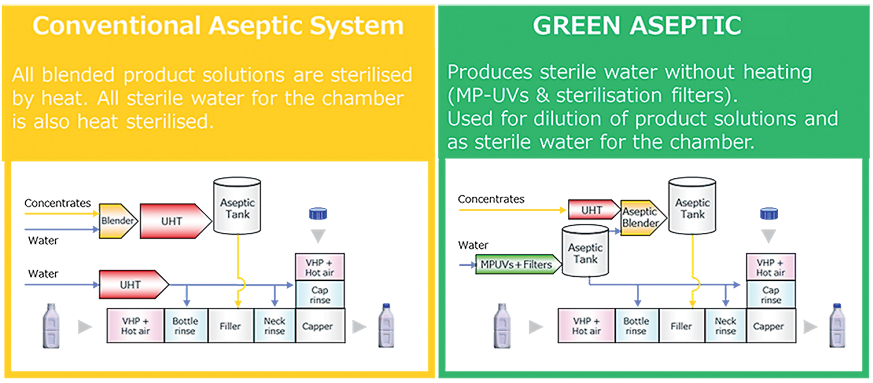
Aseptic filling system with non-heated water sterilisation

Water is the main ingredient in soft drinks. To achieve decarbonisation in soft drink production process, Dai Nippon Printing Co., Ltd. (DNP) has developed a new generation of Green Aseptic, a processing system for non-heat sterilisation of water.

DNP's PET bottle aseptic filling solution for low-acid beverages using non-heat sterilisation was installed at a major beverage producers' factory in Shizuoka Prefecture, Japan, with production starting in April 2024. Due to increased demand the new factory was built in March 2024 to produce soft drinks and provide warehousing facilities.

With the DNP system, the product concentrate is heat sterilised in a small UHT steriliser and diluted with non-heat sterilised, but sterile water. After being mixed in an aseptic blender, the product is filled with an aseptic filler. Compared to the conventional method of sterilising product liquids using UHT sterilisers alone, this new aseptic processing achieves approximately 80% decarbonisation and energy savings, said DNP. This new sustainable system is called Green Aseptic.



Comparison of aseptic PET filling systems

Green Aseptic

Mount Fuji's underground water is naturally filtered over a long period of time. The company uses this water as a raw material to produce clear, full-flavoured tea and mineral water. To make the tea, carefully selected tea leaves from Japan are steeped in hot water within an extractor to maximise the flavour and richness of the tea leaves. They are then sterilised in a small UHT steriliser and sent to an aseptic tank. High-temperature, short-time sterilisation in the UHT steriliser preserves the original flavour and colour of the teas.

Water is pumped up from approximately 180 m below ground and, after removing foreign matter, is sterilised using powerful UV lamps and sterilisation filters. DNP focused on Atlantium's HOD system, which uses medium-pressure UV lamps that have proven their worth as disinfection devices for raw water in beverage production. After repeated sterilisation tests in the laboratory, the lamps were modified to specifications for use in aseptic zones.

The sterilisation filters are automatically subjected to 'integrity testing' where the pore sizes of the filters are checked before and after production to ensure that sterility is not compromised, while maintaining the precise aseptic conditions. To further extend the life of the 0.1 µm sterilisation filters, DNP's F_0 solution has been installed, performing SIP on these filters, minimising the effects of thermal damage to the filters.

By combining these particular Atlantium medium-pressure UV lamps and customised 0.1 µm sterilisation filters, DNP produce sterile water for low-acid beverages in large quantities without heating.

UHT-sterilised tea extract and virtually carbon-free sterile water are aseptically mixed at a high dilution factor. Then 500 ml PET bottles are aseptically filled at 36,000 bph. All conventional heat-sterilised sterile water used for rinsing bottles, closures and chambers in the aseptic filling machine has been replaced by non-heated, sterile water.

Aseptic verification

Aseptic verification was carried out to determine whether the Green Aseptic system was as sterile as a conventional UHT steriliser. This verification was conducted on site by Aseptic Systems Co., Ltd. (APS), DNP's aseptic technology department. The method was to first heat sterilise a highly concentrated pH7 media broth in the small UHT steriliser.

Aseptic filler

Sterile water was produced by non-heat sterilisation using medium-pressure UV lamps and sterilisation filters. These were mixed in the aseptic blender and filled aseptically by filler. More than 10,000 media-filled bottles were incubated per test.

After one week of incubation at 30 °C, all bottles were visually inspected to ensure there were no spoilt bottles. This media fill test was carried out three times, and afterwards, all tests confirmed zero spoilage. These test results confirmed the confidence in Green Aseptic and allowed production to start, as planned, on April 1, 2024.

Creating future standards

The history of aseptic packaging began in the 1960s. The technology fills heat-sterilised products into sterilised packs in an aseptic environment. Products that cannot be heat sterilised are filtered and sterilised using a 0.2 µm sterilisation filter. However, 0.2 µm sterilisation filters have been reported to allow ultra-small and filterable bacteria to pass through.

DNP tested the UV resistance of these bacteria and found UV irradiation conditions that kill UV-resistant filterable bacteria at 12 Log or more. By combining medium-pressure UV lamps with 0.1 µm sterilisation filters, DNP successfully produced sterile water with the same level of sterility as conventional heat sterilisation without heating. This patented technology has enabled significant decarbonisation and energy savings in liquid processing equipment for low and high-acid beverages. DNP is committed to using its long-established aseptic technology to solve today's societal challenges and contribute to the realisation of a sustainable society.

www.dnp.co.jp/eng/group/aseptic-systems

MP-UV lamps and sterilisation filters