SMALLOPS
Nanoparticles for sustainability

NANOPARTICLES FOR WATER TREATMENT

The growth of industry, urbanization and the human population, together with the increasing use of fertilizers and pesticides in agriculture have a significant influence on the deterioration of the quality of natural waters, increasing pollution problems and, consequently, the potable water supply. For this reason, at Smallops we have developed a product (OPS) for water treatment.

1. WATER

Water is essential for the survival of all known life forms. Without it we could not live, and the truth is that we have less and less drinking water on the planet. That is why it is necessary to establish actions for water treatment.

2. WATER TREATMENT

Water is a vital resource for food, hygiene and human activities, as well as for agriculture and industry. Since ancient times, man has established populations of it in areas close to water courses, not only because it is essential for life, but because it is useful for many of the activities that he develops. Because of this, rivers have frequently been the recipients of much of the waste generated by man.

The growth of industry, urbanization and the human population, together with the increasing use of fertilizers and pesticides in agriculture have a significant influence on the **deterioration of the quality of natural waters** and increase **pollution problems** and consequently the supply of drinking water.

In order to adopt solutions, it is necessary to know the possible causes and sources of contamination of the water environment. Aquatic pollution can be punctual (in the event that it is produced by a specific and identifiable emitting source affecting a specific area) or diffuse (when the origin is not clearly defined and large areas are affected in which multiple sources of pollution coexist). issue). In a general sense, we can consider as sources of contamination of the water environment, u**rban wastewater, industrial, agricultural/livestock,** and **atmospheric contributions.**

Likewise, we can classify the basic contaminants that can be found in natural waters into 4 groups:

- **Organic contaminants,** such as pesticides, hydrocarbons or surfactants.
- **Radioactive contaminants,** both of natural and anthropogenic origin.
- **Biological contaminants,** such as bacteria, fungi, or viruses, all of which carry disease.
- **Inorganic contaminants,** such as heavy metals.

This last group, the heavy metals, present three fundamental aspects that characterize them:

- Unlike most organic pollutants, they are not removed or biotransformed in aquatic ecosystems by natural processes.
- Most of these metals are enriched in minerals and organic substances that reach the water, tending to accumulate in suspended matter and in the superficial layers of sediments.
- They are bioavailable contaminants for living organisms, they bioaccumulate in them and undergo a biomagnification process through the trophic chain.

Of the 106 elements known to man, 84 are metals, so it is not surprising that the possibilities of metallic contamination in the environment are numerous. In fact, **population growth in urban areas and rapid industrialization have caused serious pollution problems and environmental deterioration, especially in developing countries.**

HEAVY METALS IN WATERS

Human activity has notably contributed to the increase in the levels of metals in the waters, sediments, flora and fauna, both marine and epicontinental. The presence of high concentrations of metals in the environment causes adverse effects on the environment and human health. Such is the case of Minamata disease, caused by an excess of mercury.

The concentration of metals in the water column is generally low; on the contrary, these elements accumulate in sediments and in aquatic organisms, reaching important levels. **In especially polluted areas, the metal content in animals and plants reaches values that can be toxic to organisms, which turn out to be a source of contamination for humans as a result of their consumption.**

For all these reasons, the progressive contamination of the water environment by heavy metals and the detrimental effects that this produces in the biota have given rise to the need to determine the concentration of metals in various aquatic samples.

From the point of view of Chemical Oceanography, since metal concentrations in natural water are usually found at levels below 50 nM, they are included within the group known as trace elements, which, despite their low concentration levels , have important chemical and biological implications in natural aquatic systems.

According to **UNEP** (United Nations Environment Programme), **2,000 million tons of water are polluted daily** due to waste, and it warns that without urgent action to improve the management of these two million tons of waste that contaminate the waters, the situation will worsen. This not only affects the health of millions of people, especially the poorest, but also affects marine ecosystems, in such a way that there are **245,000 km2 of marine dead zones**, and the climate, due to methane emissions that contribute to global warming.

MAIN CONTAMINATED PLACES

These are the main recipients of water pollution in **Spain:**

Rivers: It is estimated that 50% of the rivers in our country are in poor conservation conditions, and this can directly affect the ecosystem that surrounds them. In addition, many rivers end up in reservoirs directly oriented to human consumption, which is why it is even more worrying. Rivers have vegetation that is responsible for cleaning the water and conserving it in dry periods, so if it is affected it could be harmful for our consumption.

