

# Providing Successful Pretreatment of Challenging Feedwater at Egypt's First Zero-Liquid Discharge Plant



## The challenge

As Egypt instituted new environmental regulations prohibiting wastewater discharge, the Egyptian Ethylene and Derivatives Company (ETHYDCO), the largest polyethylene (PE) production facility in Egypt, was determined to implement zero-liquid discharge (ZLD). The initial design-phase review estimated that the finished plant would consume a staggering 2,600 cubic meters per hour (m<sup>3</sup>/h) and would need to optimize the water consumption through conservation and recycling, reducing it by nearly 70% at 700 m<sup>3</sup>/h. Thus, to maximize the lifecycle of incoming water from the Nile River and preserve freshwater resources, ETHYDCO worked with Engineering for the Petroleum & Process Industries (ENPPI) to provide Egypt's first ZLD water treatment facility designed to recycle wastewater, allowing it to be continuously used in the production line.

The plant, which was installed at ETHYDCO's site in Alexandria, needed to identify a reliable filtration system capable of successfully handling inconsistent water quality with high peaks of total suspended solids (TSS) to allow the treated water to achieve ZLD. The pretreatment is required before the ZLD, as high-efficiency reverse osmosis systems call for highly filtered water, free of solids and with very low turbidity.



*"I first conceptualized this plant in 2004 and worked with the [Aria Filtra] team to turn this concept into a process solution. ENPPI and ETHYDCO worked together to engage Aquatech, a Pennsylvania-based company, to deliver the ZLD solution. The [Aria Filtra] team was incredibly accessible and professional during the production process. We are extremely pleased with the strength and reliability of the filtration system, which has helped us meet environmental regulations and gain global recognition."*

Hossam El-Fahmy, engineer and general manager for ETHYDCO Utilities and Offsite

## The solution

Aria Filtra™ was the pretreatment step to the ZLD system, delivered through its Aria FLEX™ membrane filtration system. The Aria FLEX system's ability to treat the challenging feedwater, which is a composite mix of treated effluent and water from the Nile River, was a driving factor in its selection. The quality of the feedwater varies throughout the year, resulting in seven different cases based on varying TSS, feed turbidity, and other feedwater characteristics. Aria Filtra's ability to design the filtration system with special controls to allow operation at different feed scenarios was a differentiator, as Aria Filtra was able to provide a complete, smart solution. The Aria FLEX solution is based on six trains with a total filtration area of 22,800 square meters. Hydraulically, the system is capable of flow of more than 1,500 m<sup>3</sup>/h, but to accommodate the various scenarios, it is designed to operate between a range of 900 to 1,090 m<sup>3</sup>/h of filtered water to meet the ZLD plant's massive capacity.

## The results

Following production, the Aria FLEX system treats all the ETHYDCO facility's collected wastewater, purifying the water to a high enough quality that allows it to be used again in the polyethylene production process. Despite the inconsistent water chemistry and difficulties associated with the feedwater, the strength of Aria Filtra's fibers could run constantly at high recovery levels—ranging from 91% to 93%—at 100% production. Well-suited for the challenges of the feedwater, the reliability of Aria Filtra's membrane system has proven crucial for operating at full capacity despite spikes in TSS, which at times can reach 177 parts per million, and varying feed conditions.

With Aria Filtra's pretreatment system and the complete ZLD plant operational, ETHYDCO was able to meet all the requisite norms of ZLD established by the Egyptian government to minimize water consumption and protect the country's only life-giving aquifer, the Nile River.

With the successful completion of this project, ETHYDCO became the pioneer in ZLD and the model for all industries in Egypt and across other Gulf Cooperation Council countries. Becoming the first ethylene plant globally to achieve ZLD made ETHYDCO 100% environmentally friendly with no liquid waste released into the environment. As a result, ETHYDCO received the 2016 Global Water Awards.

## The benefits

The Aria Filtra system can run at full capacity, despite varying feed conditions, to provide successful pretreatment at Egypt's first ZLD plant. Overall, the Aria FLEX operation was able to meet the following requirements:

- **Achieve ZLD and meet environmental discharge regulations.**
- **Establish a robust system capable of handling varying feed conditions.**
- **Allow water to be recycled and reused in the polyethylene production process.**



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