Honorable Mention

BOX-TYPE SOLAR COOKER FOR DISINFECTION

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DESIGN CONCEPT

The box solar cooker is made of galvanized aluminium sheets. It is mainly divided into two sections, the upper cover and the lower box. The upper cover holds the reflecting mirror, which is supported by the wooden ribs. The lower box has a fitting of the electric heating arrangement which consists of indicator lamps, thermostat and heating elements. The main heating area is painted black and has the capacity to hold the metal box as was used in our study. The lower box also has a lining of glass wool in the base to improve the insulation. A transparent glass sheet covers this lower area, which is lined with clips. A rubber lining covers the periphery of the box on which the glass cover rests.

The single reflector mirror facing the solar radiation reflects solar energy on the heating area of the box. The glass cover sheet lined with rubber lining and glass wool in the lower box help in raising the temperature. In our design we have included immersion of waste in water which is placed in the metal box. Water addition has improved the heat penetration of the waste.

The design is easily fabricated in India and currently used for cooking purpose. Earlier in the research studies solar disinfection has been used for drinking water and oral rehydration solutions as pointed out in the references.[1] The experimental work[2] and the field study carried out by us, confirms almost 7 log reduction of hospital bacterial pathogens such as staphylococci, E coli, Klebsiella, Pseudomonas in the solar cooker. Further studies need to be carried out. The aim of disinfection of biomedical waste should be to grossly reduce the vegetative bacterial and viral pathogens.

TECHNICAL ILLUSTRATION

The design at present involves disinfection of waste in a metal aluminium box which is further placed in a box type solar cooker. The volume handled at present is around 10 litres.

[1] (a) Reed RH, Mani SK, Meyer V. Solar photo – oxidative disinfection of drinking water : preliminary field observations. Lett. Appl. Microbiol. 2000; **30(6):** 432-36. (b) Rijal GK, Fujioka RS. Synergistic effect of solar radiation and solar heating to disinfect drinking water resources. Water Sci. Technol. 2001; **43(12)**: 155 – 62. (c) McGuigan KG, Joyce TM, Conroy RM, Gillespie GB, Elmore – Meegan M. Solar disinfection of drinking water contained in transparent plastic bottles: charecterising the bacterial inactivation process. Appl. Microbiol. 1998; **84(6)**: 1138 – 48. (d) Conroy RM, Elmore Meegan M, Joyce T, McGuigan KG, Barnes J. Solar disinfection of drinking water and diarrhoea in Maasai children: A controlled field trial. Lancet 1996; **348(9043)**: 1695 – 97. (e) Joyce T, McGuigan KG, Elmore Meegan M , Conroy RM. Inactivation of faecal bacteria in drinking water by solar heating. Appl. Environ. Microbiol. 1996 ; **62(2)** : 399 – 402. (f) Unicef Regional Office Middle East N.Africa 1984. Solar disinfection of drinking water and ORS. Guidelines for household application in developing countries.

[2] Manuscript of study has been sent for review process to a journal.

However, it can be increased to 20 liters by designing larger box solar cookers or using two units at a time.

