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# Decontamination of hazardous medical wastewater via combined solar driven photocatalytic processes

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**Abstract** Treatment of liquid hazardous medical wastewater produced by healthcare laboratories is a global matter that has been inadequately addressed. The term "healthcare waste" includes all the waste generated within healthcare facilities, research centers and laboratories related to medical procedures. Hazardous healthcare wastewater may contain a wide range of chemicals, i.e. laboratory reagents, disinfectants, solvents and dyes used for diagnostic purposes, pharmaceuticals including antibiotics and cytotoxic drugs used in cancer treatment, as well as various infectious agents. Since this wastewater is hazardous, it is collected and transferred to authorized facilities and processed separately from the main stream of hospital wastewater that results, ideally after biological processing, to the municipal treatment plant. Among the key elements necessary to improve healthcare waste treatment and management are strategies that aim at favoring the safe and environmentally sound treatment of hazardous healthcare wastes over current practices to protect both human health and the environment. In this context, the current study aims to the development and application of an autonomous solar photocatalytic pilot reactor for the inactivation of liquid hazardous medical wastewater containing toxic pollutants and/or pathogens.

**Keywords**: photocatalytic oxidation; hazardous medical wastewater; autonomous solar pilot reactor

Health units such as medical, biochemical and molecular laboratories produce liquid hazardous medical wastewater (LHMW). Treatment of LHMW produced by healthcare laboratories is a global matter that has been inadequately addressed. Hazardous healthcare wastewater may contain a wide range of chemicals, i.e. laboratory reagents, disinfectants, solvents and dyes used for diagnostic purposes, pharmaceuticals including antibiotics and cytotoxic drugs used in cancer treatment, as well as various infectious agents. Depending on its composition, LHMW may be classified as toxic (LHMW-TC), infectious (LHMW-IN), or mixed (infectious and toxic, LHMW-MC). LHMW is heterogeneous regarding its constitution, a property that hampers the use of a universal processing method that would effectively deactivate any kind of pollutant and pathogen.

Since this wastewater is hazardous, it is collected and transferred to authorized facilities and processed separately from the main stream of hospital wastewater that results, ideally after biological processing, to the municipal treatment plant. Furthermore, application of currently available, traditional, liquid waste processing methods entails several intermediate processing steps that require expensive equipment, which results in high processing costs. Moreover, available methods are not fully effective at several cases, as they are unable to completely inactivate the abovementioned pollutants. Among the key elements necessary to improve healthcare waste treatment and management are strategies that aim at favoring the safe and environmentally sound treatment of hazardous healthcare wastes over current practices to protect both human health and the environment.

This study is part of a research project aiming to the development and application of an autonomous solar photocatalytic pilot reactor for the inactivation of LHMW containing toxic pollutants and/or pathogens. The aim of this work was the implementation and optimization of heterogeneous and homogeneous photocatalytic oxidation, that can completely inactivate both chemical organic pollutants and pathogens. More specific, in this work is presented the application of the preceding methods at the degradation of simulated medical wastewater, in order to provide a further insight to oxidation kinetics (i.e. determination of factors affecting oxidation rate) and estimate mineralization degree towards the corresponding oxidation process. Simulated medical

wastewater was synthetically produced in the laboratory, taking into consideration the characteristics of real medical wastewater samples taken by local health units.

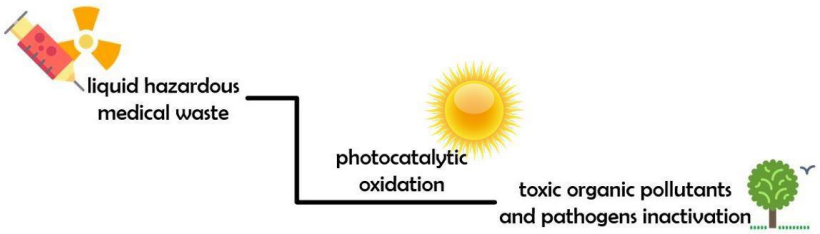


**Figure 1.1** Solar driven photocatalytic oxidation of liquid hazardous medical waste.

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