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Digital Insights:

Reverse Osmosis Systems in Airport Infrastructure: A Comparative Perspective with Industrial Applications

By: Moataz A. Alazwri– Basil S. Alamri - Naif S. Alotaibi
Abdulkarim S. Alharbi – Abdulrahman A. Aldossari
Indu Sekhar Potnuru

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ABSTRACT

Reverse osmosis (RO) systems are a widely adopted solution for water purification in both airport and industrial environments. While the core filtration principles remain similar, the operational requirements, water quality specifications, and end-use applications differ significantly. This article explores the role of the RO system within the Tanajib Airport Expansion Project, where the purified water is used for aircraft and helicopter wash operations. The system is engineered to maintain optimal mineral balance, reducing the risk of corrosion to sensitive aircraft surfaces. In contrast, RO systems in industrial contexts are often tailored for high-volume processes such as boiler feed, chemical production, or cooling systems, where water purity is prioritized over mineral calibration. The article highlights key design distinctions and performance requirements across both applications.

INTRODUCTION

Reverse osmosis has become a cornerstone of water treatment systems worldwide, providing high-quality water for a range of technical and operational uses. At airports, RO systems are deployed not only to produce potable or service water, but also to meet the stringent requirements for aviation surface maintenance. In the Tanajib Airport Expansion Project, the RO system has been designed to deliver purified water for aircraft and helicopter wash operations—an application that requires precise control over water chemistry. This tailored approach contrasts with industrial RO systems, which are generally engineered for capacity and purity without the same focus on surface compatibility or corrosion risk. Understanding these distinctions is key to optimizing RO systems for their respective environments.

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RO SYSTEM IN AIRPORT OPERATIONS

The RO unit installed at Tanajib Airport is tasked with producing demineralized water specifically suited for aircraft and helicopter washout procedures. Excessively pure water or water with high mineral content can both be harmful to aviation surfaces. The system is therefore calibrated to maintain a controlled level of minerals such as calcium and magnesium within acceptable limits to prevent surface etching, scaling, or corrosion.

Key characteristics of the airport RO system include:

- Multistage filtration units to remove sediment, organics, and chlorine prior to membrane Saudi Aramco: Company General Use contact
- High-rejection membranes rated for stable operation under coastal environmental conditions
- Post-treatment re-mineralization filters to adjust water softness and pH
- Automated control systems that ensure consistent output quality and monitor total dissolved solids (TDS) levels

Water produced by the system is stored in dedicated non-metallic tanks and distributed to designated aircraft wash areas viacorrosion-resistant piping.

INDUSTRIAL RO SYSTEMS

Industrial reverse osmosis systems are typically designed for high-capacity, continuous operation in sectors such as oil & gas, power generation, pharmaceuticals, and manufacturing. In these settings, the primary goal is often maximum contaminant removal, with little to no concern for downstream surface interaction. As a result, industrial RO systems tend to:

- Operate at higher pressures to maximize permeate yield and recovery rates
- Employ pretreatment technologies like antiscalants, media filters, or chemical dosing to manage fouling
- Produce highly demineralized or ultrapure water with TDS levels well below 10 ppm
- Lack the re-mineralization stage used in aviation-focused applications.

In many cases, this ultrapure water is used for applications such as boiler feed, product rinsing, or closed-loop cooling—scenarios where corrosion of equipment surfaces is managed through internal chemical treatment rather than tailored water chemistry at the source.

COMPARISON AND KEY DIFFERENCES

While both airport and industrial RO systems share a reliance on semipermeable membranes and high-pressure pumps, they diverge in the following critical areas:

- Purpose of Water Use: Airport RO systems prioritize surface safety and corrosion prevention for aircraft. Industrial systems prioritize process compatibility and total purity.
- Water Chemistry Control: Airport systems intentionally maintain a balanced mineral profile. Industrial systems remove nearly all mineral content.
- Post-Treatment Requirements: Aviation applications often require pH adjustment and mineral stabilization. Industrial systems usually bypass this step.
- Operational Redundancy: Airport RO systems may operate in batch cycles with redundant tanks to accommodate flight schedules. Industrial systems typically run continuously with emphasis on uptime.
- Maintenance and Monitoring: Monitoring in airport systems includes not only flow and pressure but also TDS thresholds specific to aircraft material compatibility.

CONCLUSION

The reverse osmosis system deployed at Tanajib Airport reflects a purpose-built approach tailored to aviation needs, particularly in aircraft and helicopter wash operations. Unlike generic industrial RO systems, airport-focused designs must balance filtration effectiveness with surface compatibility. By understanding and respecting the differences between these two applications, engineers and operators can better select, configure, and maintain RO systems that deliver consistent, safe, and efficient results for their specific operational context.