Technical Applications Bulletin 106

Feed Water Quality Guidelines

For successful operation of the membrane system, it is strongly recommended to operate the membrane system within the feed water quality limits per manufacturer's suggestion and to maintain membrane elements by good industry engineering practices. The table below summarizes some of the feed water quality parameters, along with comments and conditions. Additionally, critical parameters and their effects are described below the table.

Table of Feed Water Quality Guidelines

Parameter	Unit	Max. level	Comments & conditions
SDI		**5**	
Oil and Grease	mg/L	**0**	
TOC	mg/L	**2**	
Al	mg/L	**0.05**	
Mn	mg/L	**0.05**	Total form
Fe	mg/L	**3**	Ferrous iron (pH <6, oxygen<0.5ppm)
		0.05	Ferric iron
Free Chlorine	mg/L	**0.1**	Exposure to chlorine damages RO membranes and should be avoided. LG Chem recommends to continuously monitor the residual chlorine concentration and Oxidation Reduction Potential (ORP).
ORP	mV	**250**	
Turbidity	NTU	**1**	
H_2S	mg/L	**0.1**	If the system can be kept under anaerobic conditions, Sulfur precipitation may be avoided.
Ba	mg/L	**0.002**	if H_2SO_4 is dosed
		0.005	in Brackish water w/o H_2SO_4
		0.015	in Seawater
Sr	mg/L	**0.05**	
SiO_2	mg/L		Consult antiscalant manufacturer if projected concentrate SiO_2 exceeds 140 mg/L
LSI		**0**	If LSI > 0, Customer must be consulting an antiscalant selection with chemical manufacturer. The antiscalant selected, must be compatible with RO membranes

1. Silt Density Index (SDI)

SDI is a parameter to predict the colloidal fouling potential of the feed water. SDI shall be measured per ASTM 4189 standard and for 15 minutes. In general, it is desirable to have feedwater SDI below 5.

2. Oil and Grease

In principle, no oil and grease are allowed in the feed water. The detrimental effects of oil and grease on RO membranes are dependent on the nature of organics such as saturated, unsaturated, aromatic, or aliphatic and also largely dependent on the existence of functional groups. Hydrocarbons containing more than seven (7) carbons are known to have more adverse effects.

3. TOC, COD and BOD

High organics content in the feed water can increase bio- and organic fouling risks of RO membranes. Tolerable organics levels for RO membranes depends on the nature of the organics such as NOM/SOC, aromatic/aliphatic, charge, and molecular weight. General design guidelines on TOC, COD and BOD in the feed water are provided in LG Chem's projection software, QPlus.

4. Aluminum, Manganese and Iron

Aluminum and manganese can cause severe membrane fouling and should be avoided. The maximum allowable concentration of aluminum and manganese in the feed water is 0.05 mg/L. Iron typically exists in ferrous form when pH is below 6 and dissolved oxygen is below 0.5 mg/L. Iron in ferrous form has a mild impact on the membrane and is allowed up to 3 mg/L. Iron in ferric form causes severe membrane fouling and should be avoided. The maximum allowable concentration of iron in a ferric form in the feed water is 0.05 mg/L.

5. Free Chlorine

Exposure to free chlorine damages RO membranes and should be avoided. LG Chem recommends to continuously monitor the residual chlorine concentration and Oxidation Reduction Potential (ORP).

6. Chloramine

Polyamide RO membranes have better tolerance to chloramine than free chlorine. In typical municipal wastewater reuse applications, 3-5 mg/L of chloramine is acceptable. However, it is difficult to specify the acceptable chloramine concentration, as chloramine may cause catalytic oxidation damaging the membrane under high temperature and low pH operation in presence of halogen ions (i.e. bromide, iodide) and transition metals in the feed water. Hence, detailed water analysis should precede before chloramine dosing is determined.

7. Chlorine Dioxide

Use of chlorine dioxide is not endorsed by LG Chem. Chlorine dioxide in the presence of transition metals or bromide may adversely affect the RO membrane performance. Effect of chlorine dioxide is not clearly understood yet and it is recommended, if used, that chlorine dioxide is fully removed from the feed water prior to reaching the RO membranes.

8. Sodium Bisulfite (SBS)

For dechlorination, as an industry practice, 3.0 mg of SBS is typically recommended to remove 1.0 mg of free chlorine. Caution should be exercised in order to not overdose SBS, since a high concentration of residual SBS from overdosing induces two major risks: membrane oxidation and biofouling. The excess amounts of SBS may lead to rapid membrane oxidation from catalytic reactions when the feed water contains transition metals (e.g. Co, Cu, Mn, etc.) and/or membranes are fouled with the transition metals. In addition, the excess amount of SBS may lead to biofouling from the growth of sulfate reducing bacteria, severely deteriorating the membrane performance. LG Chem recommends keeping the residual SBS in the feed water below 1 mg/L.

9. Oxidation Reduction Potential (ORP)

ORP is a parameter to measure the contents of oxidative chemicals, which can do potential harm to RO membranes.

To avoid anomalous membrane oxidation such as catalytic oxidation by SBS, LG Chem recommends monitoring ORP of the concentrate side as well as the feed side. It is desirable to monitor ORP while the system is in offline as well as in online. As a rule of thumb, it is recommended to set a high alarm to take immediate corrective action at 250 mV for the feed/concentrate side and set a high high alarm for emergency shutdown to protect RO membranes at 300 mV for the feed/concentrate side.

However, proper ORP value setting/adjustment should be determined by regularly measuring the residual chlorine and correlating that with ORP values.

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