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Requirement of clinical waste autoclave in a healthcare institution: A mini-review

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Abstract:

A waste autoclave is essential for treating solid waste materials before disposing to the external environment. This can be done by the hospital itself (on-site waste treatment) or by a third party. Treatment of waste materials is based on the category of the waste and their disposal policy. Fundamentally, clinical waste autoclave mechanism is slightly different from the clinical autoclave that is used in the hospital sterile supply department. The clinical waste autoclave assures that the residual air in the chamber and waste liquids will be sterile before disposal. The objective of this article is to distinguish the clinical autoclave from the clinical waste autoclave so that the functionality and advantages of the waste autoclave in reducing environmental pollution by sterilising the waste materials and the effluents (e.g. aerosols and contaminated liquid) at the same time before draining or disposal is understood.

Keywords:

Cost involvement, maintenance, monitoring, sterilisation, waste autoclave

Introduction

The requirement of the clinical autoclave in a sterile processing department creates major importance for re-sterilising the costly medical devices for further use. The autoclaves are commonly situated in the Central Sterile Supply Department (CSSD) and in the laboratory in a health care institution. The autoclave is the only process (better than Ethylene oxide and Hydrogen peroxide gas plasma steriliser due to toxicity, penetration ability and cycle time and cost) where most of the medical devices are sterilised due to reliability and cost.[1]

The objective of this article is to highlight the requirement of the waste autoclave in a healthcare institution, where it is an important part of sterilising the clinical solid waste before delivering to the external agencies for disposal. The waste autoclave is situated in an isolated area that is away from the main hospital building to reduce environmental pollution.[1,2] There are various types of waste generated in a hospital such as human anatomical waste (e.g. body parts, placenta and tissues), biomedical waste (contaminated plastics, non-plastics and sharps), microbiological waste (culture plates, solid waste contaminated with blood and body fluids) and chemical waste (used in different laboratories). Only biomedical and microbiological waste need to undergo sterilisation before sending to the outsourced government recognised vendors. There are some stringent colour coding policies for each type of waste since their treatment and disposal policies are different.[3,4]

Differentiation between Clinical Autoclave and Clinical Waste Autoclave

In the CSSD, the instruments contaminated with blood and body fluids coming for the re-sterilisation purpose need to be cleaned and disinfected. Here, >90% of the bio-burden

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is reduced before sterilisation. Hence, the sterilisation processes are more effective in destroying microbial contamination rendering them safe for handling.

However, the materials handled by a waste autoclave are not used again, so there are no options to clean or disinfect them. Thus, the bio-burden levels of these materials are very high. As a result, when the first pre-vacuum pulse evacuates, the air from the chamber, the aerosols and contaminated liquids will be thrown into the drain as such without any decontamination. Thus, the drain is contaminated and if all the aerosols and contaminated liquid is coming out in this manner, it makes an adverse effect on the environment.

Mechanism of a Waste Autoclave

a. There are two options discussed where the first one is to use a filter between the vacuum pump and the chamber that prevents contamination of the drain. Here, the filter becomes part of the chamber and is itself sterilised during the cycle
b. The another option which we are using in our medical centre is to use of a 'secondary steriliser' that is situated between the chamber and drain so that aerosols and contaminated liquids pass through it and are sterilised before draining. During the vacuum phase in the pre-vacuum steriliser the effluents are evacuated through an ejector driven by high pressure and temperature of steam. There is a chamber outlet port that is connected with a jet-pump through a valve where another outlet of jet pump is connected with a long mixing tube that ensures a sufficient exposure time. The tube length is calculated by steam supply/velocity and jet pump capacity with temperature and time. During the sterilisation time, the condensate port is completely closed and the effluents are sterilised in the mixing tube at the same time and temperature as the load itself. Finally, the steam-effluent goes to the heat exchanger that decreases the effluent temperature before draining[5] [Figure 1].

However, before loading of the autoclave cart, it has to be ensured that all waste materials are wrapped by double plastic (polypropylene) bag and materials are sufficiently wet for steam production by itself, during sterilisation [steam cannot penetrate plastic; thus, the waste materials remain unsterile if they are dry].[4,6]

Maintenance of a Waste Autoclave

Maintenance of a waste autoclave should be proper, and the chamber should be cleaned enough so that residues of debris do not get accumulated anywhere. Supply of electricity, compressed air and water should be uninterrupted during operation. The person involved in the operation should have sufficient knowledge and use proper personal protective equipments before handling the contaminated materials. The waste reservoir bag should be replaced once it is 3/4th full for high vacuum and safe handling of waste materials. The hospital infection control team may look after all the procedures connected with this equipment and make a report for submitting to the prescribed authority every year.[7]

