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Packaging Sterilization: Aseptic Filling Technology

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of the requirements for the degree of
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ABSTRACT

Xenos Ltd. is a technology driven food company, that specializes in aseptic processing and packaging beverage products in bottles. Their aseptic filling technology is based on packaging sterilization with combined treatments of oxidizing agents and Ultraviolet radiation. Recent research studies have suggested that there is a synergistic effect of hydrogen peroxide (0.5 – 1 %) plus UV on inactivation of microorganisms including spores. Advantages of the combined treatment include rapid inactivation, minimum hydrogen peroxide residue in products, with the method being applicable to a wide range of packaging types. Based on this principle, a unique aseptic packaging technique has been developed by Xenos Ltd., which utilizes the combination of vaporized Perform (a commercial sterilizing agent manufactured by Orica Chemnet containing 25% hydrogen peroxide and 5% peracetic acid) and UV radiation at 7.5 – 12.5 W/m².

The aim of the project was to improve and validate the effectiveness of the packaging sterilization process through challenge tests. Challenge tests were conducted using *Bacillus subtilis* spores as the test microorganism to determine the log reductions delivered by the packaging sterilization system. The tests were firstly carried out on a pilot plant scale aseptic filling machine, in order to test the sterility of the small scale system, and investigate processing parameters (operational conditions) which could

affect and improve sterility. The established operational conditions for achieving target sterility were used for designing and modifying an upgrade aseptic packaging system. Finally validation of the upgrade packaging sterilization system was conducted through challenge tests to prove sterility.

It is highly recommended that in order to ensure sterility, the packaging sterilization system with vaporized Perform plus UV treatment must meet the requirements listed below during the sterilization process:

- Hydrogen peroxide concentration of Perform condensate on bottles (after steaming) is best within 0.5 – 1 %;
- Perform loading level should be minimum 300 mg/bottle after vaporized Perform treatment;
- UV treatment time applied is greater than 2 seconds during UV treatment;
- At least 20 seconds of penetration time (time between Perform treatment and UV treatment) should be allowed.

The upgrade sterilization system used by Xenos Ltd. has been improved to meet the above operational conditions. With spore loading level of 10^6 per bottle and 10^5 per cap, the system is able to deliver at least a 6 log reduction of *B. subtilis* spores on PET or glass bottles and a 5 log reduction on bottle caps. Moruzzi et al. (2000) stated that at least a 4 log reduction is commercially required for an aseptic packaging process. Therefore, the system's sterility would meet the commercial acceptable sterility.