1. THE HYDROCLAVE PROCESS – AND HOW IT WORKS

The Hydroclave is essentially a double-walled (jacketed) cylindrical, pressurized vessel, horizontally mounted, with one or more side or top loading doors, and a smaller unloading door at the bottom. The very small Hydroclave units have a single side door for both loading and unloading.

The vessel is fitted with a motor driven shaft, to which are attached powerful fragmenting/mixing arms that slowly rotate inside the vessel.

When steam is introduced in the vessel jacket, it transmits heat rapidly to the fragmented waste, which, in turn, produces steam of its own.

A temperature sensor is located in the bottom inside part of the vessel, which measures the temperature of the waste as it is agitated and mixed, and this sensor reports back to the main computerized controller, which automatically sets treatment parameters ensuring complete waste sterility – even liquid infectious waste.

After sterilization, the liquid but sterile components of the waste, are steamed out of the vessel, re-condensed and drained to sewer. The remaining waste is dehydrated, fragmented, and self-unloaded via a reverse rotation of the mixer/agitator.

In summary, the Hydroclave:

- Sterilizes the waste utilizing steam, similar to an autoclave, but with much faster and much more even heat penetration.
- Hydrolyzes the organic components of the waste such as pathological material.
- Removes the water content (dehydrates) the waste.
- Breaks up the waste into small pieces of fragmented material.
- Reduces the waste substantially in weight and volume.
- Accomplishes the above within the totally sealed vessel, which is not opened until all waste it totally sterile.

There is no correlation between waste characteristics and treatment efficacy. All the waste is consistently sterilized.

Liquid and heavy loads, however, will take somewhat longer to reach the temperature and pressure required to initiate the sterilization cycle, but sterilization automatically occurs.

There is no need for “pre-and post-vacuum”, that is, pull infectious air and liquids of the vessel, as is the case with autoclaves. Pulling air and liquids out of an infectious environment increases the risk of live pathogen emission.

The Hydroclave eliminates this risk due to the vigorous dynamic activity within the Hydroclave, which mixes and heats any entrained air with the steam and waste material.

2. DETAILED DESCRIPTION OF THE TREATMENT CYCLE

a) Loading

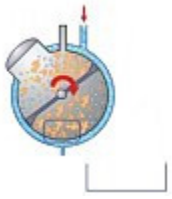
The waste can be loaded into the Hydroclave treatment vessel by various means, depending on your requirements:

- in smaller units dropping the waste bags manually into a side or end door.
- In medium-sized units by tipping waste containers into top or angled loading doors. Electric or hydraulic tipping devices are an available option with the Hydroclave.
- In medium to large sized units, for large scale commercial operation, a combination of conveyors, hoppers and tippers are available to load the waste into large top loading doors.

The Hydroclave can be fitted with loading doors to suit your requirements, from small side doors to multiple angled or top doors, which are sized to accommodate your infectious waste stream - small doors for bagged biomedical waste, to very large doors for disinfecting large objects such as large animal carcasses.

No special operator skill is required, since over-loading or loading too tightly is not an issue with this type of process.

b) Heat-up and fragmentation



After loading, the vessel doors are closed, and the outer jacket of the vessel is filled with high temperature steam, which acts as an indirect heating medium for heating the waste.

The jacket steam condenses into clean, hot condensate, which is returned back to the steam boiler. This unique feature makes the Hydroclave so efficient in operation – no steam or hot condensate is lost.

During heat-up, the shaft and mixing arms rotate, causing the waste to be fragmented and continuously tumbled against the hot vessel walls.

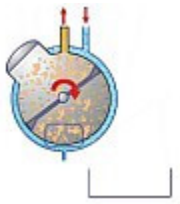
At this point, the waste is broken up into small fragments, and all material heats up rapidly, being evenly and thoroughly exposed to the hot inner surfaces. The moisture content of the waste will turn to steam, and the vessel will start to pressurize.

Initially, no steam will be injected into the waste. If there is not enough moisture in the waste to pressurize the vessel, a small amount of boiler steam is added until the desired pressure is reached.

The uniform jacket heat, and the location of the temperature sensor ensures that even liquid waste will be heated up uniformly.

At the end of this period, the correct sterilization temperature and pressure are reached, and the sterilization period is initiated automatically.

c) Sterilization period



By computer or PLC control, the temperature and pressure are maintained for the desired time to achieve sterilization. If for any reason the sterilization parameters drop below desired levels, the sterilization cycle is stopped, and re-initiated. This ensures sterilization prior to commencement of the next stage.

The mixing/fragmenting arms continue to rotate during the entire sterilization period, to ensure thorough heat penetration into each waste particle.

