



Photo: Rostein AS

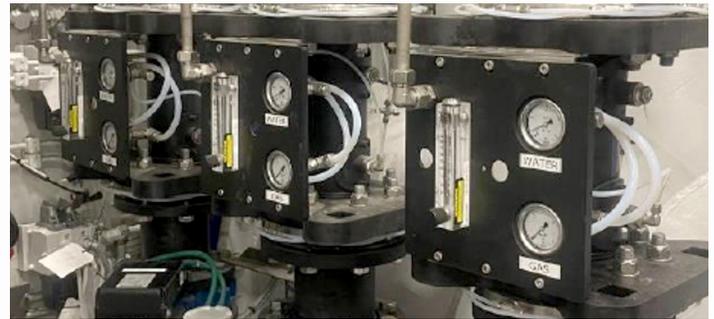
**A COMPLETE GAME CHANGER FOR EFFICIENT AQUATIC LIFE SUPPORT:
MOLEAER NANOBUBBLES DOUBLED OXYGEN
EFFICIENCY FOR ROSTEIN'S WELL-BOAT**

How Moleaer's Technology Reduces Costs, Lowers Emissions, and Increases Capacity—all While Ensuring Fish Welfare

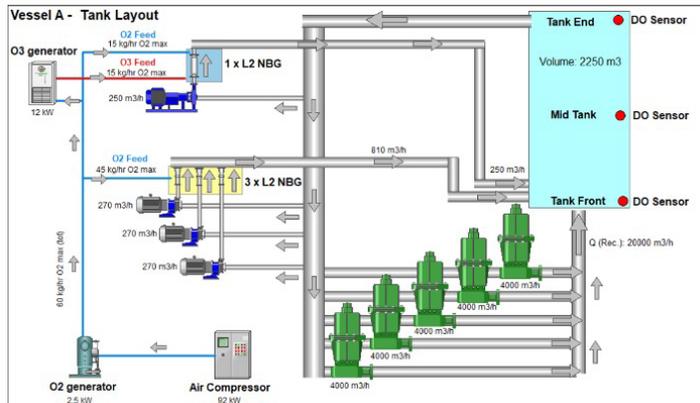
Client: Rostein

Location:	Dates:	Unit:	Key Results:
Norway	November 2024	8 Trinity L2	<ul style="list-style-type: none"> • Doubled Oxygen Transfer Efficiency (86% vs. 41% with Injectors) • Estimated O2 savings of 230-360 tons/year • Estimated reduction of 60-100 tons of diesel and 130-200 tons of GHG emissions • Estimated cost savings of up to 80.000 euros/year on diesel

Rostein, one of the world's largest well-boat operators, tested Moleaer nanobubble technology to meet oxygen demand and ensure fish welfare during fish transportation and loading. Water quality, and specifically optimal oxygen levels, is one of the critical factors to ensure welfare of the fish during well-boat transportation. To achieve this, Rostein integrated 8x Trinity L2 nanobubble generators into one of their vessels, each operating at a liquid flow rate of approximately 270 m³/hour. These nanobubble generators provided oxygenation to two tanks with a total capacity of 4500 m³ (four units per tank). Three units were used for oxygenation, while the fourth one served as a backup or for ozonation purposes. This set up was compared to another vessel using 3 venturi injectors.



Moleaer's Trinity Nanobubble Generators



Schematic layout of one (of two oxygenation systems for 2250 meters of capacity). Vessel A is equipped with two identical tanks as the one described in the Figure.

**Doubled Oxygen Transfer Efficiency:
Nanobubbles vs. Venturi Injectors**

When comparing both systems, the Moleaer nanobubble generator achieved an average oxygen transfer efficiency (OTE) of 86%, significantly higher than the 41% recorded for the venturi injectors. This resulted in an additional

oxygenation capacity of 22 kilograms per hour compared to the injectors when both systems are operated at the same total oxygen mass flow rate of 45 ± 5 kilograms per hour (15 kg O₂/hr per unit). This means that Moleaer's technology achieved approximately twice the transfer efficiency of the compared venturi injectors.

For many years the well-boat industry has used venturi-based injectors for life support oxygenation on vessels. With the introduction of Moleaer's nanobubble technology to increase efficiency, DO control and consequently less energy usage – the industry is facing a paradigm shift for oxygenation technology.

