NICO NANOBUBBLE INDIA CO.

Case Study

Nanobubble-Driven Process Optimization of a 7 MLD STP for Capacity Enhancement and Energy Reduction

Overview

Aeration remains the most energy-intensive component of municipal wastewater treatment plants, often limiting both operational efficiency and plant capacity. Conventional aeration systems typically suffer from low oxygen transfer efficiency, resulting in higher energy consumption and restricted biological performance.

This case study presents the full-scale implementation of NICO Nanobubble Technology in a 7 MLD MBBR-based Sewage Treatment Plant in Ganaur, Haryana. The objective was to enhance oxygen-transfer efficiency, reduce aeration energy demand, and unlock additional treatment capacity without any civil infrastructure expansion.

Project Details

- **Application:** Municipal Sewage Treatment
- **Location:** Ganaur, Haryana, India
- **Existing Process:** MBBR with activated aeration
- **Plant Capacity:** 7 MLD
- **Technology:** NICO VARUNA 100 Nanobubble Generator
- **Gas:** Air
- **Integration:** Retrofit within the existing aeration process
- **Primary Objective:** Energy reduction and capacity enhancement
- **Civil Modification:** None
- **Plant Operation:** Continuous biological treatment

The nanobubble system was incorporated as a supplementary oxygenation solution within the existing aeration process. It operated in coordination with the plant's conventional blowers, allowing their operating load to be reduced while maintaining the required aerobic conditions.

Pre-Implementation Challenges

Prior to nanobubble integration, the plant exhibited common limitations associated with conventional aeration, including high aeration energy consumption, limited oxygen-transfer efficiency, uneven dissolved oxygen distribution, and restricted treatment capacity within the existing biological infrastructure.

Maintaining stable aerobic conditions under increased hydraulic and organic loading also presented operational challenges, limiting the ability to increase plant throughput without additional infrastructure.

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NICO Nanobubble Solution

NICO deployed its VARUNA 100 Nanobubble Generator as a side-stream oxygenation system connected to the existing aeration tank. Water from the biological reactor was withdrawn, enriched with air nanobubbles, and returned through a circulation arrangement designed to improve oxygen distribution across the treatment zone.

The system was integrated with the existing blower infrastructure, allowing blower operating load to be reduced while supporting stable aerobic conditions.

Performance Outcomes

Performance Indicator	Unit	Before Nanobubble Integration	After Nanobubble Integration
Plant Capacity	MLD	7	9
Capacity Increase	%	-	25-30
Aeration Energy Reduction	%	-	20-25
Blower Power Demand	kW	35-40	18-20
Combined Power Consumption	kW	Baseline	25-30 kW
Dissolved Oxygen (DO)	mg/L	2-3	5-6
COD (Treated Effluent)	mg/L	100	49
Oxygen Distribution	-	Localized variation	More uniform and stable
Biological Operation	-	Conventional loading	Intensified and stabilized

The system achieved stable oxygenation while reducing the operating requirement of the conventional blower system. The higher and more uniform DO profile allowed the biological reactors to process additional wastewater while maintaining treatment performance.

Key Improvements

30%

Increase in Effective Treatment Capacity

The plant capacity increased from **7 MLD to 9 MLD**, enabling higher wastewater throughput using the existing treatment infrastructure without major civil expansion

25%

Reduction in Aeration Energy

Integration of NICO Nanobubble Technology reduced the overall aeration-related energy demand while maintaining stable biological treatment conditions.

5–6 mg/L

Stable Dissolved Oxygen Levels

DO levels increased from approximately **2-3 mg/L to 5-6 mg/L**, supporting a more stable and uniform aerobic environment

Impact Analysis

The capacity enhancement enabled the plant to manage higher wastewater loading using its existing treatment infrastructure, reducing or deferring the need for additional aeration tanks, major civil construction, high-capacity blowers, or plant-footprint expansion.
The reduction in aeration energy also generated significant operational savings. The blower power requirement was reduced by approximately 45–50%, while the combined nanobubble and blower system maintained the required oxygenation conditions.

The improved and more stable dissolved oxygen environment supported aerobic biological processes, helping maintain treatment performance under increased loading conditions and reducing the risk of localized oxygen-deficient zones.

The reduction in aeration energy delivered indicative operational savings of approximately:

Economic Indicator	Benefit
Monthly Electricity Saving	₹0.8-1.0 lakh
Annual Electricity Saving	₹10-12 lakh
Additional Treatment Capacity	25-30%
Civil Expansion	Avoided or deferred
Operational Benefit	Lower blower loading and improved process stability

Conclusion

The full-scale implementation demonstrates that NICO Nanobubble Technology can address two major constraints in wastewater treatment: **high aeration energy demand and limited plant capacity.**

By enhancing oxygen transfer and stabilizing biological treatment conditions, the system enabled higher wastewater throughput while reducing dependence on conventional blower operation. The project increased the effective treatment capacity of the 7 MLD STP by approximately **25-30%** while delivering approximately **20-25% reduction in aeration-related energy consumption.**

The results demonstrate a practical and scalable approach for modernizing existing municipal STPs, improving treatment performance and energy efficiency while unlocking additional capacity without capital-intensive civil expansion.