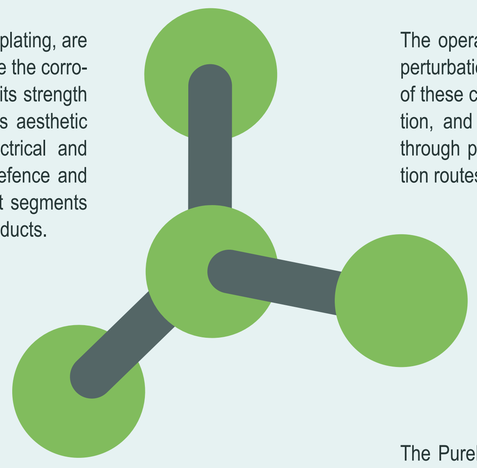
# pureNano

The PureNano project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 821431

#PureNanoProject

## SCOPE OF THE PROJECT

Electroplating and electroless plating, are two processes used to improve the corrosion resistance of a material, its strength and hardness and improve its aesthetic appearance. Automotive, electrical and electronics, aerospace and defence and jewellery are the main market segments requesting plating industry products.

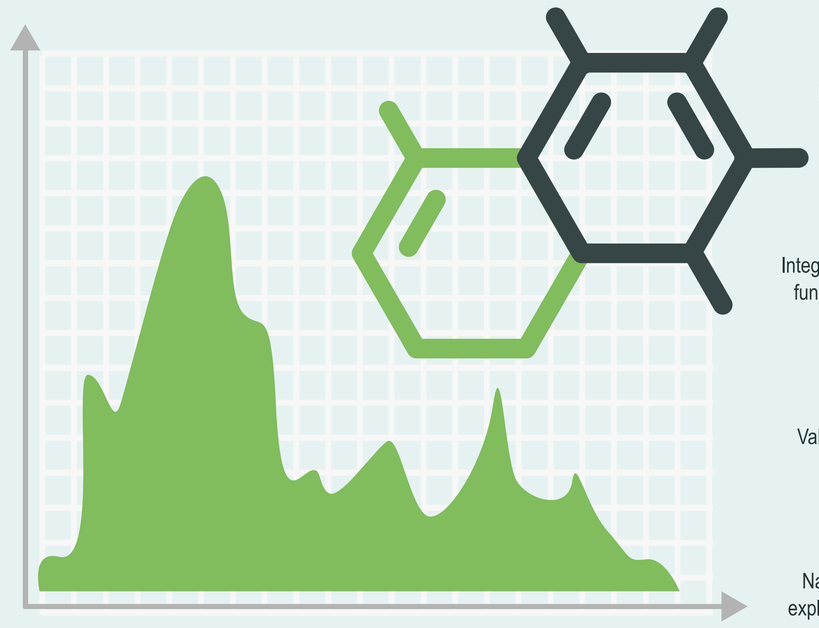


One of the challenges of the plating industry is the production of hazardous waste. Every year a total amount of 300.000 tons of hazardous waste is produced per year (an average of 16 tonnes per installation).

The operation of a plating bath leads to perturbation of the proper concentration of these chemicals due to their consumption, and the production of by-products through parallel reactions or decomposition routes.

The PureNano process offers a sustainable, low-risk, economic solution for the purification/regeneration of the plating bath, by using Magnetic Nanoparticles (MNPs), leading to an extension of up to 10 times of the life of the bath.

## OBJECTIVES OF THE PROJECT



**OBJECTIVE 1:**
Develop and functionalize magnetic nanoparticles to capture specific contaminants

**OBJECTIVE 2:**
Integration of a purification system using functionalised MNPs and safe disposal of MNPs

**OBJECTIVE 3:**
Validation and demonstration activities of purification process at pilot scale

**OBJECTIVE 4:**
Nanosafety, LCA analysis, innovation, exploitation and dissemination activities

## BATHS TO BE TREATED AND MNPS RECOVERY SOLUTIONS

**Bath1: Zinc/ Copper electroplating.** Zinc plating is mainly used for corrosion resistance and decoration while copper plating is used for electronic applications and decoration as well. During the operation conditions, organic substances and metal ions accumulate in the baths. To keep working with the bath a regeneration/ purification is needed. Once the MNPs are used for the bath treatment, they can be integrated in concrete formulation for improving the properties or the captured metals can be recovered through an electrolytic process.