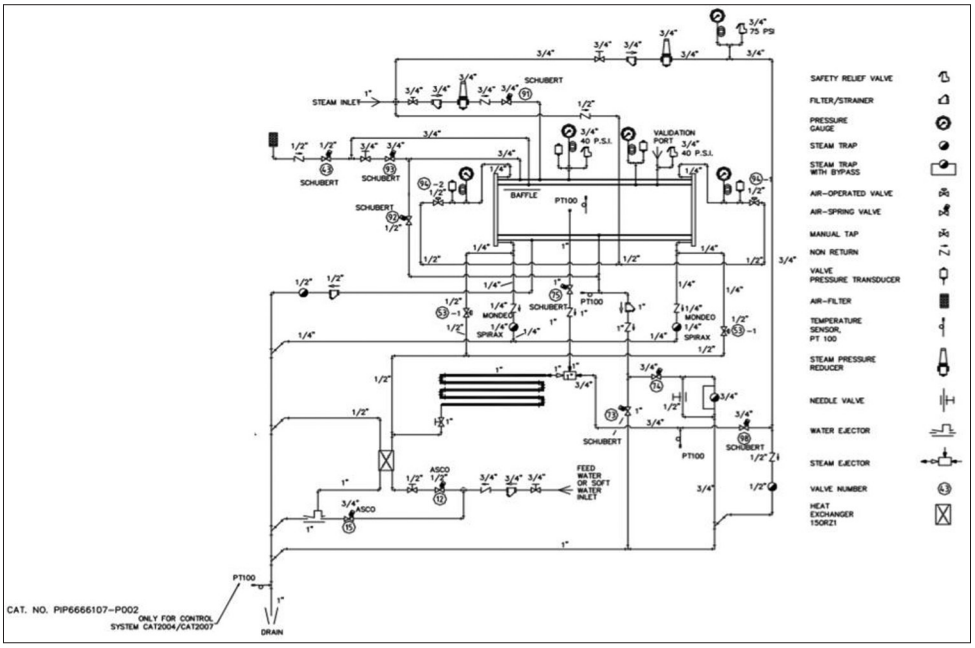

Figure 1: Schematic diagram of a clinical waste autoclave

Table 1: Running cost of a waste autoclave cycle per year at Tata Medical Center, Kolkata

Description (15 cycle run per week)	Cycle wise consumption	Cost per cycle (INR) (USD)	Monthly cost (INR) (USD)
Polypropylene bag for one cycle (required 12 bags for one cycle)	Rs. 5.00 × 12 pcs/cycle	60 (0.92)	3600 (55.38)
Electricity cost	5.5 kw/cycle	28 (0.43)	1680 (25.84)
Water cost	185 l/cycle	45 (0.69)	2700 (41.53)
Quality control cost- chemical indicator	Rs. 15.00 × 2 pcs/cycle	30 (0.46)	1800 (27.69)
Quality control cost- biological indicator	Rs. 120.00/week	12 (0.18)	720 (11.07)
Comprehensive maintenance contract cost		122 (1.87)	7320 (112.61)
Depreciation cost		300 (4.61)	18,000 (276.92)
Total cost (per month)		597 (9.18)	35,820 (551.07)
Total cost (per year)			429,840 (6612.84)

Routine Quality Monitoring

For quality control of the waste autoclave the same procedure should be followed, just as maintained in CSSD such as mechanical, chemical and biological monitoring. Mechanical monitoring is depending on gauze glasses (e.g. time/temperature), and automated printout system, where chemical monitoring is depending on chemical indicators as a simulator. Biological monitoring can be done at-least-weekly so that they measure the sterilisation process directly by using the most resistant microorganisms is (e.g. *Bacillus stearothermophilus*) and can monitor the lethality of a given sterilisation process.[6,8]

Running Cost of a Waste Autoclave

The attributable cost of a waste autoclave cycle includes the cost of electricity and water, cost of the non-chlorinated plastic bag, cost of quality control and the cost of equipment depreciation [Table 1]. In our 190 bed cancer centre in Eastern India nearly 3500–4000 kg of solid waste (e.g. culture plates, culture broths, blood culture bottles, mycobacterium spp. cultures, blood bank waste [blood bags], non-conforming blood component units) are treated in the waste autoclave every month which is also an additional quality indicator in our hospital for providing safe and healthy environment. The operational cost of a waste autoclave is quite high (with the running cost of waste autoclave per year being approximately Rs. 429,840.00) that makes an appreciable difference in the yearly budget [Table 1].[8,9] This is offset by the reduction in environmental hazard that it provides. State pollution control boards are already insisting on decontamination and this is a feasible solution to be thought of at the inception of the hospital itself.

Conclusion

Requirement of the waste autoclave in any healthcare institution is of great importance in avoiding environmental pollution. The waste autoclave (also called thermal effluent sterilisation system) ensures an effective and safe sterilisation of air, aerosol and liquids by destroying the biologically harmful elements of the waste. This can only be possible (achieved) when regular monitoring of physical, chemical and biological indicators are performed satisfactorily for validating the equipment to assure the sterilisation processes. Every hospital should have a waste autoclave to ensure that whatever they regularly dispose as waste gets treated before to protect environment and healthcare workers.

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Conflicts of interest
There are no conflicts of interest.

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