As independently tested by the University of Ottawa, Dept. of Microbiology, a sterilization time of 15 minutes at 132 C., or 30 minutes at 121 C. achieves 6log10 inactivation of the spores of bacillus stearothermophilus.

The intense subjugation of the waste to such temperature and pressure moisture in a dynamic environment will also cause the waste to hydrolyze, that is a rapid decomposition of organic waste material.

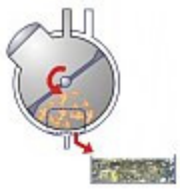
d) De-pressurization and De-hydration

After the sterilization period ends, the vessel is de-pressurized via a steam condenser, which causes initial waste dehydration due to depressurization.

The steam to the jacket will remain on, agitation continues, and the waste loses its remaining water content through a combination of heat input from the jacket and continued agitation.

All waste, no matter how wet initially, even liquid waste, will be dehydrated by this process.

e) Unloading



At the end of the depressurization/dehydration period, jacket steam is shut off, the discharge door is opened, and the powerful mixing arms are reversed to a clockwise rotation.

Due to the unique construction of the mixing arms, the opposite rotation causes the fragmented waste to be pushed out of the vessel discharge door, into a waste container, or onto a conveyor.

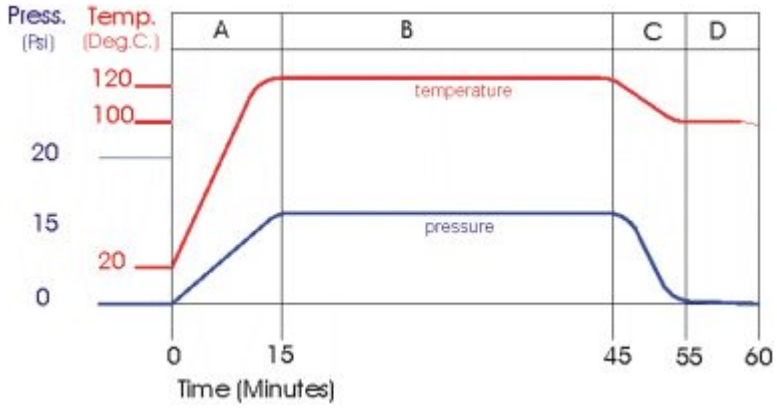
If desired, the waste can be further fine-shredded prior to final disposal, by a separate shredding system. The dry, sterile, fragmented waste is well suited for further fine shredding.

The vessel is now ready for another treatment cycle, having retained most of its heat for the treatment of the next batch.

3. GRAPH OF THE TREATMENT CYCLE

Below is a typical graph of the Hydroclave treatment cycle. The time for heat-up, depressurization and dehydration may vary somewhat with the different Hydroclave models, and with the liquid content of the waste. However, sterilization time is always the same, regardless of waste load and waste characteristics.

A: Heat-up
B: Sterilization
C: Depressurization
E: Dehydration



4. AUTOMATIC PROCESS CONTROLS

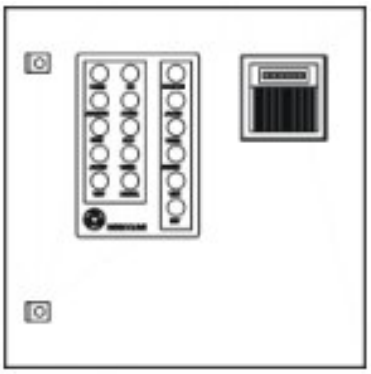
Safety and Operating Features
An essential part of safe, consistent waste sterilization is the automation and safety features provided by the Hydroclave control system.

The entire cycle is computerized, PLC controlled, with all essential operating parameters locked in and password protected.

For documentation of a treatment cycle, a two-pen printer/recorder is normally included, providing a hard copy of essential data such a temperature, pressure, treatment time, date, and batch. Furthermore, this data can be exported via Rs232 port to an external computer, and integrated with other data, such as waste source and weight.

As a safety feature, should any of the automatic features of operation fail, the operator is still able to go through a complete cycle in the manual mode.

The control panel is normally fitted with the following features:



1. Jacket steam pressure gauge
2. Vessel steam pressure gauge
3. Power "on" light
4. Auto/manual switch
5. Manual jacket valve on/off switch
6. Manual vessel valve on/off switch
7. Manual drive activation switch.
8. Automatic mode "start" pushbutton
9. Open door warning light
10. Jacket steam light
11. Vessel steam light
12. Sterilization indicator light
13. Two pen strip chart recorder.
14. Digital temperature and pressure display