Wetlands: Wetlands are nature's filters. They are responsible for cleaning water pollution and protect us from floods. In addition, they are home to many species, so their contamination is very dangerous. It must be taken into account that thousands of people work in these areas, so their contamination affects various spheres of society and biodiversity. Our country is the one with the greatest diversity of wetlands in Europe, so this issue touches us even more closely, and the worst thing is that these areas are highly threatened by water pollution.

Agriculture: 70% of the water we consume in our country is used for irrigation. As can be seen, it is a crucial resource for the Spanish economy, therefore its contamination could seriously affect the development of the country. In Spain, irrigation systems that are responsible with the resources available to us are still not applied, which is why this much-needed resource is often wasted.

Four out of ten rivers in the country do not pass the water quality cutoff, according to the summary document of the river basin management plans for the second planning cycle (2015-2021). Of a total of 4,390 river-type water bodies in Spain, only 55% are considered to be in good ecological condition; 43% fail in quality; and 2% are not monitored.

Of all surface water bodies in Spain – 85% are rivers, and the rest are lakes, transitional and coastal bodies – 44% are affected by point pollution (controlled and authorized discharges, such as effluent from a treatment plant, due to example); and another similar percentage is affected by diffuse sources of contamination, for example, returns from irrigation or rain from crops treated with agrochemicals, which end up in rivers or aquifers. Many of these agrochemicals have a synthetic origin, which increases the presence of nitrates and phosphates, leading to **eutrophication problems in the water.**

In Spain we still lack 15% of the population treated in purification and we also have a certain deficit of compliance in sensitive areas. According to the study "Progress in the management of Contaminated Sites in Europe" developed by the Joint Research Center in 2014, it is estimated that there are **2.5 million potentially contaminated sites throughout Europe**. Both in groundwater and in the subsoil, the most persistent contaminants are: heavy metals (≈30%), petroleum derivatives (≈25%), BTEX (≈13%) and organochlorine compounds (OCs) (≈9%). .

3. OPS FOR THE ELIMINATION OF WATER POLLUTANTS

At Smallops we have a **product from the recovery of olive oil waste.** These are iron nanoparticles encapsulated in carbon that help to eliminate different contaminants and provide different advantages in the process:

- **Removal of heavy metals.** Thanks to the OPS it is possible to eliminate heavy metals such as Cr, Cd, Ni, Cu and Zn, present in industrial wastewater such as those from the chrome plating industries of the automotive sector.
- **Pesticide removal.** Thanks to OPS it is possible to eliminate pesticides such as 2, 4-dichlorophenoxyacetic acid or 2,4-D present in industrial wastewater.
- **Elimination of sulfur compounds.** In the different wastewater treatment plants (EDAR) the application of the OPS allows the elimination of sulfur compounds (H2S) present in the gas phase which are the cause of bad odors.

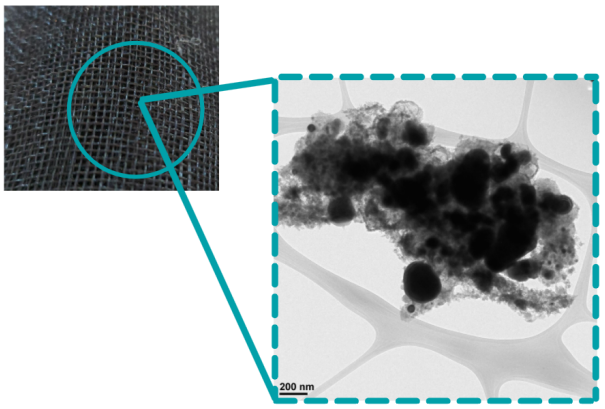
3.1. BETTING ON R+D+i

Being aware of the growing and serious problem that water pollution presents, at Smallops we have opted for research for the design of a mesh made from encapsulated iron nanoparticles from olive oil residues for the treatment of contaminated water.

OPS are mixed with polymers to produce a fabric that can collect contaminants from water, without the energy and pressure that wastewater treatment plants typically use.

The research team of the project is made up of personnel from SMALLOPS, AITEX, the University of Extremadura and the Plataforma Solar de Almería (CIEMAT-PSA). In addition, we have the support of the Junta de Extremadura thanks to the help received co-financed with FEDER Funds.

You can check the project here.



CONTACT

info@smallops.eu

www.smallops.eu