Autoclaves and their use for Biohazardous Waste

Autoclaves are sealed containers that heat water vapor to high temperatures in order to sterilize objects that might harbor biological hazards. When used properly, an autoclave can purify a device or container of any biological contaminants such as bacteria, mold and viruses.

Autoclaves operate on the principle that pathogens, like all organic matter, can be killed by prolonged exposure to high temperatures. This was first seized upon by Louis Pasteur, who developed a way to prevent wine from spoiling by briefly heating it almost to its boiling point. The high temperatures cause proteins and other building blocks of life to disintegrate or reconstitute, thus killing microbial organisms that might spread disease.

Autoclaves are often compared to pressure cookers because they often operate at very high internal pressures. This is because when water becomes steam it follows the Ideal Gas Law, which dictates that the pressure and volume of a gas are directly proportional to its mass and temperature. When water is heated to above 100 degrees Celsius in a confined volume, the pressure within the autoclave quickly increases. The increased pressure also forces more thorough contact between the heated steam and the object being sanitized.

The advantage of having extremely hot steam within an autoclave is that the high temperature and high pressure drastically increase the rate of exchange of thermal energy. As a result, items sterilized in an autoclave will have foreign microbial matter die much sooner than by other methods. Because different organisms are more resilient than others, microbes are referenced as having a thermal death time, or TDT, that should be observed to guarantee sterilization in an autoclave.

Once the chamber is sealed, all the air is removed from it either by a simple vacuum pump (in a design called pre-vacuum) or by pumping in steam to force the air out of the way (an alternative design called gravity displacement). Next, steam is pumped through the chamber at a higher pressure than normal atmospheric pressure so it reaches a temperature of about 121–140°C (250–284°F). Once the required temperature is reached, a thermostat kicks in and starts a timer. The steam pumping continues for a minimum of about 3 minutes and a maximum of about 15-20 minutes (higher temperatures mean shorter times)—generally long enough to kill most microorganisms. The exact sterilizing time depends on a variety of factors, including the likely contamination level of the items being autoclaved (dirty items known to be contaminated will take longer to sterilize because they contain more microbes) and how the autoclave is loaded up (if steam can circulate more freely, autoclaving will be quicker and more effective).

When sending Biohazardous waste to be autoclaved or prior to loading the autoclave, the bag should have at least an inch opening at the top. The bag cannot be tightly sealed. The steam must be able to penetrate the bag and reach the materials within the bag and the pockets residing between the materials. If the bag remains tightly sealed it is unlikely the autoclave will have an effective cycle. The cycle times depend on the equipment and the material being processed. Cycle times for different machines needs to be validated. The Massachusetts Department of Public Health requires validating autoclaves used for treating Biomedical and Biological Waste on a quarterly basis. Cycles can run from 45 minutes to 90 minutes depending on the autoclave. Be sure to verify the effectiveness of the equipment being used for an effective "kill time". Clear bags should be used for the waste. Once "treated" by the autoclave it is considered non-infectious and can be disposed of as regular trash in the dumpster. The red-bag with the BioHazard symbol is used for shipping out infected waste by a vendor authorized for such shipments.

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