

STUDY ON WATER PROCESSING USING HIGH ELECTRIC FIELD PULSE

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ABSTRACT

In this review paper the effect of high intensity pulsed electric field on water containing bacteria's like Escherichia coli, Staphylococcus aureus, Bacillus subtilis and Pseudomonas fluorescence Lactose broth was explained and how the nature of electric field affects the count of bacteria, this will determine the level of water purification. The results show that a different type of micro-organism affects the purification level of the water and how to make this method more effective.

KEYWORDS: Electric Field Fluid Treatment Chamber, Water Processing by High Intensity Pulsed Electric Fields

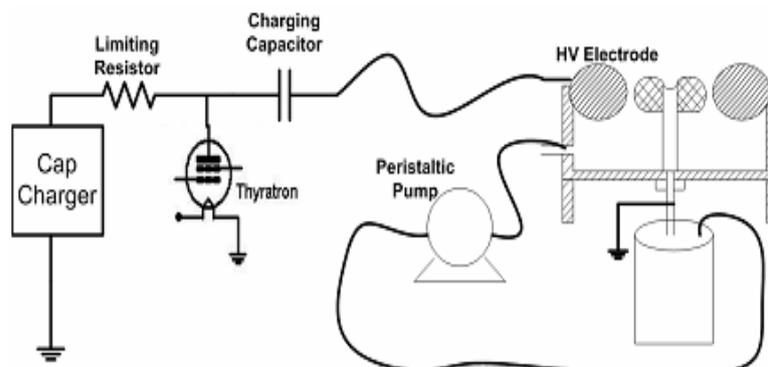
INTRODUCTION

The pollution of water is one of the major causes of worries. New technologies are being developed for water treatment like pulsed corona, uniform streamer discharges, the discharges in water and aqueous solutions are efficient in the creation of shockwaves, ultraviolet radiation, high electric fields and formation of chemically active species. One of the recent methods of using electrical pulses for water treatment has become popular as it increases the efficiency of water purification and addition of chemicals is avoided.

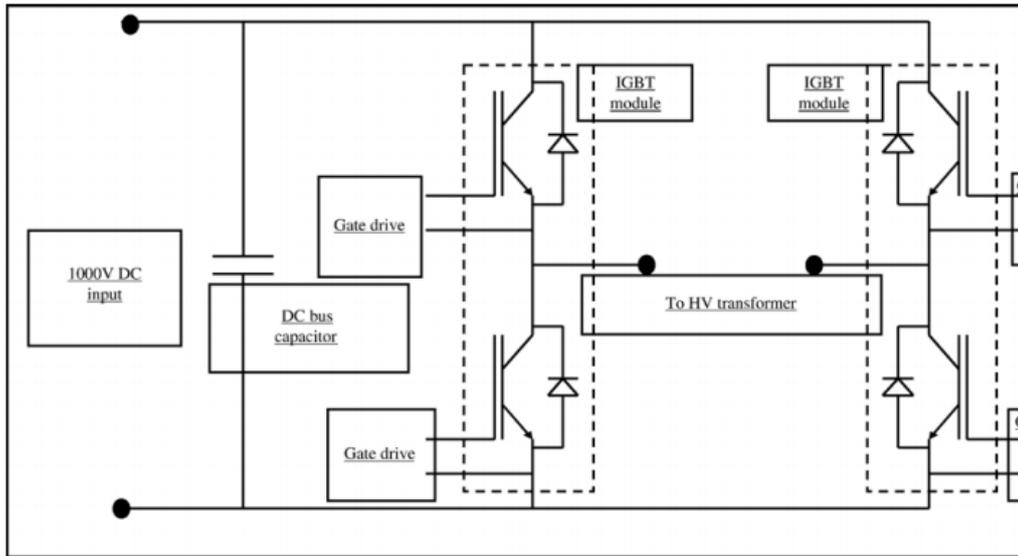
Pulse electric field of range 2-9 kV/mm is used to inactivate the bacteria, very good results have been obtained with medium as milk and juices but as in water treatment high volume of water with high flow rate is used as medium so the results may differ, also for this purpose a large chamber has to be designed.

MATERIALS AND METHODS

Four types of bacteria are used namely- Escherichia coli, Staphylococcus aureus and Bacillus subtilis and Pseudomonas fluorescence. Lactose broth is used and bacterial colonies are agitated in a container. The pulsed electric field treatment unit consists of a thyatron based pulse power supply. The components of power supply are cap charger, limiting resistor, thyatron switch, charging capacitor and a treatment chamber. The chamber maintains a uniform electric field and it is designed to hold large volume of liquid. A pump is used to pump the water in the chamber continuously.



