KOVALUS
Separation Solutions™

CASE STUDY

Aquapolo Ambiental Water Reuse Project

Overview

The State of São Paulo is the world's seventh most populous urban area and is considered the economic, financial, and technical hub of Brazil. The region contains nearly one quarter of the country's population, but less than 2% of Brazil's water.

The state government, recognizing the importance of safeguarding drinking water for the region's inhabitants, issued regulations to restrict the industrial use of potable water, forcing factories to look for ways to reuse their wastewater, or obtain recycled water from another source.

The Aquapolo Ambiental water reuse venture was created to address these new regulations. The reuse water is delivered to a petrochemical complex through an 18 km long distribution system. The reuse water is used for cooling tower make-up or is further treated with an additional RO system to produce demineralized water for boilers at the petrochemical companies. Aquapolo has performed as designed and delivered high quality reuse water since commissioning in 2012.

Upon completion, this innovative facility freed up enough drinking water to continuously supply a population of 350,000 inhabitants, with the expansion capacity to reach 600,000. At the time of commissioning, Aquapolo was the largest water reuse project in the Southern Hemisphere, and the fifth largest of its kind in the world.

The Challenge

To design and commission a treatment plant capable of easing pressure on São Paulo's potable water supply by producing industrial reuse water in lieu of using potable water.

Key Highlights

Kovalus TMBR system offered lower operating costs, lower process risk, and negligible interference with the current plant operations.

1. Tertiary MBR (TMBR) utilized 96,000 m2 of membrane area
2. Average flux rates of >25 L/m^2 h were achieved
3. Daily maintenance cleaning enhanced UF performance

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> “KSS offered a comprehensive engineering solution and dedicated extensive pre-engineering man-hours to produce the most reliable design and the state-of-the art technology for our project. The availability of a pilot plant convinced us their solution was the best one.”

Emyr Diniz Costa,
Senior Project Director at Odebrecht

The Solution

KOVALUS SEPARATION SOLUTIONS™ (KSS) conducted an in-depth feasibility study to identify the most cost-effective and reliable approach to upgrading the existing plant infrastructure. After evaluating several alternatives, the study concluded that implementing membrane bioreactor (MBR) technology in a Tertiary Membrane Bioreactor (TMBR) configuration would offer the optimal solution for the new facility.

To validate this approach, a comprehensive one-year pilot study was carried out. A conventional MBR pilot unit was used to confirm key design parameters, optimize operational conditions, and assess long-term operating costs. In parallel, a standard reverse osmosis (RO) pilot was deployed to simulate the RO configuration proposed for the full-scale system. The target water quality for reuse was achieved through a carefully controlled blend of permeate streams from both the TMBR and RO processes. These pilot results confirmed the feasibility and robustness of the proposed full-scale water reuse solution under fluctuating feedwater conditions.

KSS was selected for the Aquapolo project due to its exceptional technical support, advanced biological process design capabilities, extensive experience in water reuse projects, and proven ability to meet aggressive project timelines.

KSS’s scope of supply for the Aquapolo facility encompassed:

- Full biological and membrane extraction system design
- Supply of sixty-four (64) PURON® PSH 1500 modules
- Two parallel, custom-engineered reverse osmosis trains
- Centralized control systems for the entire process
- Comprehensive aftermarket support and service

The TMBR system was designed to treat secondary effluent and polish it to meet strict reuse standards. Key infrastructure additions included a pretreatment stage, advanced chemical dosing systems, and the construction of a 650 L/s (14.8 MGD) TMBR facility. The biological process features an oxidation ditch configuration with enhanced anoxic zones, delivering a total bioreactor volume of 7,000 m^3 (1.85 million gallons).

The membrane extraction system includes 96,000 m^2 of membrane surface area, arranged in eight trains with eight PURON® PSH 1500 modules per train. A portion of the treated effluent undergoes further polishing through two parallel RO systems, each with a capacity of 6,500 m^3/day (1.7 MGD). The final reuse water quality is achieved by blending the permeates from both systems constructed as a greenfield project. The TMBR configuration minimized operational disruptions and reduced both cost and risk. Construction commenced in April 2010, and the system was successfully commissioned by June 2012.

At the heart of the system are the PURON® submerged membrane modules, which consistently produce high-quality effluent that meets stringent water reuse standards. These modules are known for their compact footprint, energy efficiency, and low air scour requirements — among the lowest of any commercially available MBR module.

Key design features of the PURON modules include:

- A single-header configuration that enhances solids management
- Reinforced hollow fibers, anchored only at the base, reducing the risk of fiber breakage
- A highly effective air scouring system that virtually eliminates fouling and sludging
- A free-floating fiber tip that prevents the accumulation of hair and fibrous debris — common causes of clogging in conventional MBR systems

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Operation Experience

Since commencing operations in 2012, Aquapolo has consistently delivered high-quality reclaimed water, meeting performance expectations from day one. The treated water is conveyed through an 18-kilometer distribution network to a nearby petrochemical complex, where it is primarily utilized as cooling tower makeup water. A portion of this water is further treated using an additional reverse osmosis (RO) system to produce demineralized water suitable for boiler feed applications.

One notable challenge encountered at the site was a significant deviation in the characteristics of the source water compared to original design assumptions. This change resulted from upstream upgrades to the secondary effluent treatment plant before the TMBR system commissioning. While these improvements enhanced effluent quality, they inadvertently reduced nutrient levels in the feedwater — posing operational challenges for biological treatment processes.

To address this, the site implemented a twofold solution: careful sludge conditioning and the strategic supplementation of carbon. The latter was achieved by incorporating carbon-rich wastewater streams sourced from a nearby brewery and soft drink production facility, effectively restoring the nutrient balance required for optimal process performance.

Throughout this period, KSS has partnered closely with the site to ensure optimal system performance. One significant outcome of this collaboration was the reduction of membrane system air scour usage by approximately 37%, bringing the rate down to 0.084 $Nm^3/h/m^2$ (0.0046 $scfm/ft^2$). This improvement enhanced operational efficiency and contributed to the long-term sustainability of the process.

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