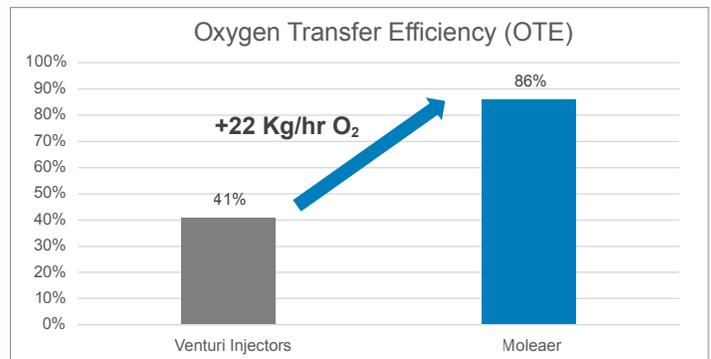




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What Rostein says:

“We have tested and documented the Nanobubble technology from Moleaer on one of our vessels. It provides faster and better control of the O₂ environment in the cargo holds during operation. This technology is a huge step forward for our industry.”

Joar Sandøy, Project Manager – Rostein AS

Potential Cost Savings and Increased Loading Capacity

The increase in oxygenation capacity provided by integrating Moleaer nanobubbles translates into significant cost savings, reduced fuel consumption, lower carbon emissions, or the ability to increase fish loading capacity while maintaining welfare standards.

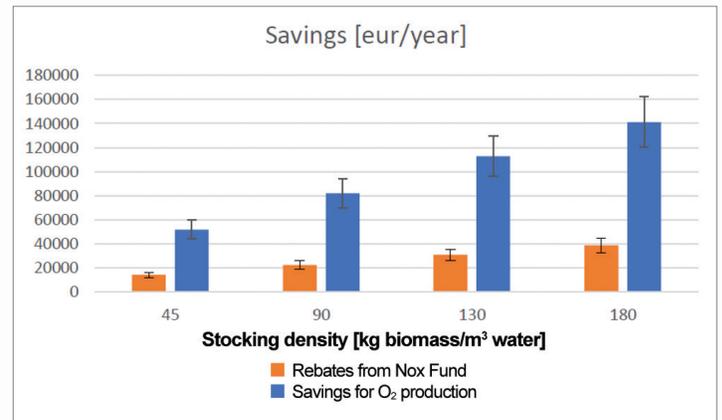
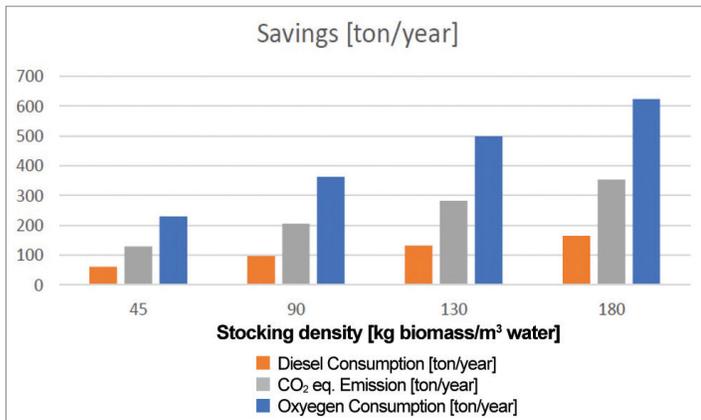
If the Moleaer equipment is operated to meet the same oxygen demand as the venturi injectors, estimated oxygen range between 230 and 360 tons per year. This corresponds to approximately 60 to 100 tons of diesel saved annually and a reduction of 130 to 200 tons of greenhouse gas (GHG) emissions (CO₂ + NO_x). These efficiencies result in potential annual cost savings of up to 80,000 euros in diesel – with 2025 fuel prices, plus an additional 14,000 euros in potential tax rebates from NO_x funds due to reduced emissions.

Alternatively, if the Moleaer system is operated to maintain the same oxygen consumption as the injectors, the results indicate that replacing the venturi injectors with Trinity L2s nanobubble generators would optimize stocking density and capacity until the maximum allowed by the industry regulations - without compromising fish welfare during normal transport conditions.

Overall, switching to the Trinity L2s nanobubble generators would lead to substantial annual savings, including reduced power consumption, lowered O&M costs, decrease carbon footprint, extend operational range, and ultimately improve the vessel's sustainability.

Dual-Function Use: Oxygenation and Ozone Injection

Following this comparison, Rostein began using all onboard nanobubble generators for effective ozone transfer efficiency in addition to oxygenation.



Get connected with an expert to know more about personalized nanobubble solutions:

info.moleaer.com/moleaer-background-information

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