# Educational Session: Pulsed Electric Field (PEF) Technology for Environmental Applications

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The environment is the external conditions, including all the biotic and abiotic factors that interact and affect the survival and development of an organism or population. It is obvious that changes in the environment have an impact on the organisms and populations in such an ecosystem. The aim of environmental applications is the reduction of hazardous waste, water contamination, air and atmospheric pollution and soil degradation. The dramatic increase in the world's population, combined with industrialisation, urbanisation, intensification of agriculture and water-intensive lifestyles, is increasingly leading to shortages in water supply. Currently, about 20% of the world's population has no access to safe drinking water. While water is a renewable resource, it is also a finite one. Global freshwater consumption has increased sixfold in the last century. At the same time as consumption is increasing, water resources in surface and underground waters are being polluted by industrial and municipal waste. Industrial wastewater is contaminated with chemical pollutants, while the discharge of sewage and sewage sludge leads to microbiological contamination of water bodies. The discharge of industrial effluents, sewage and sludge into water bodies is responsible for infection risks and health effects from contaminated drinking water. Therefore, improved technologies need to be developed to control chemical and microbial contamination and the high consumption of this valuable resource.

This lecture will discuss the environmental impact of bacterial contamination of industrial water circuits and hospital wastewater and how the application of PEF technology can help solve these environmental problems. The aim of these applications is to reduce water consumption and prevent the spread of antibiotic-resistant bacteria in water bodies. In the last decays PEF techniques gained increasing importance in cellular biology, in gene technology, in medicine, in food production and in biotechnology. These versatile applications are based on the fundamental effect of polarization of the cell membrane and on the subsequent effect of membrane electroporation. The significant part of the lecture will focus on the PEF treatment for bacterial decontamination of hospital wastewater effluents. The stringent necessity of decontamination of such wastewater effluents relies on the fact that these effluents are loaded with pathogenic and increasingly with antibiotic-resistant bacteria. One important issue addressed during the lecture is the safety of the PEF technology, related to mutagenicity and induced electro tolerance in reference bacteria. In the second part of the presentation, a promising application of PEF treatment in electrocoating systems of paint shops will be presented. The aim of this application is to prevent the bacterial contamination in the pretreatment and coating process to eliminate the use of biocides and drive down both freshwater consumption and wastewater generation. In addition, by efficiently monitoring the bacterial load in process liquid, a high finish quality can be maintained, reworking is avoided, and less paint consumption make more efficient use of resources and lower operating costs. We have found that PEF treatment with short bipolar pulses and even with a high specific treatment energy, which is required in extreme cases to achieve maximum bacterial inactivation, does not affect the quality of the coating. PEF treatment is therefore a suitable method for automation and effective in bacterial decontamination of paints.