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TASK 1. DEFINITION OF THE GOAL AND SCOPE

Case study 1.1 Wastewater treatment

Greywater is domestic wastewater originated in washing machines, kitchen sinks, baths, and hand basins. Spanish law allows its recycling under several circumstances. Hence, it is adequate for toilet flushing, irrigation, laundry, fire extinguishing, groundwater discharge or car and window washing. This kind of water contains surfactants, which are compounds commonly used in the formulation of detergents and personal care products that represent an environmental hazard due to their low biodegradability and their ability to provoke. One of the most representative surfactants is the sodium dodecylbenzenesulfonate (SDBS). Several methods have been considered for greywater treatment including biological, chemical, and physico-chemical processes. Nevertheless, most of these techniques are ineffective for the total removal of surfactants or they can only transport these contaminants to a different phase resulting in a concentrated waste volume.

Advanced oxidation processes (AOPs) have been presented as environmentally friendly treatments for wastewater remediation; they achieve the successful degradation of different contaminants of emerging concern (CECs). AOPs are based on the in situ generation of reactive oxidizing species, mainly hydroxyl radicals (•OH). Among them, **heterogeneous photocatalysis** appears as an attractive emerging technology to treat greywater because it avoids secondary pollution and works at ambient temperature and pressure. In this process, a source of appropriate light and a solid semiconductor material, the photocatalyst, are necessary to promote the mineralization of the organic pollutant (Fig. 1).

Solar light is the most environmentally friendly light source and solar-assisted photocatalysis has shown positive results over the last years in the removal of emerging contaminants. However, several barriers still need to be overcome for its full implementation worldwide. Thus, the effective application of TiO_2 photocatalysis to the removal of recalcitrant compounds requires artificial illumination such as light emitting diodes (LEDs).

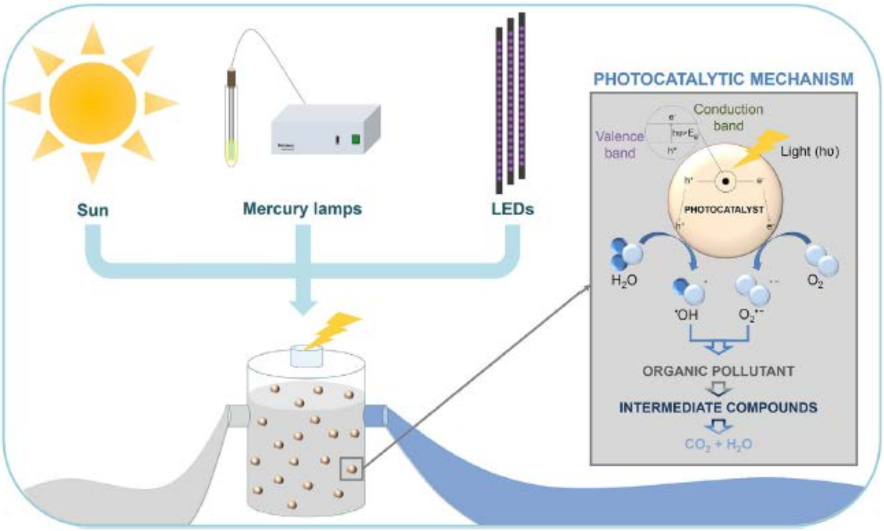

Fig. 1. Light source alternatives in photocatalysis.

Another promising technical alternative to treat greywater consists in the use of **membrane biological reactors (MBR)**, which combine traditional activated sludge biological treatment with membrane filtration.

Both, photocatalysis and MBR, have shown their suitability for the treatment of greywater. Nevertheless, their deployment generates an environmental impact associated with an intensive use of resources (chemicals and energy) and the construction of the required infrastructures.

In order to determine the most environmental friendly treatment of greywater a life cycle assessment (LCA) study will be conducted. The following scenarios will be evaluated:

- Scenario 1 (Sc. 1), photocatalytic technology with LEDs.
- Scenario 2 (Sc. 2), photovoltaic solar-driven photocatalysis with photovoltaic panels.
- Scenario 3 (Sc. 3), MBR technology.

Case study 1.2 Partial Dealcoholisation of wines

Wine, in moderation, is considered to be heart healthy, particularly the red variety. Furthermore, despite the health benefits of wine, and especially red wine, the alcohol content limits wines consumption due to civil restrictions and health reasons. In this sense, a proliferation of wines with low ethanol content has been observed in USA and European buyers. The European Commission regulation has not been immune to this new situation and has set that in wine dealcoholisation should not remove more than 2 percentage points of ethanol and that the minimum concentration should not be less than 8.5% v/v. Therefore, a small adjustment in the alcohol content between 1 and 2% is currently one of the most important objectives for the wine industry. Several different techniques for producing low and reduced alcoholic strength beverages have been developed over the last several years. The most common treatments are vacuum distillation, spinning cone column (SCC), membrane-based technologies such as nanofiltration (NF) and reverse osmosis (RO) and in lesser extent adsorption on zeolites and supercritical fluid extraction. Among all of these technologies, SCC and RO are the most used methods in the industry to produce low alcohol-content. Conversely, EP is an innovative technology that has been successfully applied to concentrate juices and has shown promising results for partial dealcoholisation of wine while barely altering the organoleptic properties of the product. In order to state the environmental benefits and drawbacks and environmental impacts of obtaining the dealcoholised wine by means of the conventional technologies (RO and SCC) and the innovative technology (EP), an LCA study was conducted. Three scenarios were evaluated and compared:

- Scenario 1: Evaporative pertraction (EP).
- Scenario 2: Reverse osmosis (RO).
- Scenario 3: Spinning Cone Column (SCC)

Deliverables

According to the ISO 14040, firstly the goal and scope should be defined, and within this step the determination of the function and functional unit are key issues. Therefore, based on the supplied information you have to determine:

- Goal of the study
- The function of the system
- The functional unit

Prepare a mini-report with all the assumptions and hypothesis that you consider in the goal and scope definition.