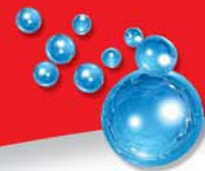


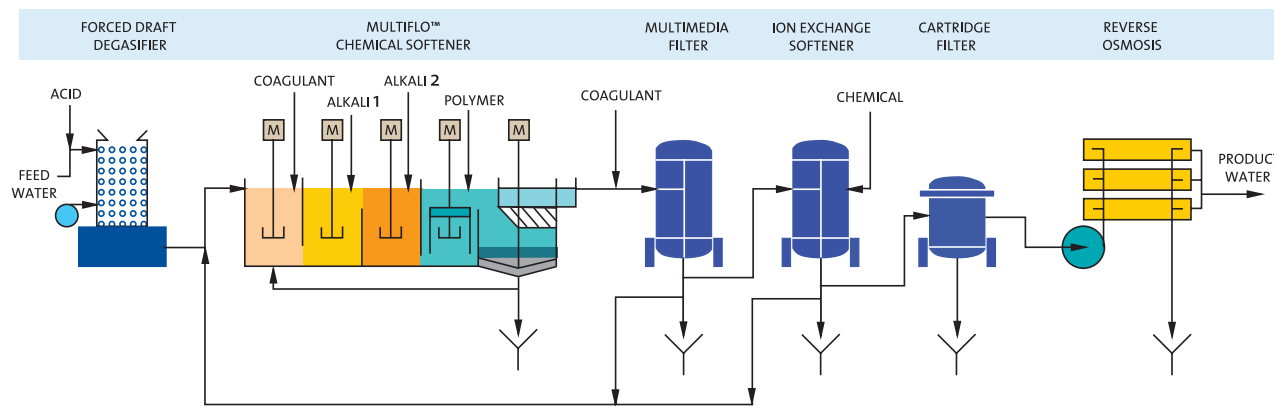
OPUS™

Optimized Pretreatment and
Unique Separation Technology



The OPUS™ technology is a proprietary Optimized Pretreatment and Unique Separation process for desalination of feed water with high concentrations of silica, organics, hardness, boron and particulates.

Developed by N.A. Water Systems, a Veolia Water Solutions & Technologies company, the OPUS™ technology utilizes a reverse osmosis process operated at an elevated pH. By combining a proprietary high-rate chemical softening process known as Multiflo™ with filtration, ion exchange and reverse osmosis, this unique technology generates high quality water with a low waste volume.



Technology Description

The OPUS™ technology consists of multiple treatment processes, involving degasification, chemical softening, media filtration, ion exchange softening, cartridge filtration and reverse osmosis (RO) technologies. The pretreatment processes ahead of the RO are designed to reduce the hardness, metals and suspended solids in the feed water. The RO process operates at an elevated pH, which effectively controls biological, organic and particulate fouling, eliminates scaling due to silica, and increases the rejection of silica and boron.

On feed water applications with high dissolved gases and excess alkalinity, the feed water is subjected to degasification with the addition of an acid to reduce the quantity of solids generated in the downstream chemical softening process and the alkali demand associated with raising the pH. The degasified water is then softened in a multi-stage process using a proprietary high-rate chemical softening and thickening technology called the Multiflo™ process.

This process utilizes a proprietary draft tube mixing technology to assist in the formation of crystalline solids. These dense solids (6 to 10% by weight) are then removed in a settling zone using lamella plates.

The water from the Multiflo™ process is then further treated with media filtration, ion exchange softening, and cartridge filtration to reduce the hardness, metals and suspended solids to lower concentrations, without pH correction. Removal of total hardness and metals in the feed water eliminates the potential for scaling of the RO membranes due to calcium carbonate, calcium sulfate, calcium fluoride, barium sulfate, strontium sulfate, iron and manganese precipitates. The pretreated water is then pressurized through an RO system, operated at an elevated pH in either single pass or double pass mode, to reduce the total dissolved solids, silica, boron, and organics present in the feed water.

Benefits

- High Water Recovery Rate
- Low Waste Volume
- Reliable Operation with Minimal Downtime
- Ability to Handle Variations in Feed Water Quality
- Effective Control of Fouling due to Organics and Particulates
- Effective Control of Scaling due to Calcium Salts, Silica and Metal Precipitates
- High Salt Rejection
- Continuous Clean-In-Place Process
- Low Energy Consumption

Applications

- Oil & Gas**
 - Produced Water Treatment
 - Refinery Wastewater Reuse
- Power**
 - Cooling Tower Blowdown Treatment
- Tertiary Wastewater Reuse**
 - Industrial Wastewater
 - Municipal Wastewater

Performance Data

Constituent Type	Feed Water	First Pass Brackish RO Permeate	Second Pass Brackish RO Permeate	% Removal
Total Dissolved Solids, mg/l	6,500	538	25	99.6%
Total Hardness, mg/l as CaCO ₃	242	<0.01	BDL	>99.9%
Silica, mg/l	240	9.5	0.30	99.9%
Boron, mg/l	26	1.3	0.15	99.4%
Total Organic Carbon, mg/l	80	3.0	0.80	99.0%
Total Suspended Solids, mg/l	100	BDL	BDL	>99.9%

BDL - below detection limit





 **N.A. Water Systems**

 **Krüger**

 **HPD**

 **John Meunier**

 **Whittier Filtration**

**Beyond Technology -
The Total Solutions
Approach**

N.A. Water Systems provides unique water and wastewater solutions from initial studies and process design to complete turnkey installation and start-up services. With technical expertise gained from more than 95 years of experience, our complete capabilities include:

- Environmental studies
- Process development and testing
- Detailed design
- Innovative technologies
- Project and construction management
- System start-up and operator training

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