figure 6 Pressed tile with coloured drops visible

AKCOAT

After physical separation, firstly, AKCOAT has characterized the solid and liquid components by carrying out a compatibility study of both. After that, and once defined optimum compositions have succeeded in producing inkjet ink by replacing part of the inkjet ink for recycled ink obtained with LIFE REPLAY by-products ("cake").

Depending on the colour to be developed, in some cases it has been introduced up to 40% recycled ink.

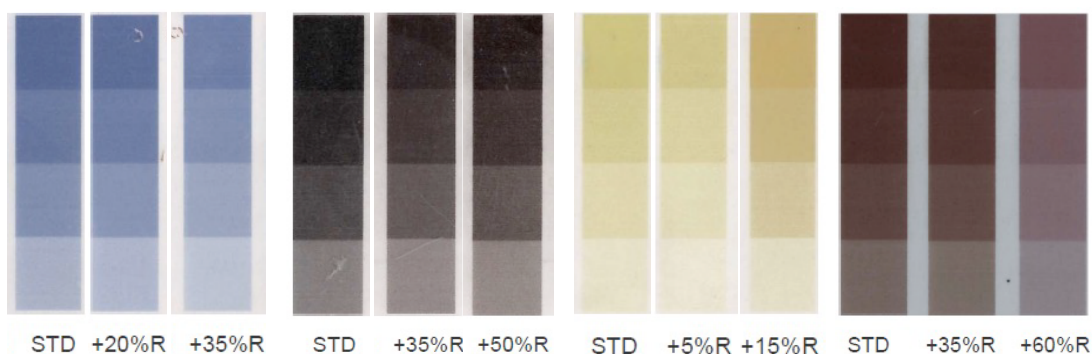


Figure 7 Colour adjustment images depending on the amount of recycled ink introduced

New formulated inks are applied and fired in LEVANTINA-TECHLAM facilities.



Figure 8 Digital decoration



Figure 10 Ceramic tiles obtained using LIFE REPLAY by-products

Regarding **liquid effluent** has been discharged for digital inkjet application. It cannot pass the filtering test (mandatory for digital application). Despite this, it has been possible to introduce this liquid in compositions for screen printing inks (applied by screen).

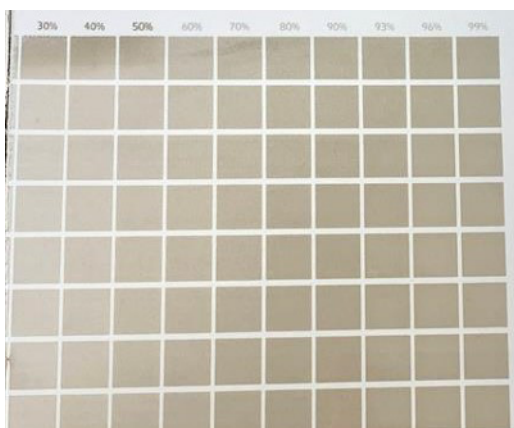


Figure 11 Ceramic tile obtained using LIFE REPLAY by-products. Screen-printing

4.5. DISSEMINATION AND COMMUNICATION ACTIVITIES

During the project execution, the beneficiaries have participated in several dissemination and communication activities, for sharing the project results. Despite the pandemic circumstances, several activities with high impact have been developed.



INFODAY: “¿Qué podemos hacer para mejorar la sostenibilidad en la industria cerámica?” Ceramic Technology Conferences, Castellon (Spain), 2021.





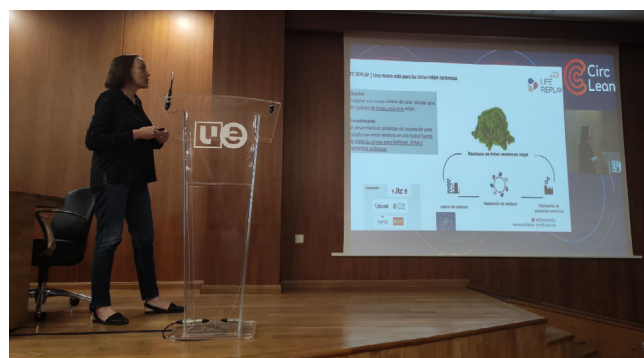
 LIFE REPLAY KOMeeting, Castellon (Spain), 2021.



