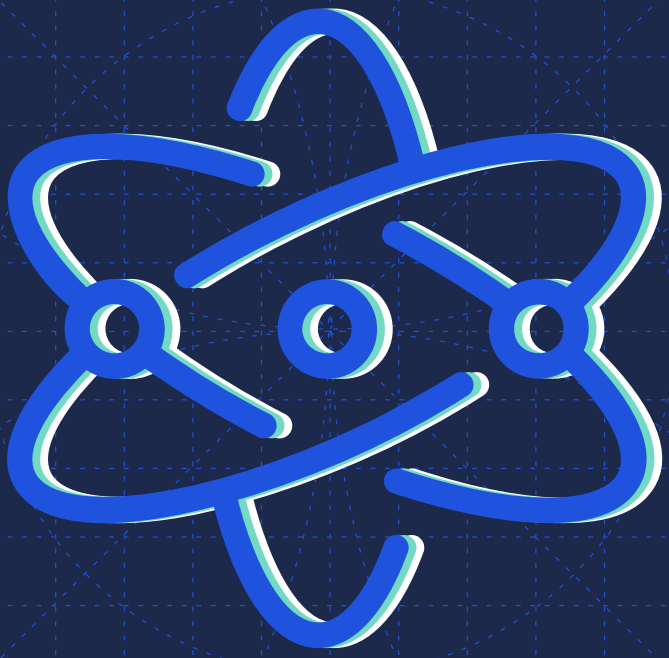
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Feed Water Degassing:

Membrane or Thermal?

White Paper

A comparison of the two technologies for Pure Steam and WFI Feed Water

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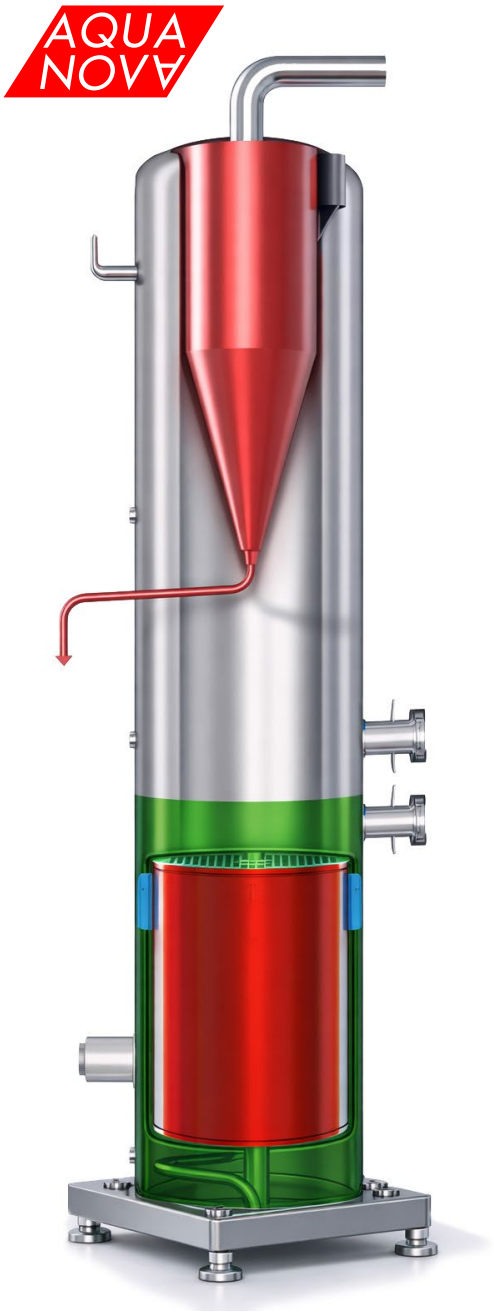
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Helena specialises in pharmaceutical sterilisation and powder handling, bringing extensive application expertise to complex processing challenges, from depyrogenation and drying to containment, dosing and bulk material handling.

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1. Context and Purpose



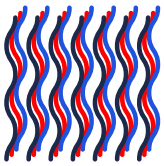
Pure Steam used for sterilisation must comply with the non-condensable gas (NCG) requirements of EN 285 and HTM 2010 — no more than 3.5% v/v of gas in the Pure Steam condensate. Where the feed water carries a meaningful dissolved gas load, a dedicated feed water degassing system is the most direct way to secure that compliance.

Gases dissolved in the feed water (CO_2, O_2, N_2) are carried into the Pure Steam during generation. Excess NCG impair steam penetration during sterilisation cycles and can lead to failed steam quality tests. Degassing the feed water addresses this risk at the source.

Two technologies can achieve this objective: traditional thermal degassing, and membrane degassing. Aqua-Nova systems are normally supplied with a membrane degasser as standard, but both technologies can be applied — Aqua-Nova can supply and integrate either one, and both are valid solutions. This white paper compares the two approaches in terms of service costs, robustness of gas removal and day-to-day operation, and explains why membrane degassing is our preferred and recommended solution for most Pure Steam and WFI applications.

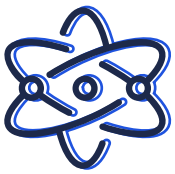
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2. The Two Technologies in Brief



2.1 Thermal Degasser

A thermal degasser keeps the feed water at boiling point (typically slightly above 100 °C, under slight pressure) in a steam-heated vessel. Gas solubility falls with temperature and the dissolved gases are vented with the exhaust vapours. It is a proven technology, but one that involves a continuously steam-heated pressure vessel with its accessories: safety valve, steam traps, level and pressure control.



