SILT DENSITY INDEX EXPLAINED

MEMBRANE FOULING CONTROL

Membrane fouling is the main cause of permeate flux decline and loss of product quality in reverse osmosis (RO) Systems, so fouling control dominates RO system design and operation. Sources of fouling can be divided into four principal categories: scale, silt (particular), bacteria (bio fouling, growth of bacteria) and organic fouling (oil, grease).

Fouling control involves pre-treatment of the feed water to minimize fouling as well as regular cleaning to handle fouling that still occurs. Fouling by particulates (silt), bacteria and organics generally affects the first modules in the plant the most. Scaling is worse with more concentrated feed solutions, therefore the last modules in the plant are most affected, because they are exposed to the most concentrated feed water.

SILT DENSITY INDEX

Silt is composed by suspended particulates of all types that accumulate on the membrane surface. Sources of silt are organic colloids, iron corrosion products, precipitated iron hydroxide, algae, and fine particular matter. Silt Density Index testing is a widely accepted method for estimating the rate at which colloidal and particle fouling will occur in water purification systems, especially using reverse osmosis (RO) or Nanofiltration membranes.

SDI is a measurement of the fouling potential of suspended solids. It's not measuring the quantity of particular matter, since the size, shape vary. Turbidity is a measurement of the amount of suspended solids. They are not the same and there is no direct correlation between them. In practical terms however, the membranes show very little fouling when the feed water has a turbidity of < 1 NTU. Correspondingly the membranes show very low fouling at a feed SDI of less than 5.

The SDI test is used to predict and then prevent the particulate fouling on the membrane surface. Other names for it are the Kolloid-Index (KI) or the Fouling-Index (FI). The test is defined in ASTM Standard D4189, the American Standard for Testing Material.

PROCEDURE FOR MEASURING SILT DENSITY INDEX (SDI)

This bulletin provides general instructions for measuring the silt density index (SDI). The SDI is a popular method for determining feed water quality in RO applications. It is based on the time required to filter a volume of feedwater through a 0.45 □m filter pad at a feed pressure of 30 psig. Operating an RO system with SDI <4.0 results in a lower rate of colloidal fouling.

TEST EQUIPMENT SET UP

1. Assemble the test equipment per figure 1.
2. Locate a sample tap on the feedwater piping and install the test equipment.
3. Adjust the pressure regulator to 30 PSI with a filter pad installed. Use a fresh filter for the actual test.

Note: For best results:

- Use dull tweezers when positioning the filter to prevent puncturing the filter.
- Ensure that the O-ring is clean and in good condition, and is properly positioned.
- Avoid touching the filter with fingers.
- Flush the apparatus to remove any contaminants that may be held within it.

TEST PROCEDURE

1. Take the temperature of the feedwater. The temperature should not vary more than $\pm$ 1 degrees C between the start and end of the test.

2. Bleed any entrained air in the filter holder. Depending on the model of the filter holder, either open the bleed valve, or loosen the filter holder while cracking the ball valve. Then close the bleed valve or filter holder.

3. Place a 500 ml graduated cylinder under the filter to measure the amount of water that passes through the filter.

4. Open the ball valve fully, and measure the time required to collect 100 ml and 500 ml* from the time the ball valve is opened. Record these times, leaving the valve open and letting the flow continue.

5. After 5 minutes, repeat the time measurement required to collect 100 ml and 500 ml samples. Repeat again after 10 and 15 minutes of elapsed time.

6. If the time required to obtain a 100 ml sample is greater than about 60 seconds, pluggage will be about 90%, and it is not necessary to continue the test.

7. Measure the water temperature again to ensure that it did not vary by more than 1 □C from the initial temperature.

8. After completing the test and disconnecting the apparatus, the filter paper may be saved in a plastic bag for future reference.

CALCULATIONS

$$SDI \ = \ P_{30} / T_t \ = \ 100 * (1 - T_i / T_f) \ / \ T_t$$

where SDI = Silt Density Index

P_{30} = % pluggage at 30 psig feed pressure**
T_t = Total test time in minutes (usually 15 minutes, but may be less if 75% pluggage** occurs in less than 15 minutes).
T_i = initial time in seconds required to obtain sample.
T_f = time required to obtain sample after 15 minutes (or less).
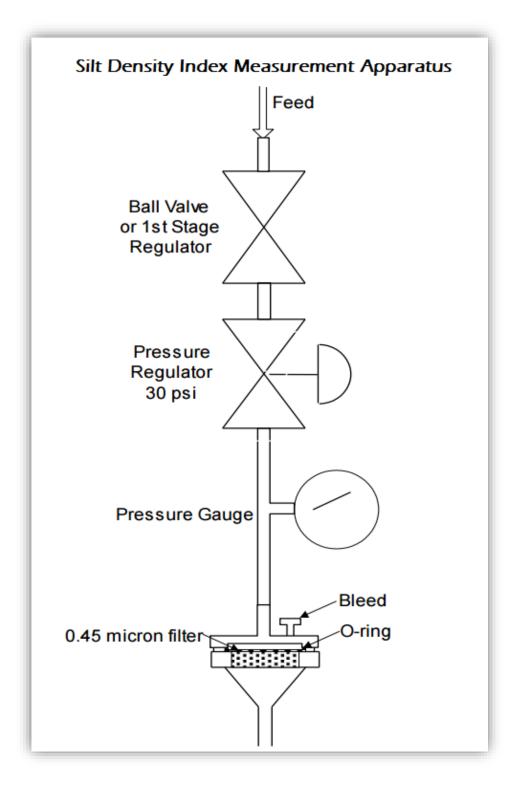
NOTES
* Time to collect 500 ml should be approximately 5 times greater than the time to collect 100 ml. If 500 ml collection time is much greater than 5X, SDI should be calculated using 100 ml collection times.

** For accurate SDI measurements, P_{30} should not exceed 75%. If P_{30} exceeds this value, re-run test and obtain T_f at a shorter time, (T).

Silt Density Index Measurement Apparatus

Feed

Ball Valve
or 1st Stage
Regulator

Pressure
Regulator
30 psi

Pressure Gauge

Bleed

0.45 micron filter

O-ring