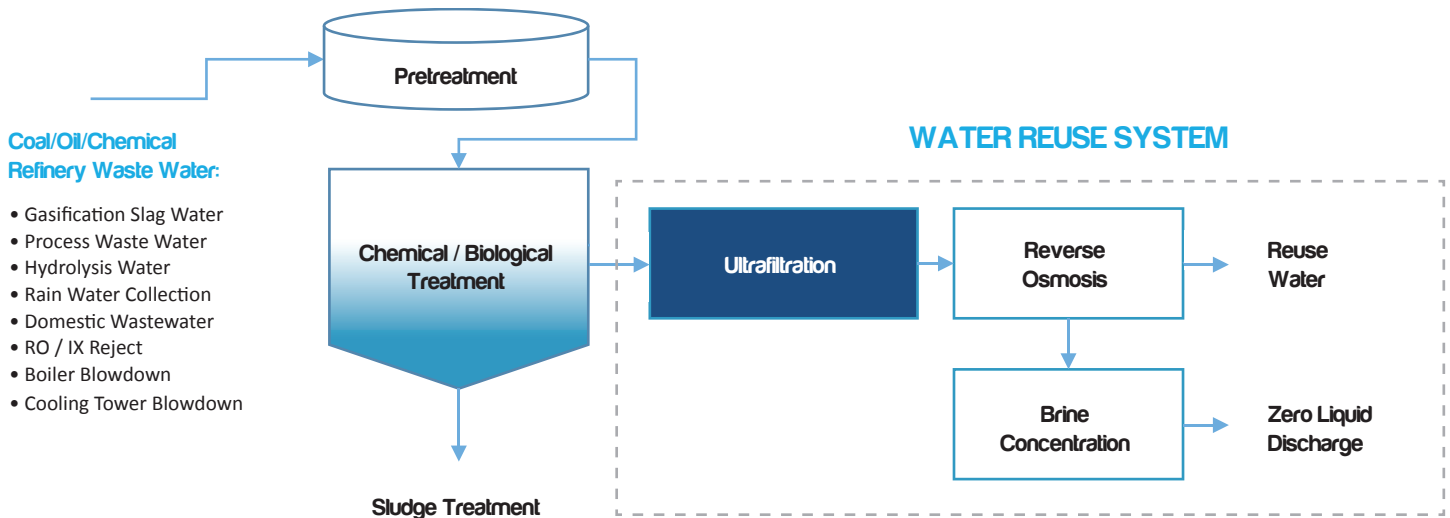


TYPICAL WASTE WATER TREATMENT SYSTEM



With regulations requiring industrial refineries to reuse waste water and in some cases meet zero liquid discharge standards, the waste water treatment system requires additional process steps to be able to reuse that waste water. Ultrafiltration (UF) and Reverse Osmosis (RO) are the technologies of choice to do this. Whether your waste water comes from coal gasification, oil refining, or other chemical refining one thing remains clear – you need a robust ultrafiltration membrane that you can rely on. If your UF membrane fails then your ability to meet your reuse requirements is at risk.

Traditionally polymeric ultrafilter membranes (PUF) membranes have been used as pretreatment to RO in industrial waste water reuse systems. The waste water stream is often highly variable with multiple waste sources that can cause big upsets with

the biological or chemical clarification process. PUF membranes in this case are unreliable with fouling, fibers breaking, frequent cleaning and shorter lifetime. Upsets and unplanned downtime cause increased operational costs, reduced production, and potential discharge violations.

For new systems or retrofitting existing systems you can be confident in the reliability of Nanostone’s CM-151™ ceramic membrane. Testing shows our ceramic UF has a higher suspended solids limit, lower fouling potential and the ability to recover completely with chemical cleaning without reduction in membrane life. The Nanostone CM-151 ceramic membrane technology is a more robust, reliable, and easy to operate as compared to PUF membrane systems.



Consider the Nanostone CM-151 ceramic membrane as compared to regular PUF membranes:

- Ceramic nets >5% water recovery— >50% reduction in water discharge
- Ceramic has 2 to 10 times longer lifetime—Lower replacement and associated costs
- Ceramic can reverse fouling— Elimination of unexpected replacement costs
- Ceramic has high chemical resistance —Allows rigorous cleaning/flexibility
- Ceramic has no fiber breakage —Minimal integrity risk with low maintenance

Nanostone Ceramic Membrane Case Study

Chemical Refinery Waste Water Reuse

A chemical refinery plant located in Qinghai China operated a non biological waste water treatment plant with chemical precipitation followed by clarification, conventional media filtration, and finally with reverse osmosis (RO). The waste water was reused in the plants cooling tower. The conventional filtration system did not adequately pretreat the water before the RO membranes and the system was unreliable with frequent cleaning and short RO membrane life. They needed to upgrade it to reduce their operating risk and expense. The owner, working with the engineering and an equipment company, decided that ultrafiltration (UF) was the best solution to fix the problem. The end user wanted a more reliable and robust solution than regular polymeric UF membranes and they selected Nanostone ceramic UF membranes for the project upgrades.

In November 2016, the Nanostone ceramic UF system was commissioned to pretreat the RO system. To date the system operation is excellent with the ceramic UF net flux rates between 130 and 170 liters per hour per square meter (LMH). The Nanostone ceramic UF has an overall recovery of >95% and an average transmembrane pressure (TMP) of < 1Bar. The system uses a daily chemically enhanced backwash (CEB) and the recovery cleaning frequency is greater than 30 days. The Nanostone ceramic UF produces water to feed the RO with low silt density index and turbidity well below the limits for RO feed water quality.

The Nanostone ceramic UF modules are installed in a state of the art fully automated UF system. With the superior water quality now feeding the RO membranes the waste water reuse system overall is much more stable and reliable. The operator also has more confidence in the more robust ceramic UF membranes so they can rest assured that the system will perform well into the future.



WASTE WATER REUSE SYSTEM AT CHEMICAL REFINERY

Left Image: Failed RO membranes before installing Nanostone Ceramic UF.

Right Image: Nanostone Ceramic UF membranes in operation

Feed Water to RO System Before Installing UF Membrane

- Flow Rate | 125 m³/hr
- COD | 55 – 110 mg/L
- Turbidity | 4-13 NTU
- pH | ~ 8
- NH₃-N | 0.6 mg/L
- Temperature | 25-30°C

Performance of Nanostone Ceramic Membrane

- Net Flow Rate | 124-129 m³/hr
- Silt Density Index | < 3 (15 min)
- Turbidity | < 0.1 NTU
- Net Flux | 130-170 LMH
- TMP | 0.7 – 1.5 Bar
- CEB with HCl | 24 hours
- Recovery CIP | > 30 days

