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Techno-economic evaluation of a solar sterilizer

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ABSTRACT

In present energy crisis scenario it has become necessary to exploit new and renewable energy sources which are available at almost negligible cost. For efficient utilization of solar energy paraboloidal solar collector having aperture diameter 1.3 m depth 0.30 m and focal length 0.35 m was tested for sterilization process. The sterilization temperature 121^{0}C and corresponding pressure 1.05 kg/cm^2 for 15 min was achieved within an hour under bright sun shine period. The solar sterilizer inactivates and inhibited the growth of microorganisms in test tube culture media. The surgical instruments, test tube culture and more than 100 syringes were sterilize in a batch of solar sterilizer. The microbiological test suggested no growth of any environmental microbes over solid and liquid culture media. The system may therefore, be useful for rural hospitals where problems of non-availability of conventional fuels is faced very often. The solar sterilizer therefore, can be integrated in rural energy system for sterilization of surgical instruments and syringes. The economic analysis suggested that the system is economical and the benefit cost ratio for solar sterilizer were found to be 3.03, 3.06 and 2.25 for kerosene, firewood and electricity equivalent respectively.

Key words : Sterilization, Microbiological test, Temperature, Solar, Evaluation.

INTRODUCTION

Sterilization is a process in which the material is made free from micro-organisms including spores. The threat of highly communicable diseases such as AIDS and Hepatitis B can lead to suspicion of inoculation campaigns among the residents of developing countries. Fear of transmission of diseases by reused syringes may cause such campaigns to falter and development of "On spot" disposable syringes is now underway. Such an campaign is much more expensive than reuse of conventional syringes by onsite sterilization. But on site sterilization is only available at regional centres and not in small villages.

In addition there exist a separate problem of poor sterilization in which medical instruments are sterilized in a hot water bath at around 90^{0}C temperature for 15-20 minutes. Such poor sterilization method of surgical instruments are adopted during the child birth in remote areas and small health centres.

Hospitals in rural India often face the problem of sterilizing surgical instruments due to erratic and late supply of electricity. The availability of conventional fuels like kerosene and LPG gas are quite erratic. In perfect sterilization, steam temperature of 121^{0}C and corresponding pressure 1.05 kg/sq.cm is maintained for 15 minutes (Dey *et al.*, 1978).

In bacteriological work, sterilization is obligatory for the study of bacteria from a culture medium free from any contamination. As the temperature required for sterilization is in between 100 and 121^{0}C therefore, solar energy is an ideal source for sterilization in rural hospitals and in laboratory study. A focussing type parabolic solar collector was tested for both energy transfer performance and killing ability of the micro organisms. The solar sterilizer was found useful in sterilization of surgical instruments in rural hospitals (Mehdi *et al*. 1976, Singhal *et al*. 1990, Mills *et al*. 1991). Viewing to these essential tasks, there is need to develop a reliable, efficient and conventional device especially renewable energy type which can be available at village level and can be integrated in present energy system. Therefore, study was undertaken to develop a focusing type solar collector for efficient utilization of solar energy for sterilization and its performance was tested for no load, full load and microbial testing.

Solar sterilizer is very cost effective alternative to disposable syringes and for sterilization of surgical equipments.

The economic feasibility of any solar system includes various aspects of techno-economic analysis in terms of life cycle saving, internal rate of return, cost saved in energy, payback period, and benefit cost ratio.(Jain *et al*.1988.

MATERIALS AND METHODS

The solar sterilizer basically consists of a paraboloidal dish and a conventional autoclave which was placed at

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