 LIFE20 ENV and GIE WcMeeting Thematic Session, (online), 2021



 LIFE REPLAY REDIT. Information Session of the Valencian Community on the LIFE programme and its 2022 call, (online) 2022



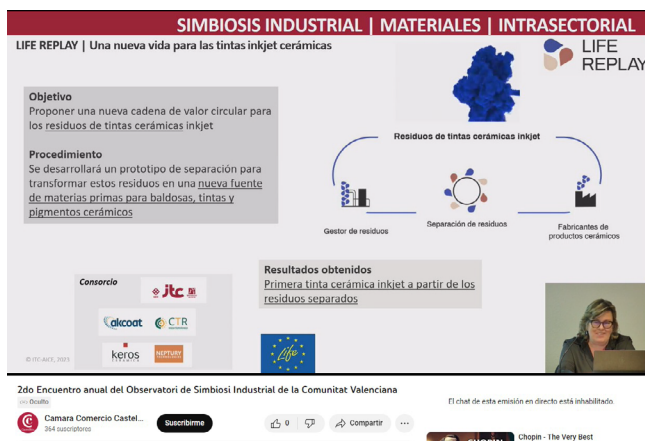
 CIRCLEAN OPEN INNOVATION WORKSHOP, 2022, ADEIT-Fundació Universitat-Empresa, Valencia (Spain), 2022



 ECOFIRA, Feria Internacional de las Soluciones Medioambientales y Transición Ecológica 2022



 MATSUS 2023, Materials for Sustainable Development Conference, Valencia (Spain), 2023



2º ENCuentro ANUAL DEL OBSERVATORI DE SIMBIOSI INDUSTRIAL DE LA COMUNIDAD VALENCIANA. Castellón (Spain), 2023



JORNADA PRE-CONGRESUAL DE ECONOMÍA CIRCULAR E INNOVACIÓN EN EL SECTOR CERÁMICO. Castellón (Spain), 2023

II CONGRESO DE Economía Circular

Av. Hermanos Bos, 79
12003 Castellón de la Plana

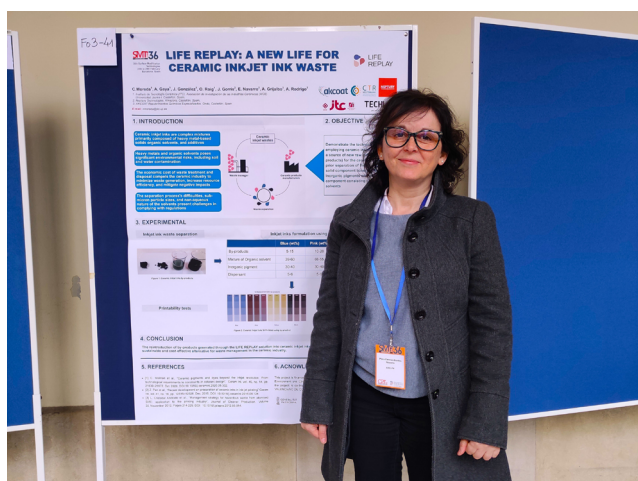
PROGRAMA	
8:45-9:15 h	Recepción de Asistentes
9:15-9:30 h	Bienvenida D.ª M.ª Dolores Guillamón, Presidenta de la Cámara de Comercio de Castellón D. Jordi Sureda, Director Relaciones Externas, VACE.
9:30-10:00 h	BLOQUE I: SINDICATOS Jornada de Simbiosis Industrial con empresa Verónica Ruchonch
10:00-10:30 h	Coffee Networking
10:30-12:45 h	BLOQUE II: SECTORES INDUSTRIALES SECTOR I Alquiler Economía Circular aplicada al sector del plástico: casas de éxito. Sergio Gómez
SECTOR II	ITC-ANDE ECONOMÍA CIRCULAR EN EL SECTOR CERÁMICO: CASOS DE ÉXITO. Dña. Mónica Vicent Caballero
SECTOR III	Fundación de Estudios Bursátiles y Financieros (FEBF): FINANZAS SOSTENIBLES: ¿Oportunidad de inversión o Requisito regulatorio? Isabel Comas Barrio
12:45-14:00 h	RUECOS Y PREGUNTAS BLOQUE III: CASOS DE ÉXITO CASO I Muhle-Ber: Diseño y fabricación de muebles ecológicos. Residuo Cero Chao Vives Dorca
CASO II	Ornela: Reciclar el Mar Mediterráneo desde su fondo marino Natalia Caló y Fernández
CASO III	Secret Loom: Nueva definición de calidad Carmen Bonet Bonada
CASO IV	Claussell Studio: Eco diseño en producto Vicente Clausell
CASO V	Fran Clausell: Formas de habitar Fran Clausell CDR
CASO VI	Encapsulados: "Desarrollo y comercialización de aditivos funcionales para la aceleración de la degradación de envases plásticos" Dora Sureda Hernández Rueda
	RUECOS Y PREGUNTAS

Programa Sostenibilidad
Financiado por:
Organizado por:
Cámara de Comercio de Castellón