2.2 Membrane Degasser (3M™ Liqui-Cel™ Technology)

A membrane degasser uses 3M hydrophobic hollow-fibre membrane contactors: the membrane lets gases pass while retaining water. Under vacuum (optionally assisted by a strip gas), dissolved gases cross the membrane and are extracted continuously, at ambient temperature, in a fully closed system and without chemicals. Properly dimensioned, this technology achieves very low residual levels — typically below 1 ppm CO_2 and O_2 levels in the ppb range.

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3. Service Costs: The Structural Difference

The difference in operating cost between the two technologies is not marginal: **it follows from their very nature.**

3.1 Periodic Statutory Inspections

A thermal degasser is a steam-heated pressure vessel. Depending on its classification (PED and the applicable national regulations), it is typically subject to mandatory periodic inspections by a notified body — commonly on a four-year cycle — as well as recurring testing of its safety valve. Each inspection carries a direct cost (intervention, preparation, documentation) and an indirect cost (equipment unavailability during inspection).
A membrane degasser operates at ambient temperature and contains no steam-heated pressure vessel: it is not subject to this regime of periodic notified-body inspections. This recurring cost item therefore does not arise.

3.2 Energy

A thermal degasser consumes heating steam continuously to keep the water boiling — and the degassed water, at over 100 °C, must often be thermally managed downstream. A membrane degasser operates at ambient temperature; its consumption is essentially limited to the vacuum pump. Over the life of the equipment, the difference in energy consumption is substantial.

3.3 Consumables and Field Experience

Membranes are, in principle, replaceable elements. Our field experience on this point is worth sharing: Sofinn has used this technology for six years, and to date no client has reported the need to replace a membrane. When replacement does eventually become necessary, it is a simple cartridge exchange — with no work on a pressure vessel and no heavy requalification.

To put this in perspective: the only significant consumable of the membrane degasser is the membrane cartridge itself, which has never yet had to be replaced in six years of operation across our client base. Over the same period, a thermal degasser would have undergone at least one full statutory inspection (notified body, preparation, equipment shutdown), in addition to its continuous heating steam consumption.

3.4 Routine Maintenance

A membrane degasser has no steam traps, no level control, no safety valve to have tested and no insulation to maintain. Routine maintenance comes down to monitoring the vacuum pump and simple performance checks (residual CO_2/O_2 measurement or downstream conductivity).

The table below summarises the comparison of service cost items:

Cost item	Thermal degasser	Membrane degasser
Notified-body inspections	Yes — pressure vessel: mandatory periodic inspection (commonly every 4 years) + safety valve testing	No — no steam-heated pressure vessel
Energy	Continuous heating steam; thermal management of degassed water	Ambient temperature; limited consumption (vacuum pump)
Consumables	Gaskets, steam traps, seals	Membrane cartridge — no replacement reported in 6 years of operation across our client base
Routine maintenance	Steam traps, level/ pressure controls, safety valve, insulation	Vacuum pump and simple performance checks
Inspection-related downtime	Periodic shutdowns for statutory inspection	No statutory shutdowns imposed

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4. Robustness of Gas Removal

Beyond cost, four design characteristics make membrane degassing particularly robust for removing dissolved gases — and underpin our recommendation:

- Fully closed system: the degassed water is never in contact with the atmosphere: unlike a vented thermal degasser, there is no possibility of CO_2 or O_2 re-absorption between the degasser and the still;

- Performance decoupled from steam utilities: gas removal is a continuous physical process across the membrane, independent of the availability and stability of heating steam; it does not rely on maintaining a thermal equilibrium;

- Stability across the flow range: the installed exchange surface is modular and performance remains stable across the still's entire feed flow range, including during Combi load changes (WFI / Pure Steam / simultaneous mode switching);

- Performance margin: typical residual levels below 1 ppm CO_2 — a comfortable margin against typical still feed water specifications (dissolved CO_2 compounds < 1.0 ppm) and the 3.5% v/v NCG limit of EN 285 and HTM 2010.

This robustness benefits the still directly: stably and predictably degassed feed water translates into consistent, testable and documentable Pure Steam quality — precisely what a steam quality (NCG) test has to demonstrate.

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5. Hygiene and Sanitisation

The membrane degassing systems Aqua-Nova supplies are hot-water sanitisable, allowing a unit to be integrated into the periodic sanitisation strategy of the feed water loop without chemicals. The closed, compact design also reduces contamination risk compared with a vented vessel, and the footprint is considerably smaller than that of a thermal degasser.

6. A Balanced Choice — and Our Recommendation

Thermal degassing is a proven technology that does its job. Aqua-Nova systems are normally supplied with a membrane degasser, but either solution can be applied: where a thermal degasser is preferred, we will engineer it into the system with the same care. Membranes, for their part, are consumables that will eventually need replacing. Our recommendation of the membrane solution therefore rests not on what we can supply, but on the structure of its service costs and its operational robustness: no periodic notified-body inspections, no continuous steam consumption, a six-year track record with no membrane replacement reported across our client base.



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7. Summary

Pairing an Aqua-Nova Combi still with 3M membrane-based feed water degassing guarantees NCG compliance with EN 285 and HTM 2010, with a service cost structure that is durably lower than a thermal degasser — no recurring statutory inspections, reduced energy consumption, minimal maintenance — and robust gas removal, being continuous, closed and independent of steam utilities. Hot-water sanitisable and compact, the solution integrates naturally into the installation and the site's quality strategy. Aqua-Nova can equally supply and integrate a thermal degasser where that route is preferred; membrane degassing is simply the solution we recommend by default.



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