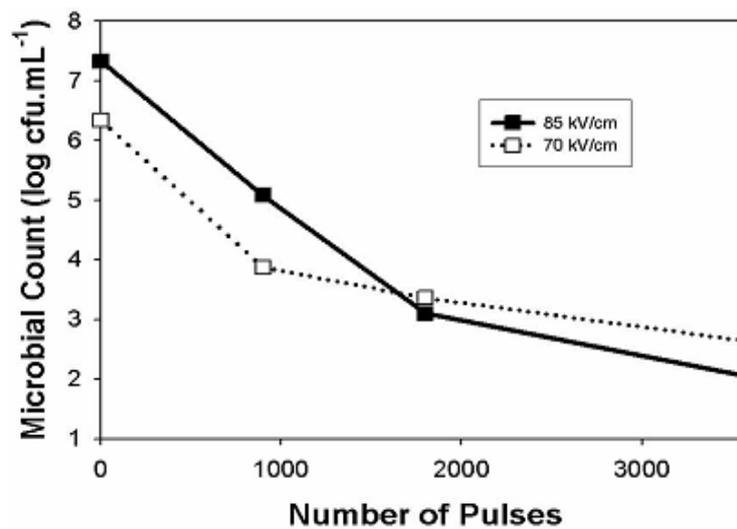
Pulsed power technology is used for producing high intensity electric field. It works at power levels >0.1 GW, which are power levels that are not available from small or medium-sized conventional energy sources. Typical durations of single or repetitive power pulses are in the range between nanoseconds and milliseconds. The energy stored in the capacitors is used to generate electric or magnetic fields. Electric fields are used to accelerate charged particles, leading to thermal, chemical, mechanical, electromagnetic wave, or breakdown effects. Electromagnetic fields transfer energy as electromagnetic waves. Magnetic fields facilitate the generation of extremely high pressures ranging from 0.1 Gpa to many Gpa. These effects are applied to modify the surface of organic and inorganic parts and particles.



RESULTS

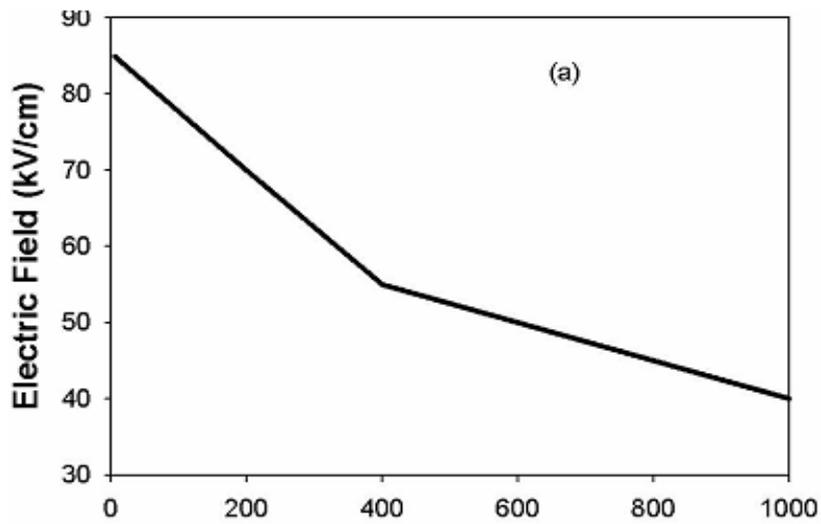
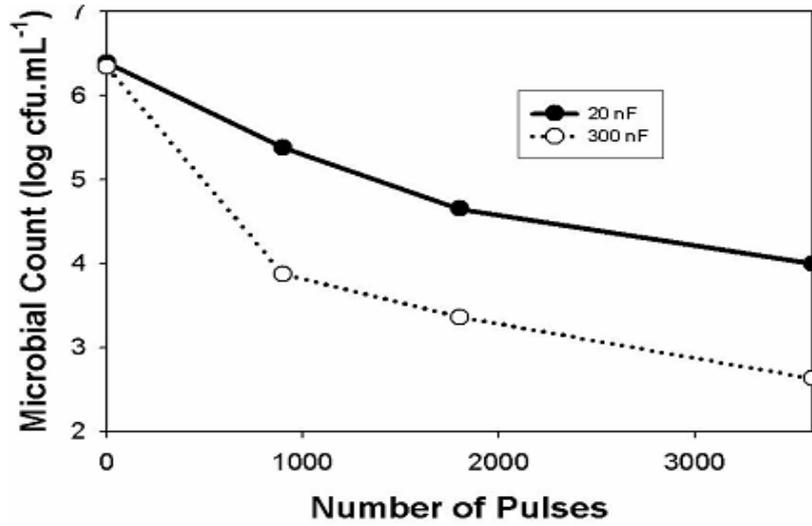
Effect of Electric Field

Various levels of electric field are applied to the water sample and it is observed that higher value of electric field results in greater reduction of bacteria whereas when low value of field is applied less reduction is achieved.



