ABSTRACT

Medical instruments and implants are needed in sterile condition before use. Medical instruments and implants are made from materials that vary, so need different sterilization techniques. Techniques of sterilization without causing the heat sorely needed, because not all medical instruments and implants material resistant to heat. One of these techniques and is being studied is using the pulsed electric fields. Generally, the research that has been carried out using the electric field above 18 kV/cm, so when used on large-sized materials procurement costs for the equipment to be expensive. This research was conducted using a combination of electric field and light. The intensity of the electric field used is 2.5 – 4.0 kV/cm, while the intensity of light used is 50 – 250 mW/cm^2. The electric field is derived from high-voltage power supply, whereas light generated by a laser diode with a wavelength of 405 nm. Parallel plate as cathode and anode is made of titanium. The samples were bacteria Pseudomonas aeruginosa and Staphylococcus epidermidis which formed a biofilm on the catheter 1x1 cm^2. Biofilms are grown for 6 days at a temperature 37^{o}C. Exposure to biofilm is done using the electric field, the light, and the combination of an electric field and light. The exposure is done with the room temperature of 30^{o}C and humidity of around 75%. The results showed that the exposure with the intensity of electric field is 3.5; 3.75; and 4.0 kV/cm in the Pseudomonas aeruginosa in a row needed a density of energy of 2.88; 2.08; and 1.72 kJ/m^3 to decrease 4 log$_{10}$. Moreover, for declining of Pseudomonas aeruginosa by 5 log$_{10}$ with the electric field strengths 3,5; 3.75; and 4.0 kV/cm, it was required energy density of 6,42; 4,53; dan 3,65 kJ/m^3, respectively. On the other hand, the decline of Staphylococcus epidermidis by 4 log$_{10}$ was required the energy density of 1,415; 0,659; 0,153; 0,035; 0,012 kJ/m^3 for the electric field strength 3.0; 3.25; 3.5; 3.75; and 4.0 kV/cm, respectively. Moreover for the decline of Staphylococcus epidermidis by 5 log$_{10}$, it was required the energy density of 2,223; 2,108; 0,764; 0,281; 0,120 kJ/m^3, respectively. The biofilm exposure to light was required the energy density of 6,408 and 4,095 kJ/cm^2 for declining of Pseudomonas aeruginosa by 4 log$_{10}$ using the light intensity of 200 dan 250 mW/cm^2, respectively. The exposure of Staphylococcus epidermidis to the wavelength of 405 nm light obtained the decrease of the growth of bacteria in the relatively small amounts. Using this result, it was not needed the further light exposure. A Mathematical model of the decrease in the number of bacteria due to exposure to a combination of an electric field and light is logarithmic functions. The electric field exposure 4,0 kV/cm in 25 minutes towards bacteria Pseudomonas aeruginosa obtained the significant decrease in the numbers of bacteria from 4.798 log$_{10}$. If the exposure is combined with light at 250 mW/cm^2 intensity, then going on a decrease of 5.390 log$_{10}$. In addition, the significant decrease was also occurred in the number of Staphylococcus epidermidis from 5,992 log$_{10}$ using the electric field exposure (4,0 kV/cm in 25 minutes) to 6,273 log$_{10}$ using the combination of electric