

Blood Bag disinfection by OptiMaser Microwave System

Interim Report

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सीएसआईआर-भारतीय विषविज्ञान अनुसंधान संस्थान
CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH



वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH



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Blood Bag Disinfection by Microwave Technology

More than six lakh units of blood are collected annually in India [1]. Around 40,000 - 60,000 units need decontamination due to the presence of infectious agents like HIV, Hepatitis B, Hepatitis C, bacteria and expiry. The Indian Bio-medical waste (BMW) rules [2] require that these units be disinfected prior to disposal. The options for disinfection can be either incineration, chemical disinfection, autoclaving or microwave treatment. However, poly vinyl chloride (PVC) content of blood bags discourages incineration due to the release of environmentally hazardous chemicals like dioxins and furans. Chemical disinfection of blood bags has limitations of volume available for the addition of disinfectant (not more than 35 ml) since the PVC blood bag generally contains 400 mL blood and 65 mL of anticoagulant, citrate phosphate dextrose adenine (CPDA) solution. The addition of excess disinfectant seems impractical and not feasible.

The main objection to the autoclaving of sealed PVC bags is the level of the penetration of steam. The liquids in sealed containers can be sterilized by steam but blood is coagulated by heat and therefore adequate steam is unlikely to be generated in the sealed bag. In addition, the temperature achieved in the blood bag kept in autoclave has been reported to be lower than the set temperature of the autoclave. Due to these limitations, blood bag disinfection requires prolonged treatment of 2-3 hr [3].

Sterilization of blood bags by microwave technology is a promising concept. Microwaves are non-ionizing electromagnetic waves with frequencies between 0.3 and 300 GHz (i.e., with wavelengths from 1 meter to 1 millimeter, respectively). When irradiating living organisms, microwaves produce two types of effects: *thermal* and *non-thermal*. Thermal effects are the consequence of absorption of microwave energy by cell molecules, causing them to vibrate much faster and producing general heating of the cell (4). The disintegrating effect of microwave irradiation is time-dependent, where the intensity of the cell wall damage is proportional to the total absorbed microwave energy. The extent of microwave absorption within a cell depends on its dielectric constant and electrical conductivity (4). The concept of non-thermal effects of microwaves came from experiments in which bacterial cultures were to a large extent destroyed by microwave-induced heating as compared to other heating methods producing the same working temperature (5).

It has been shown that microwaves (2.45 GHz and 700 watts for 10 minutes) can be used for efficient decontamination of liquid wastes including blood bags [6, 7]. In scientific literature, microwaves have been demonstrated to efficiently decontaminate liquid waste including blood containing several pathogenic microorganisms, such as:

- **Virus:** Hepatitis A⁸
- **Bacteria:** *S.aureus*⁷, *Salmonella* sp.⁷, *E.faecalis*⁷, *K.pneumonia*⁷, *P.aeruginosa*⁷, *E.coli*⁷, *Streptococcus* Group B⁷, *Bacillus* sp.⁷.
- **Fungus:** *Candida albicans*⁹

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