II CONGRESO DE ECONOMÍA CIRCULAR, Castellón (Spain), 2023



JORNADA PRE-CONGRESUAL DE ECONOMÍA CIRCULAR E INNOVACIÓN EN EL SECTOR CERÁMICO. Castellón (Spain), 2023



SMT36 INTERNATIONAL CONFERENCE ON SURFACE MODIFICATION TECHNOLOGIES, Barcelona (Spain), 2025



LIFE REPLAY – Jornada sobre el criterio de fin de residuos

Fecha: 13/03/2025

Lugar: Salón de actos del Instituto de Tecnología Cerámica (ITC)
Campus Universitario Riu Sec
Avda. de Vicent Sos Baynat s/n
12006 Castellón
<https://maps.app.goo.gl/KsGH3uQzoMYR4YE18>

Inscripción: <https://bit.ly/3X0JNT9>

Primera Parte 9h30-12h30

INFODAY. Condición de fin de residuos. Aspectos prácticos e implicaciones legales.

9:30 Registro de asistentes

10:00 Bienvenida institucional.

- Irina Celades López, Directora técnica, ITC-AICE.
- Raúl Mérida Gordillo, Secretario Autonómico de Medio Ambiente y Territorio, Generalidad Valenciana.

10h15 Condición de fin de residuos. Implicaciones legales.

- Ley de residuos y concepto de fin de residuos. Situación en España.
Elisa Cacharro Caminero, directora de Programa, Ministerio para la Transición Ecológica y el Reto Demográfico, Subdirección General de Residuos.
- Consideraciones regionales. Situación en La Comunidad Valenciana.
Enrique López Balaguer, Jefe de Servicio de Prevención y Reutilización de Residuos, Dirección General de Calidad y Educación Ambiental, Generalitat Valenciana.

11h20 Soluciones y estrategias para cumplir con el criterio de fin de residuo. Ejemplo del caso del LIFE REPLAY y del sector cerámico.

- Presentación introductoria. Proyecto LIFE REPLAY – Importancia de la condición de fin de residuos para la explotación de resultados. Paqui Quereda, ITC-AICE.
- Mesa Redonda. Moderador: Paqui Quereda, ITC-AICE.
 - o Punto de vista de un gestor de residuos. Teresa Izquierdo, CTR Mediterráneo.
 - o Punto de vista de un fabricante de pigmentos y tintas. Alejandro Grijalbo, AKCOAT.
 - o Punto de vista de un fabricante de baldosas. Gloria Costas, TECHLAM.

ALMUERZO Y ZONA DE NETWORKING 12h30-13h30



El proyecto LIFE REPLAY está financiado por el Programa LIFE de la Unión Europea con referencia LIFE 20 ENV/ES/000115.
The project LIFE REPLAY is financed by the LIFE Programme of the European Union under the project number LIFE 20 ENV/ES/000115.



INFODAY: “CONDICIÓN DE FIN DE RESIDUOS. ASPECTOS PRÁCTICOS E IMPLICACIONES LEGALES”, Castellón (Spain), 2025



INFODAY: “REUTILIZACIÓN DE RESIDUOS DE TINTAS INKJET CERÁMICAS EN LA FABRICACIÓN DE BALDOSAS Y TINTAS” + TALLERES PRÁCTICOS, Castellón (Spain), 2025



4.6. NETWORKING

Several networking actions have been carried out during the project.

One of them is the synergy found with LIFE EGGSHELLENCE. LIFE EGGSHELLENCE studies the technical feasibility of using eggshell as a secondary raw material in the manufacture of ceramic tiles. This is why it has been possible to manufacture tiles by applying the principles of the Circular Economy (through the valorization of both eggshells in the tile body and recycled inks in the decoration) thanks to the collaborative efforts of both projects.



Figure 10 Ceramic tiles obtained using LIFE REPLAY and LIFE EGGSHELLENCE by-products

Subsequently, an additional synergy has been identified, complementing that of the LIFE EGGSHELLENCE project. This involves the LIFE REWAINCER project, which proposes a new model for the application and use of reclaimed water in industrial environments within the ceramic sector. As a result, even more sustainable tiles have been produced by applying Circular Economy principles through the valorization of eggshells (from the LIFE EGGSHELLENCE project), treated water (from the LIFE REWAINCER project) in the tile body, and recycled inks (from the LIFE REPLAY project) in the decoration. These synergies promote enhanced circularity within the ceramic sector through the joint efforts of the three projects.

Additionally, networking activities have been conducted among various LIFE projects:

- On one hand, with the LIFE Z-ONA4LIFE project, to explore the potential use of zeolites developed within the project as coagulants for recovering inorganic material in the LIFE REPLAY project. The integration of zeolites as coagulants may offer innovative solutions and significant benefits for both projects.
- On the other hand, a coagulant developed under the LIFE Waste2Coag project has also been tested for the recovery of inorganic material in the LIFE REPLAY project. The use of the coagulant could enable more efficient recovery of the solid fraction from ink waste, thereby offering significant benefits for both projects.