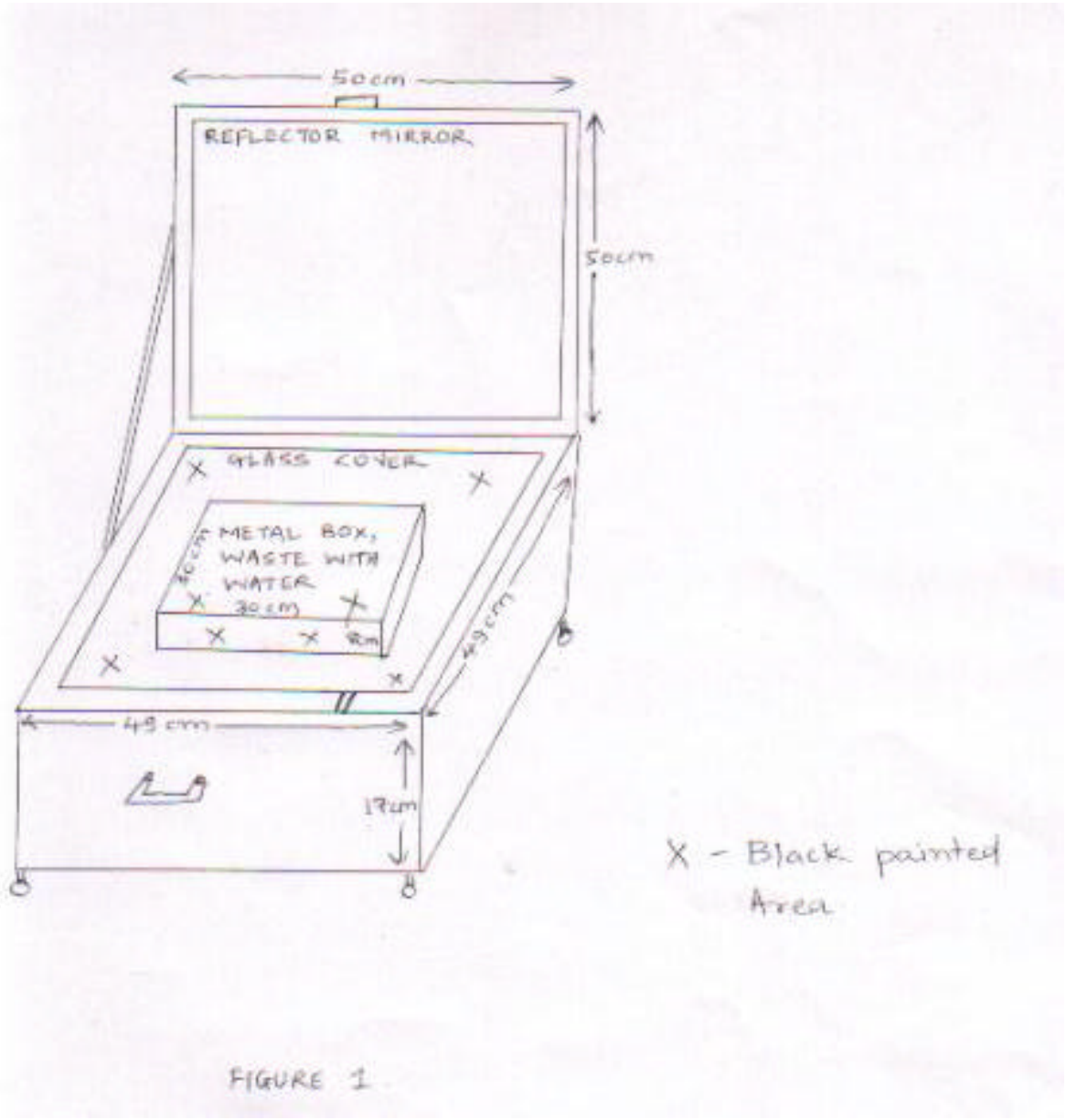

FIGURE 1

BASIC STEPS FOR CONSTRUCTION

The technology can be made with readily available materials. The items required are glass wool, aluminium sheets, wood ribs, mirror, supporting rod, wheels, aluminium ribs, transparent glass cover, electrical heating elements, electrical plug, black board paint and thermostat. The electrical heating arrangement is provided only to ensure the job during rainy season or cloudy days. The electrical attachment requires power supply of 220 Volts

and the electrical consumption is equivalent to 1000 watt. The temperature attained with the heating arrangement could be set between 70 to 110 ^{0}C using a thermostat.

The design requires basic skills like electrical arrangements, mechanical cutting and fitting of sheets; fabricating facilities are available in the poor developing countries. The design can be fabricated in a time of 2 weeks. The maintenance and repair should not be a problem and could not take more than 2 days.

OPERATION

The operation is very simple and a nursing assistant or a ward boy could be trained for the job. The box solar cooker is placed on a high rise building top or open in the ground where plenty of sunlight is available. Preheating of box solar cooker with metal box is started at 7 AM in the morning by facing the reflector mirror in the direction of sun. At 10 AM the waste is added to the metal box and filled with water till the waste is immersed. Maximum 5 liters of water is used, not necessarily potable water. Expose the waste from 10 Am to 4 PM. The direction of the reflector mirror is changed every two hours to face the sun. After 4 PM allow the waste to cool. The water is drained in a sewer line. After disinfection in the solar cooker, the waste needles and sharps can either be buried in a cemented pit or can be sent for metal smelting operation. Glass could be sent for recycling. Plastic wastes and other wastes shredded and sent for recycling. The metal waste added to constructed cement pit or sent for smelting. The biodegradable waste could be buried in a trench.

In cloudy and rainy days the electrical heating system can be used. At 9: 30 AM start heating by setting the temperature control knob of box solar cooker to 70^{0}C. Fill waste in the metal box and add water as above, rest of the procedure is same as above.

SAFETY PROCEDURES AND MAINTENANCE

The accessories like Industrial gloves, face mask and gown can be provided for safety of the worker. The box solar cooker has a glass cover as shown in the diagram that separates the infectious area from the worker. There is no question of over heating. A thermostat is available in the electrical heating arrangement. The solar arrangement maximum attains temperature around 110^{0}C, only in very hot areas like deserts the temperatures can be raised to 130 – 150^{0}C. For maintenance, daily cleaning and painting once in three months is adequate. Electric connections may be checked periodically. A chemical indicator system (chemical indicator tape) could be developed to monitor the temperature attained in the system. Bacteriological inactivation could be checked once or twice a month.