# DEVELOPMENT OF NEW CERAMIC PRODUCTS ON VALORISING HEAVY METALS FROM THE SOLID COMPONENT IN INKJET INK WASTE

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## ABSTRACT

The competitive edge afforded by inkjet digital printing as main method for decorating ceramic tiles is being offset by the generation of waste that is difficult to classify. Such waste mainly consists of a solid component based on heavy metals such as Co, Cr, Ni, Pr, and Fe, entailing inherent risks for health and the environment and potentially polluting soil and water.

The present initiative seeks to respond to European directives on waste and waste management, in support of a circular economy and industrial symbiosis. To this end, it is sought to extract the largest possible amount of heavy metals, using physico-chemical treatment, thus enabling them to be valorised and reused in the manufacture of new ceramic products.

Different experimental methods are being started to develop forms of extraction that are reproducible on an industrial scale, while maximising sustainability. This is all aimed at minimising industry's environmental footprint by valorising the extracted metals, putting them back into the market, and reducing waste management and its economic costs from transport and storage, as well as high environmental costs.

## 1. INTRODUCTION

In recent years, the convenience of treating the ceramic inkjet ink waste generated during the current ceramic tile manufacturing process (tiles and inkjet inks) and how such waste is to be treated have generated a great debate in the scientific and industrial community. This waste is generally made up of complex mixtures consisting mainly of a solid component based on heavy metals that include (individually or jointly) inorganic pigments/refractory materials/ceramic frits (25–55 wt%), organic solvents (45–65 wt%), and different additives (1–10 wt%). The presence of heavy metals such as Ni, Pr, Cr, Co, and Fe in the solid component entails important environmental problems that increase the risks for health and the environment.

As a result, during the current recycling process, several types of waste are generated: sludge (disposed of at landfills) and wastewater. Consequently, waste management has drawn great attention, owing to the environmental concerns involved in treatment as well as to the recognition by regional, national, and European authorities that natural resources are limited. Waste valorisation has therefore become a "high-priority objective" that will yield both social and economic benefits from the minimisation of its environmental impact and of the costs associated with disposal at landfills. In order to comply herewith, waste valorisation shall fall under the concept of "circular economy", which goes beyond the extractive industrial model based on "taking, using and throwing away", innovation reigning throughout the system in order to redefine products and services, with the ultimate goal of eliminating waste and minimising negative impacts.

In the course of this project, it will be possible to spotlight the seriousness of ceramic inkjet ink waste, with a view to putting forward different initiatives on sustainable manufacturing and consumption in order to close the circle and promote a "circular economy". This coordinated effort between the scientific community and industry shall foster and help negotiate with the Valencian and national public authorities the introduction of new processes and environmental policies that drive ceramic inkjet ink waste management. This fact, together with the great number of ceramic tile and ink manufacturers located in the Valencia Region, particularly in Castellón province (location of the ceramic cluster) where the estimated amount of this type of waste generation exceeds **500 tonnes/year**, underscores the project's importance.

In fact, the European Commission has implemented Directives 2008/98/EC, 2014/957/EU and 1357/2014 on waste, as well as COM(2015) 614 on the circular economy. The EU Member States have therefore adopted these strategies by means of specific regulations. In Spain, a draft law (APL/2020) has been established for transposing EU directives. However, despite the importance of implementing these directives, currently only 12% of the industrial materials used on a European level comes from a recycling process, this being even less, for example, in Spain where this is only 8%. As a result, this value needs to be raised considerably with the ultimate goal of complying with the new regulations, a fact that this research, METAMORPH, can help achieve.

## 2. OBJECTIVES

The main aim consists of separating heavy metals and/or other elements in the solid component in ceramic inkjet ink waste, in order to valorise such waste and re-introduce it in the manufacture of new ceramic products. This will require a physico-chemical separation stage that sustainably allows key elements to be obtained from the solid component in ceramic inkjet ink waste (made up of a mixture of inorganic pigments, frits, and other ceramic compounds), in order to reuse it in the ceramic manufacturing process itself, with the ultimate goal of fostering and driving the circular economy.

The project seeks to generate sufficient insight to enhance the positioning of new ceramic products, valorising waste and promoting the circular economy in a production sector so severely punished by the increase in raw materials prices and energy costs.

***Figure 1*** *Waste from inkjet inks*

## 3. EXPECTED RESULTS

The expected results of the METAMORPH project are detailed below:

- Minimising resource depletion, pursuing a substantial net saving for the EU, the authorities, and producers/consumers.
- Providing new economic opportunities.
- Contributing to long-term competitiveness.
- Preserving and improving natural capital by controlling finite stocks and balancing renewable resource streams.
- Optimising resource efficiency by always circulating products, components, and materials in both technical and biological cycles.
- Fostering effectiveness by revealing and preventing negative externalities.

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