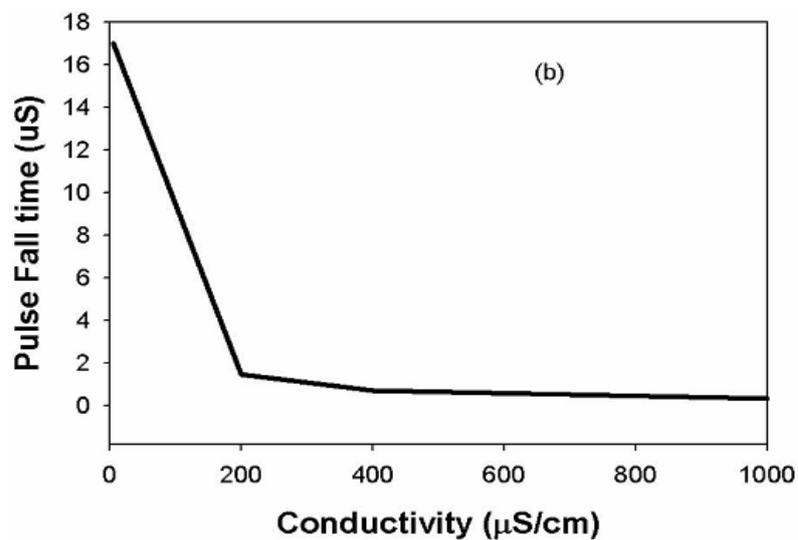
Effect of Pulse Width

Different charging capacitors are used to change the pulse width of the electric field. It is observed that with the larger value of charging capacitor there is a greater reduction in the bacteria count. With small values of capacitor, there is less reduction.



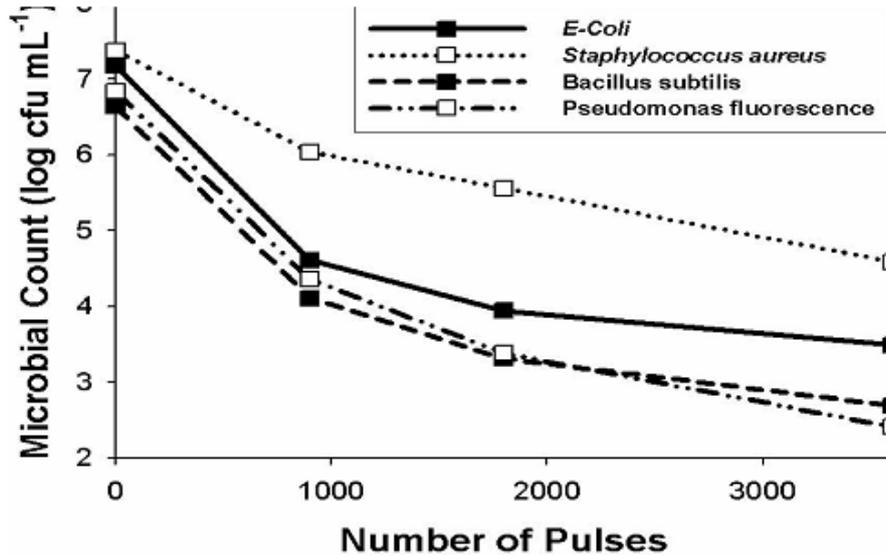
Effect of Medium Conductivity

It is seen that when we increase the conductivity of the medium, the killing efficiency of the pulsed electric field is reduced. It happens because both the electric field and pulse width are reduced on increasing the conductivity of the medium.



Effect of Micro-Organism Type

It is observed that the level of reduction for gram negative bacteria is more than that of gram positive bacteria. This is because the cell wall of gram positive bacteria is thicker than that of gram negative bacteria hence killing is tougher



Hence to make this process more effective high electric field of range 85-90 KV/cm should be applied, capacitor of range 300-400 nF should be used and medium conductivity should be reduced.

CONCLUSIONS

From the above results following conclusions can be made:

- Both the magnitude and width of the pulse are important in inactivating the microorganisms.
- It is difficult to kill smaller micro-organisms as compared to larger ones.
- The inactivation process decreases with reduction in micro-organisms.
- Though all the micro-organisms are not eliminated and it is highly expensive hence further scope of advancement is there.

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