Greywater. Waste or treasure?

In the last years humanity is faced with the problem of water pollution, an issue that threatens people's health and degrades the life quality. According to WHO 663 million people rely on sources of questionable quality and at least 1.9 billion people use a drinking-water source contaminated by biological effluents. The extended pollution of the aquatic environment in combination with increasing needs for clean water, require a more rational water management. Given the worldwide water scarcity and future demands, the debate on the utilization of recycled wastewater as an alternative water source is gaining increasing attention.

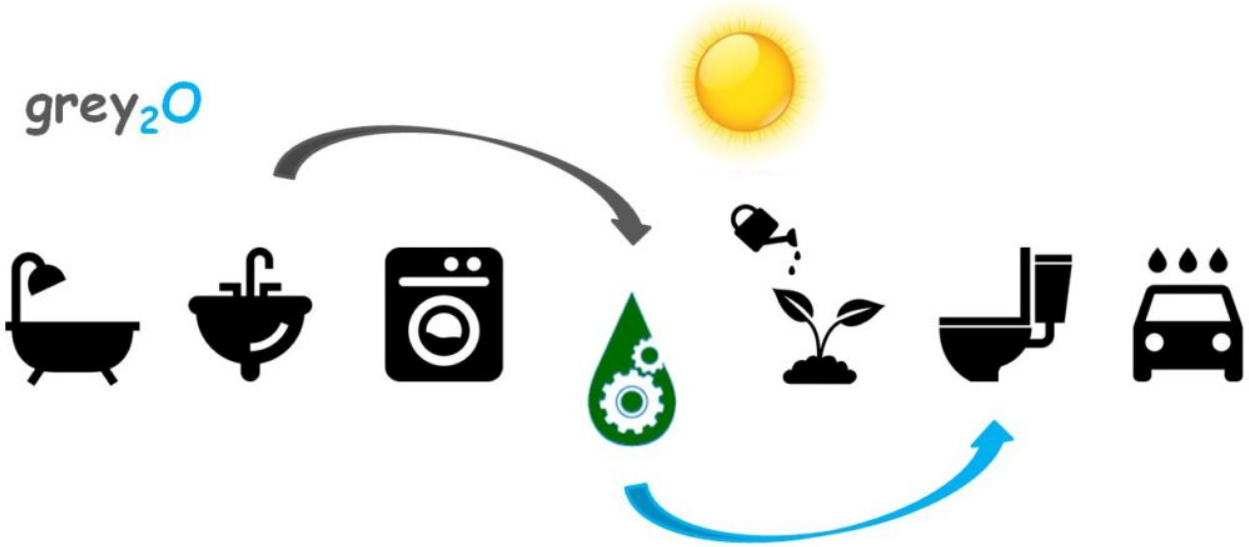

Fig. 1. Greywater treatment and reuse.

One major source of highly reclaimable water, particularly important for water-stressed nations, is urban wastewater generated from washing activities in households, excluding toilet effluents, referred to as «greywater». The quantity and quality of greywater is determined by various factors; i.e. social and cultural behavior, lifestyle, age distribution and living standards, water availability and consumption. Bearing in mind that greywater accounts for up to 75% of the domestic wastewater volume and has a lower organic load and pathogen content than municipal wastewater, it may be considered as an ideal candidate for decentralized treatment and reuse systems. The marked depletion of fresh water resources along with continuously escalating climate changes and extended pollution of the aquatic environment, render sustainable water management an essential need. Greywater reuse for applications conforming to lower than drinking water standards, could provide an alternative towards sustainable management of water resources. Greywater treatment and recycling can significantly contribute to environmental pollution tackling, providing also a

considerable boost on household economy.

Advanced Oxidation Processes are environmentally friendly methods designed to deal with the problem of gas, liquid and solid phase pollution. Among the above methods, heterogeneous and homogeneous photocatalytic oxidation have given satisfactory and promising results concerning inactivation of pollutants and pathogens. In this work both preceding methods were applied under artificial and solar illumination, so that process effectiveness onto greywater mineralization could be evaluated. Because of the extremely high variability in greywater it was deemed necessary to prepare a reproducible effluent that would simulate the actual wastewater; in this context, representative commercial personal care products were selected and used so that the simulated greywater (SGW) produced would be similar in complexity and organic load compared to actual effluents.

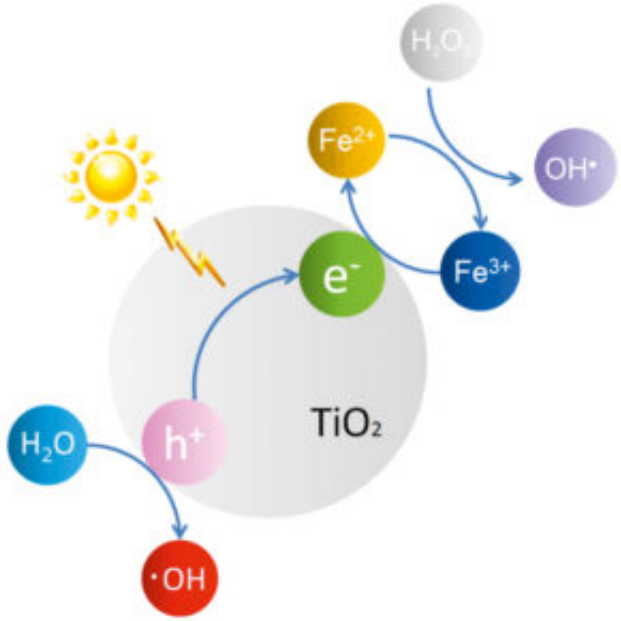

Fig. 2. Hybrid photocatalytic system.

Preliminary experiments, carried out in a bench-scale photocatalytic reactor under artificial illumination, led research strategy to the application of a photo-Fenton-assisted TiO_2 photocatalytic hybrid process. This heterogeneous-homogeneous hybrid system showed the highest efficiency and gave the best mineralization results, with 72% DOC removal after 210 min of treatment.

In the second part of the research, experiments were carried through a pilot-scale photocatalytic reactor under solar illumination. All experimental runs led to more than 35% of mineralization, with the aforementioned hybrid system exhibiting once again the highest efficiency, with more than 60%

elimination of the organic load.

During the last stages of the study, experiments were conducted estimating greywater ecotoxicity and phytotoxicity, that were assumed to be due to the complexity of the reaction mixture and also the presence of mostly unknown compounds. The toxicity evolution profile that was monitored at different stages of the process showed that as these degrade with time the effluent loses its ecotoxic and phytotoxic characteristics and becomes more environmentally compatible.

Taken together, our results suggest that greywater can be an ideal candidate on the utilization of recycled wastewater in applications conforming to lower than drinking water standards. However, it is still a question whether humanity is psychologically ready to reuse its own wastewater.

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Publication

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