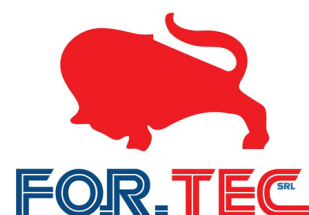


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MICROWAVE STERILIZATION FOR HOSPITAL WASTE

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FORTEC is an Italian company with **over 50 years of experience** in solutions for thermal waste treatment, cremation, and the controlled management of thermal processes. We design and **manufacture every key component in-house**, from steel structures and refractory linings to electrical panels and control systems, an advantage that ensures a **truly Made in Italy product**, full control over quality and lead times, and more effective customer support.



Each plant is developed to customer specifications, tested before delivery, and supported by dedicated sales teams for both the Italian and export markets. We also have a technical team that supports customers during **on-site commissioning worldwide**, along with a **remote assistance system** that bridges distances, enabling rapid interventions and expert support directly from our headquarters.



FTS – Integrated Microwave Sterilization and Disinfection System for Medical Waste

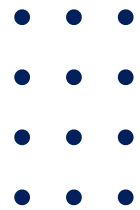
General Introduction The FTS model represents a technologically advanced solution for the **on-site treatment of infectious medical waste**. Entirely engineered and manufactured by FORTEC, the system employs a combined action of **high-speed mechanical shredding, saturated steam injection, and high-frequency microwave irradiation** to ensure deep, effective sterilization in full compliance with the highest international standards.

The entire process is conducted in a sealed and **fully automated environment**, preventing any emission or environmental contamination. The system is specifically designed for hospitals, laboratories, clinics, and public or private healthcare facilities seeking a safe, certifiable, and in-house solution for the management of biohazardous waste.

1. Operating Frequency and Disinfection Mechanisms The FTS system operates at $2,450 \pm 50$ MHz, a standardized industrial frequency within the ISM (Industrial, Scientific, Medical) band. This frequency is widely adopted in disinfection and sterilization devices due to its deep penetration capability into organic materials and its proven efficacy in the inactivation of bacteria, viruses, fungi, and spores. The effectiveness of the process is attributed to three synergistic mechanisms:

1.1 Thermal Effect (Dielectric Heating) Microwaves primarily interact with polar molecules such as water, generating volumetric heating caused by the forced rotation of molecular dipoles in a high-frequency alternating electric field. This interaction creates internal molecular friction, resulting in a rapid and uniform increase in temperature throughout the treated waste mass.

1.2 Non-Thermal Effects (Biological and Electrophysical) Microwaves also exert direct cellular action, independent of heat, known as non-thermal effects. These include: alteration of cell membrane permeability, modification of electrochemical potentials, and selective molecular resonance on enzymes and proteins, contributing to microorganism inactivation.



Processed Output from Hospital Waste Treatment
— FTS Microwave Sterilizer —



1.3 Combined and Synergistic Effects The high efficacy of the FTS system derives from the simultaneous interaction of: alternating electromagnetic fields, generation of oxidative free radicals via intracellular water activation, and optimized operating conditions including humidity, density, and waste type. These factors support certified **microbial inactivation up to $\geq 8 \log_{10}$** under validated conditions, including for spore-forming strains such as *Geobacillus stearothermophilus*, following protocols aligned with EN ISO 11138 and WHO technical guidelines

2. Description of the Operational Process The FTS process is entirely enclosed and automated, eliminating any risk of exposure or release of biological agents. The plant features a compact yet modular architecture, suitable for indoor installation within healthcare environments.

Process Steps:

1. Manual or automatic loading of healthcare waste into suitable containers.
2. High-speed mechanical shredding.
3. Controlled injection of saturated steam.
4. Microwave irradiation via waveguide.
5. Simultaneous internal/external thermal treatment.
6. Cooling and optional compaction of the treated material.

3. Emission Treatment System During the sterilization process, vapors and gases may be released, including moisture and volatile organic compounds (VOCs). The FTS system manages these emissions through a negative-pressure extraction circuit that includes: mechanical pre-filtration, HEPA filtration, UV-C photolysis, and activated carbon filtration. This ensures full compliance with local and European environmental regulations.

4. Distinctive Technical Features and Operational Advantages

· High-efficiency sterilization (up to $8 \log_{10}$), validated with certified biological indicators.

- Fully sealed and safe cycle, free of microbiological emissions.
- Construction in stainless steel AISI 304
- Industrial PLC Siemens-based control system with HMI interface.
- Low routine maintenance requirements.
- Significant reduction in treated waste volume.
- Seamless integration within hospital infrastructures.
- Certified under ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018.

Conclusions The FTS system by FORTEC is a modern, safe, and regulation-compliant solution for the management of infectious medical waste. Designed to ensure maximum environmental protection and healthcare personnel safety, it represents a strategic choice for facilities aiming to internalize waste treatment, reduce operating costs, and enhance process traceability.

Furthermore, the FTS technology is aligned with WHO recommendations for safe and sustainable healthcare waste treatment methods, promoting infection control, environmental safety, and occupational health through closed-cycle, high-efficiency sterilization systems.

