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Pulsed power as the main tool of energy-efficient non-thermal microbiological decontamination

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We demonstrate that application of the pulsed power is an indispensable condition for realization of microbiological decontamination in an energy-efficient (respectively, non-thermal) manner.

There appear two distinctive (characteristic) cases of microbiological decontamination: the case of non-selective, tough sterilization, and the case of selective, obligatory non-thermal, chemically neutral sterilization (usually applicable for foods and other thermo-labile products).

We consider that the best solution for the first case is chemical method of oxidation in non-equilibrium ("cold") plasma, combined with UV. Continuous microwaves (MW) - applied for the generation of non-equilibrium oxidative plasma - is a good method of generation, but it is usually applicable in rarified conditions. Pulsed power offers several advantages for optimal process of cold plasma sterilization. First of all, the respective reduction of the duty cycle (at the same average power!) ensures breakdown (plasma generation conditions) at normal atmospheric (or, eventually, higher) pressure conditions - it is the factor of substantial practical importance. Then, the decrease of the duty cycle causes the increase of the grade of plasma non-equilibrium, amplifying its density and oxidative activity - practically without the rise of the gas temperature (non-thermal action of plasma is the base of energy-efficiency of the decontamination process).

For the generation of the non-equilibrium (non-thermal) plasma it is not obligatory to use pulsed harmonic high frequency oscillations. The same effect can be obtained as a result of application of the short (nanosecond) high voltage impulses. In this case plasma parameters can be controlled through the amplitude, duration and duty cycle of impulses.

For the second case (of selective non-thermal action upon vegetative microorganisms in aqueous medium) is indicated sterilization due to application of the high voltage, special form impulses. We propose the theoretical analysis of the processes in the electrolyte medium (as juices, milk etc.), subjected to high voltage impulses' action. Optimal regimes of such sterilization are proposed.

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