On-Site Diagnostic Testing

After evaluating initial system performance, the system should be inspected in more detail for troubleshooting purposes.

INTRODUCTION

Underperforming membrane elements are often a symptom of a more serious issue, such as insufficient pretreatment, process upsets or improper system operation. It is recommended to perform the following diagnostic tests before contacting your membrane element supplier regarding a potential warranty claim.

SYSTEM TROUBLESHOOTING TESTS

Visual Inspection of Plant

Upstream tanks and pipes should be inspected for mold or biogrowth that can infect the membrane system. Membrane systems are particularly susceptible to biofouling when the system is not operating, giving biological contaminants the opportunity to grow and spread.

Leaking vessels and pipes should be repaired or replaced. In addition to being a potential entry point for mold or biogrowth, these leaks can also allow air into the system when the system shuts down and lead to hydraulic shock or water hammer at start-up.

Opening the Pressure Vessel

Feed Side: The face of the lead element can indicate the presence of colloidal or biological fouling. Colloidal fouling is typically characterized by the presence of particulates or discoloration. Biofouling is typically characterized by its slippery texture and foul odor. Debris on the face of the lead element can indicate a greater system issue and result in higher pressure drop.

Concentrate Side: The tail element can indicate the presence of scale or mechanical damage. Scale is typically characterized by the presence of salt crystals and its rough, sandpapery texture.

General: Elements should be properly shimmed to avoid element movement within the pressure vessel during start-up and shutdown. Refer to Element Loading Guide – Shimming Elements (TSG-O-008). Additionally, couplers should be inspected for damaged, deformed or misplaced o-rings.

System Cleaning Evaluation
How a system responds to cleanings can also be an indication of specific fouling issues. High pH cleanings are often more effective on colloidal, biological and organic fouling. Whereas, low pH cleanings are often more effective on mineral scale.

The cleaning solution coming out of the system may also hold valuable information because it may contain high amounts of removed foulants. Analyzing the spent cleaning solution for metals and TOC and comparing it to an analysis of fresh cleaning solution can indicate the type of fouling present within the membrane system.

System Profiling
Accurately profiling a system, or localizing the source of an issue, requires proper equipment to monitor the performance of each pressure vessel individually. To monitor solute passage, sample ports are commonly placed on the feed line entering each stage and the permeate line exiting each pressure vessel individually (having sample ports on the concentrate lines are also recommended). The solute passage of each pressure vessel may be calculated by measuring the water quality of the samples taken from the feed and permeate ports. Depending on the application and membrane type, various measurements may be used to determine water quality. However, the most common measurement for reverse osmosis is TDS or conductivity. The permeate water quality may also be tested for specific components using analytical methods.

Similar to monitoring solute passage, monitoring permeate flow rate and pressure differential will require the appropriate equipment. Having meters on the feed, concentrate and permeate lines can help locate the origin of a system failure to an individual pressure vessel.

Individual Pressure Vessel Probing
If a pressure vessel shows a significantly higher permeate concentration than the other vessels of the same stage, probing allows you to determine and locate the problem within the pressure vessel while remaining online and without unloading the elements. To probe a pressure vessel, please refer to **Troubleshooting – Pressure Vessel Probing Procedure** (TSG-T-007).