**BATH 1: Zinc/Copper electroplating. Accumulation of Zn2+ Cu2+ and organic substances.**

**Electrolytic recovery of the captured metals and integration in concrete formulation**

**Bath2: Electrolytic Nickel Bath.** These types of baths are used to produce corrosion and wear resistance coatings, but also for decoration and electric applications. During the utilization, decomposed additives and Ni ions accumulate in the bath. After the Ni ions reach a certain concentration, the bath cannot operate anymore and needs to be regenerate. Also in this case the metals captured in the MNPs can be removed through an electrolytic process.

**BATH 2: Electrolytic Nickel bath. Accumulation of decomposed additives and ion Ni2+.**

**Electrolytic recovery of the captured metals.**

**Bath3: Electroless Nickel.** This bath is used to create protective coatings, and the main issue is the accumulation of orthophosphites that is a reaction by-product. A concentration above 250 g/l, prevents the operation of the plating bath which is defined as "spent" and will need to be substituted. MNPs can be use to remove the orthophosphites making the bath reusable. Once the bath is regenerated, the MNPs can be used to remove heavy metals from waste water.

**BATH 3: Electroless Nickel bath. Accumulation of orthophosphites**

**Removal of heavy metals from wastewater**

## INNOVATION ASPECTS

PureNano project is characterized by the main innovation potential of regenerating a plating bath which is normally disposed. PureNano project provides a methodology which is:

**FAST**
The adsorption phase only takes around 30 minutes, and the treatment process requires only two steps (solution treatment and MNPs seperation)

**ECONOMICAL**
The method of preparing the MNPs is simple and cost effective. A given batch of MNPs, can be reused more than 20 times, with a 90% recovery rate.

**GREEN**
PureNano does not introduce harmful chemicals.

**IN HOUSE**
The PureNano technology can be installed in house. This reduses the costs and the risks associated with the transport of hazardous chemicals.

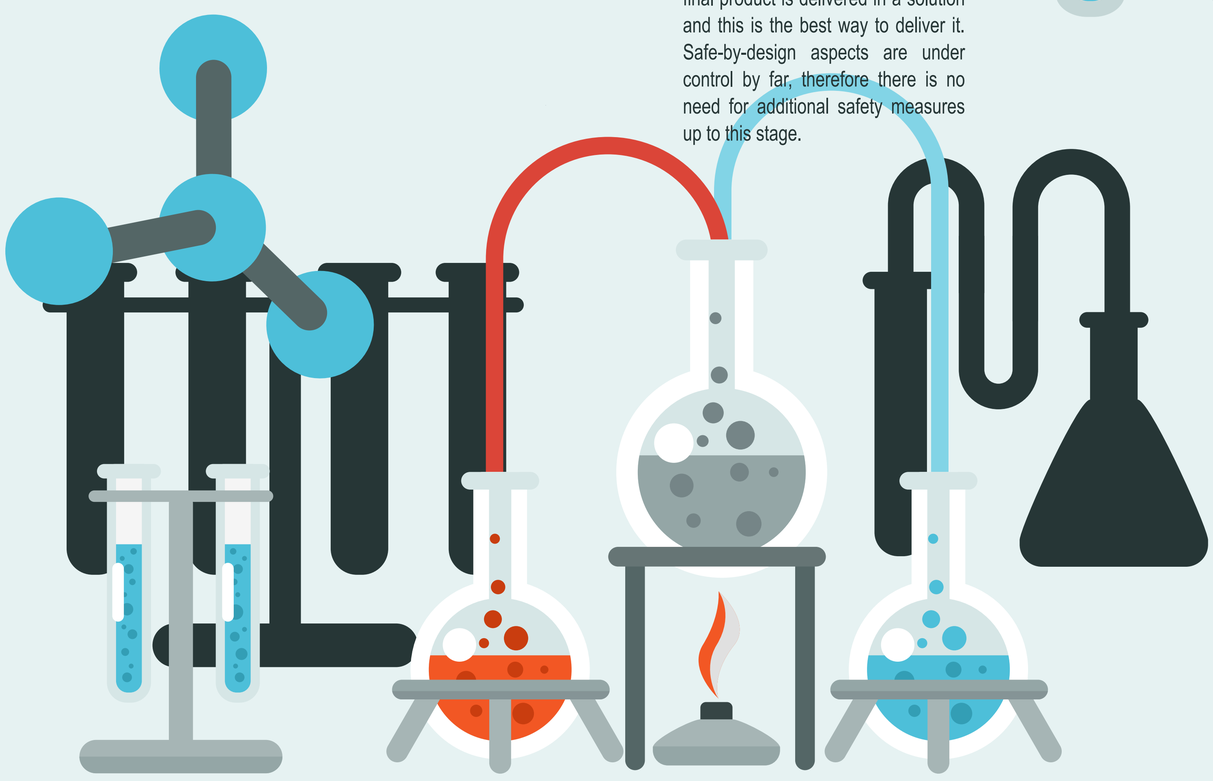
**From the circularity perspective, PureNano aims at respecting the zero waste principles, limiting the use of toxic materials and at the development of a strategy for recycling/ reuse the MNPs for different application (water treatment, cement integration or precious metals extraction and MNPs reuse).**

