

## Applicability of alkaline hydrolysis at medical waste

Although definition of medical waste (MW) is not universal and relatively variable worldwide, it can be defined as “all the waste generated by healthcare establishments, research facilities and laboratories”. This waste is a small fraction of total solid waste produced but it requires special attention due to the danger it represents to public health and environment. The majority of MW, of about 75 – 90 % is not infectious, thus can be treated as municipal waste posing no additional risk to health or the environment. The remaining 10 – 25 % is classified as hazardous waste, and it is the fraction that requires special attention and specific treatments.

There are several MW treatment processes and among them the autoclaving and incineration are the most used. Nevertheless, these processes demand high investment and exploration costs and are not appropriate to treat small quantities of MW.

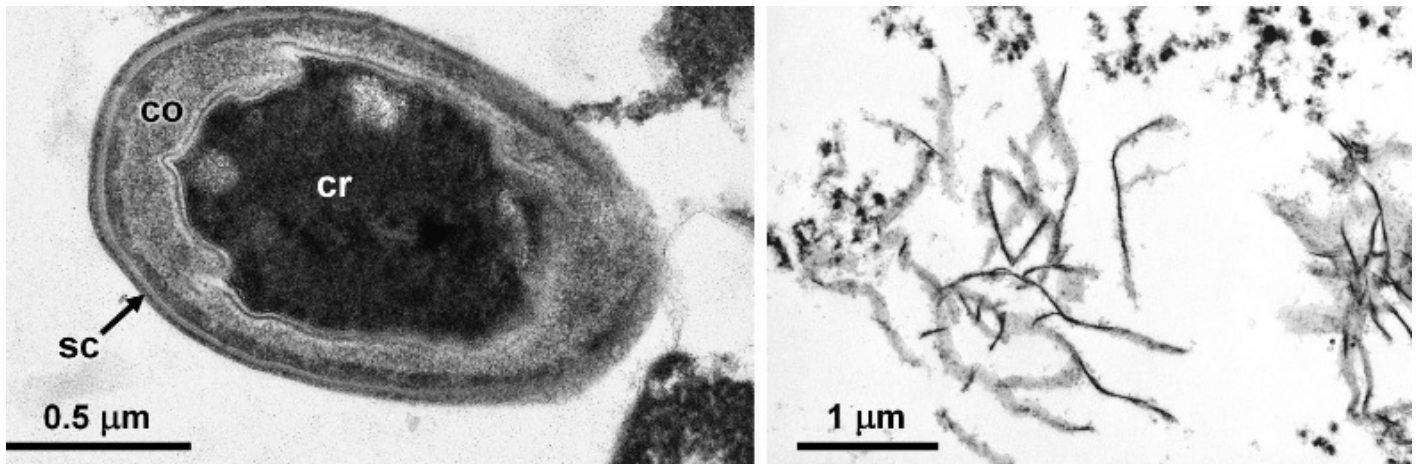


Fig. 1. TEM images of *Geobacillus stearothermophilus* before and after alkaline treatment (sc, spore coat; co, cortex; cr, core).

Alkaline hydrolysis may be an alternative disinfection/sterilization process for infectious MW. This treatment has shown to have significant advantages compared to other treatments, because it sterilizes and destroys at once, and it also reduces the total waste volume. Also, alkaline hydrolysis may have a range of application larger than autoclaving, since it can also accept organic tissues. Alkaline hydrolysis proved to be effective on inactivation of Creutzfeldt-Jakob disease (CDJ) agent, 22A strain of scrapie agent, prion decontamination, and inactivation of potentially infectious agents including virus, bacteria, fungi and protozoa.

In our study, the effective minimum sterilization conditions using alkaline hydrolysis as MW treatment and the very resilient biological indicator *Geobacillus stearothermophilus*, were evaluated. These bacteria comprise low G+C Gram-positive, thermophilic non-pathogenic

organisms, and their spores are one of the most heat and chemical agents resistant. Therefore, the spores of this organism are often used as a biological indicator to assess the effectiveness of sterilization methods.

The effect of alkaline treatment on the degree of *G. stearothermophilus* spores inactivation at three temperatures (80 °C, 100 °C and 110 °C) and different sodium hydroxide concentrations were studied. Also, the behavior of spores with materials common in MW (discarded medical components, i. e., cotton, diapers, tubes for transfusion, surgical gloves, examination gloves, adhesives, surgical masks, bag collectors for urine, serum bottles and syringes) and with animal tissues (pork meat and pork bone) was evaluated.

The survival curves, obtained when the *G. stearothermophilus* spores were exposed to alkaline conditions, exhibited biphasic curves with a slope tailing. These curves show the existence of two fractions or sub-populations with different resistance to stressful conditions. The first fraction corresponds, most probably, to the inactivation of the less resistant spores and the second of the more resistant ones.

As expected, increasing NaOH concentration, for each temperature tested, the inactivation time of *G. stearothermophilus* spores decreased as well as when temperature is increased above 100 °C. The differences for inactivation time with treatment between 80 °C and 100 °C were not significant. The complete inactivation of spores, i.e. sterilization, was achieved after 5 min at 110 °C and 1 M NaOH solution. In the presence of animal tissues and discarded medical components the time required for the complete inactivation of spores was not much longer than that needed in their absence.

These results suggest that alkaline treatment may be implemented as a disinfection or sterilization alternative method with advantages for small quantities of infectious medical waste.

## **Publication**

[Inactivation of \*Geobacillus stearothermophilus\* spores by alkaline hydrolysis applied to medical waste treatment.](#)

Pinho SC, Nunes OC, Lobo-da-Cunha A, Almeida MF  
*J Environ Manage.* 2015 Sep 15