4.7. REPLICABILITY AND TRANSFERABILITY PLAN

The objective of this action was to replicate/transfer the project results in other companies and sectors that express their interest in LIFE REPLAY solution at the end of the project.

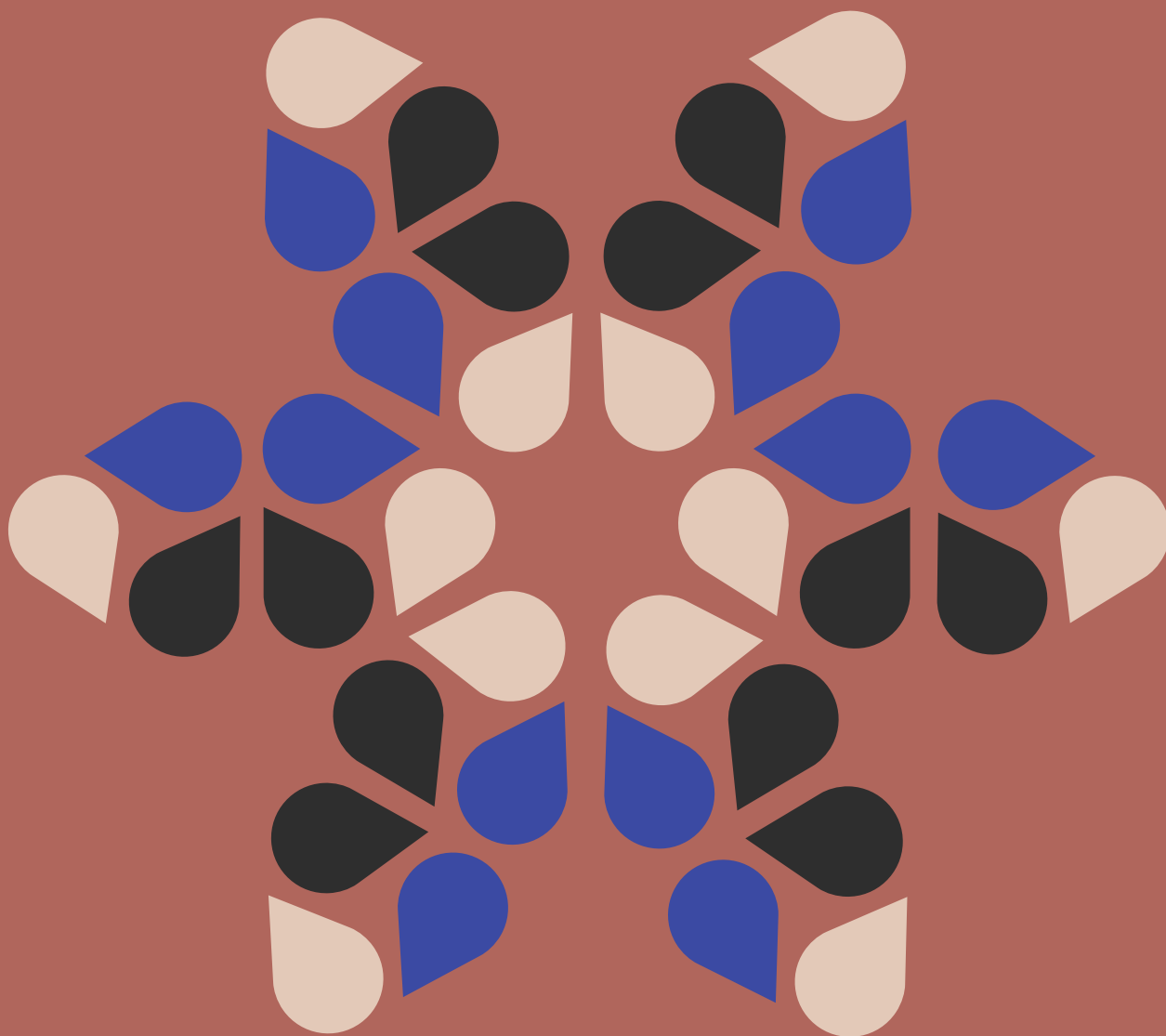
To support this task, a replication guide has been prepared to facilitate the adoption of the results to other companies and sectors that express interest in the LIFE REPLAY solution at the end of the project.

This is a public document available to all stakeholders interested in implementing the project results.

The consortium will try directly replicate the project results in ceramic tiles manufacturers. They will act as end users of the new separated waste components.

During the next five years after the end of the project, we expect to implement the new process in other companies.

The transfer strategy of the LIFE REPLAY solution considers the application of the solution to other industries with similar characteristics to the ceramic sector (basically, decorative glasses and metal-based cathodic and anodic functional substrates (batteries, etc.).



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