## SAFETY ASSESSMENT

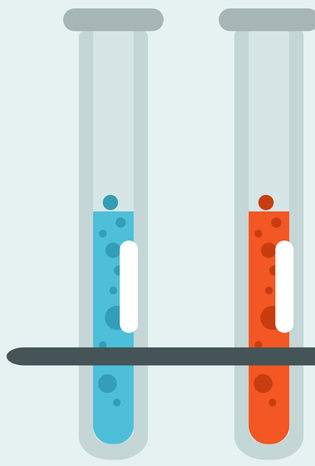
**REACH:**
Captive pilot line will produce 10 Ton/ year of MNPs. In this regard, Captive falls under the obligation to register the product in REACH. Captive needs therefore to register the substances and provide all the characterizations. The procedure has been already started, but it will take some months.

**NANOSAFETY:**
Before the MNPs are functionalized there are no problems regarding the Nanosafety, nevertheless, other analysis will be performed after the functionalization of the particles.

**RISK ASSESSMENT:**
Safe-by-design is related to the safety of the materials, processes and final product of the PureNano technology. The materials used for the production of MNs are not considered or classified as substances of very high concern (SVHC). For the processes, the Stoffenmanager nano tool was applied, and the results of the assessment indicated a low risk. The final product is delivered in a solution and this is the best way to deliver it. Safe-by-design aspects are under control by far, therefore there is no need for additional safety measures up to this stage.



## STANDARDIZATION ACTIVITIES



Several standards relevant to the PureNano project were identified. As the project advances, project outputs may be considered as an important contribution to some of these standards by supplying new knowledge on the use of nanomaterials and their HSE issues and by dissemination activities including these standards. Standardization is important in helping to protect the environment and the health and safety of workers. Key concepts of the project were assessed, and standardization areas were identified:

- Standardization landscape related to plating lines.
  European Standard EN 17059:2018 "Plating and anodizing lines - Safety requirements"
- HSE standardization landscape and applicable standards related to management of nanotechnologies and nanoparticles. The standardization on health, safety and environmental (HSE) management for nanotechnologies is still advancing.

## BUSINESS MODEL

The business plan developed in the PureNano project, is constituted mainly by 8 steps. Each aspect is analysed and developed for each SME being part of the consortium. The main key exploitable results are identified and revised during the project to meet the innovation development and a proper IP protection strategy is planned to avoid internal conflicts.

**Value Proposition**
Description of new product or service
Unique selling point

**Internal Environment**
Roadmap, collaboration with partners, milestones
Resources, funding

**Risk Analysis**
Barriers
Contingency plans

**Financial Analysis**
CAPEX, OPEX

**IPR Strategy**

**Marketing and Channels**

**External Environment**
SWOT
PESLTLE
Market Analysis and trend
Competition analysis

**Business Model**
CANVAS