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ENvironmental Safety of polyUrethanes from REnewable sources and from REcycled plastics: hazard assessment based on a battery of alternative methods

@ENSURE2project

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SUMMARY

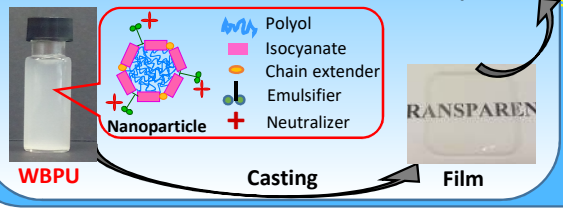
The growing concern about the adverse impacts of plastics in the environment has led consumers and companies to demand for a less persistent alternative to replace petroleum-based plastics. Although plastics are generally considered inert materials, most chemicals used for their production are derived from non-renewable crude oil and several are hazardous. Reduction of the fossil dependence, environmental impacts and hazardous chemicals can be achieved by the incorporation of renewable raw resources in the plastic production. Bioplastics are materials made of natural biomass resources, such as vegetable oils and starch, that are either bio-based, biodegradable or features both properties. Like petroleum-based plastics, discarded bioplastics are sent to recycling plants or landfills for disposal. If bioplastics end up in the marine environment or if they are used in the marine environment, they can generate micro and nanosized particles via abiotic and/or biotic processes, lasting for years, and representing a risk to marine life. Thus, there is an urgent need to evaluate the safety of these novel bioplastics in order to improve the design of these "bio" plastic alternatives. Waterborne polyurethanes (WBPUs) are a type of polyurethanes (PUs) obtained in a mainly organic solvent-free synthesis process. Moreover, WBPUs synthesised from renewably sourced precursors show properties comparable to fossil-based PUs. In spite of the wide range of applications for WBPUs and their nanocomposites, there is no information on the environmental hazard posed by WBPU nanoparticles (NPs) that are produced during the synthesis nor on the impact that PU based microparticles (MPs) that can be formed during the polymer degradation can have on aquatic organisms.

Thus, **general objective** of the **ENSURE2** proposal is to synthesize, on the one hand, partially renewably sourced WBPU NP dispersions and, on the other hand, partially renewably sourced and partially recycled WBPU NP dispersions, as well as WBPU nanocomposite NP dispersions by incorporating nanocellulose, and to investigate the environmental hazard of the nanoparticles (NPs) produced during the synthesis and of the microparticles (MPs) produced during the degradation of the casted films obtained from the dispersions, using a battery of alternative methods (bioassays) that include various species of aquatic organisms (phyto- and zooplankton, mussel cell cultures and fish embryos).

The present project proposal contributes to the objectives of the **"ecological transition"** and to the United **Nations sustainable development goals** (UN SDGs) 6, 9, 11, 12, 13 and 15.

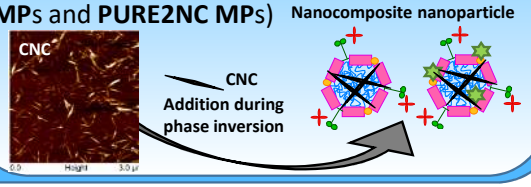
ENvironmental Safety of polyUrethanes from REnewable sources and from REcycled plastics: hazard assessment based on a battery of alternative methods (ENSURE2)

Task 1.- Development of **RE**newably sourced **P**oly**U**rethane nanoparticles (**PURE NP**s) and production of microparticles from PURE casted films (**PURE MP**s)

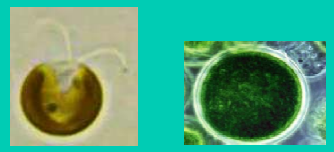


Task 2.- Development of **RE**newably sourced and **RE**cycled **P**oly**U**rethane nanoparticles (**PURE2 NP**s) and production of microparticles from PURE2 casted films (**PURE2 MP**s)

Task 3.- Development of **RE**newably sourced and **RE**cycled **P**oly**U**rethane nanocomposite nanoparticles (**PURENC NP**s and **PURE2NC NP**s) and production of microparticles from PURENC and PURE2NC casted films (**PURENC MP**s and **PURE2NC MP**s)



Task 4.- Determination of the impact of **PURE, PURE2, PURENC and PURE2NC NP**s and **MP**s in diverse species of phytoplankton


T. lutea

N. gaditana

Task 5.- Determination of the impact of **PURE, PURE2, PURENC and PURE2NC NP**s and **MP**s in diverse species of zooplankton


B. plicatilis


Artemia sp.

Task 6.- Determination of the impact of **PURE, PURE2, PURENC and PURE2NC NP**s and **MP**s in isolated mussel haemolymph cells


M. galloprovincialis hemocytes

Task 7.- Determination of the impact of **PURE, PURE2, PURENC and PURE2NC NP**s and **MP**s on the development of zebrafish embryos


D. rerio embryos

Task 8.- Integration of the data obtained to provide tools for hazard identification and for supporting environmental risk assessment of PURE, PURE2, PURENC and PURE2NC NPs and MPs from renewable sources and from recycled plastics in the aquatic environment

Task 9.- Coordination of the project, dissemination of results and exploration of possibilities of technology transfer

Ongoing related projects

PLASFITO
"Fate and effect of the microplastics, nanoplastics and additives coming from the degradation of fishing gears during their life cycle. Study in the Bay of Biscay"
(Euskampus Missions 1.0)
2022.

CAS6
"Towards a technological platform for nanoplastics detection"
(EC JRC, CAS Project 30602)
2021-2023.

ENSURE2
"ENvironmental Safety of polyUrethanes from REnewable sources and from REcycled plastics: hazard assessment based on a battery of alternative methods"
(Spanish Ministry MCIU)
2022-2024.

MIKRONANOPLAS
"Microplastics in mollusc and fish species of interest for human consumption in the Basque Country"
(Basque Government, ELIKA)
2022-2023.

FIERA
"Fate and Impact of Environmentally ReAlistic nanoplastics and of novel bioplastics in the aquatic environment"
(Spanish Ministry MCIU)
2022-2025.