



FILMTEC Membranes

Water Chemistry and Pretreatment: Scale Control

Introduction

Scaling of RO/NF membranes may occur when sparingly soluble salts are concentrated within the element beyond their solubility limit. For example, if a reverse osmosis plant is operated at 50% recovery, the concentration in the concentrate stream will be almost double the concentration in the feed stream. As the recovery of a plant is increased, so is the risk of scaling.

Due to water scarcity and environmental concern, adding a brine (RO concentrate) recovery system to increase recovery has become more popular. To minimize precipitation and scaling, it is important to establish well-designed scale control measures and avoid exceeding the solubility limits of sparingly soluble salts. In an RO/NF system, the most common sparingly soluble salts encountered are CaSO₄, CaCO₃, and silica. Other salts creating a potential scaling problem are CaF₂, BaSO₄, SrSO₄, and Ca₃(PO₄)₂. Solubility products of sparingly soluble inorganic compounds are listed in Table 2.7.

Table 2.7 Solubility products of sparingly soluble inorganic compounds

Substance	Formula	Temp. °C	Solubility product	Negative log K _{sp}
Aluminum hydroxide	Al(OH) ₃	25	3×10^{-34}	33.5
Aluminum phosphate	AlPO ₄	25	9.84×10^{-21}	20
Barium carbonate	BaCO ₃	25	2.58×10^{-9}	8.6
Barium sulfate	BaSO ₄	25	1.1×10^{-10}	10
Calcium carbonate	CaCO ₃	25	Calcite: 3.36×10^{-9}	8.5
			Aragonite: 6×10^{-9}	8.2
Calcium fluoride	CaF ₂	25	3.45×10^{-11}	10.5
Calcium phosphate	Ca ₃ (PO ₄) ₂	25	2.07×10^{-33}	32.7
Calcium sulfate	CaSO ₄	25	4.93×10^{-5}	4.3
Iron(II) hydroxide	Fe(OH) ₂	25	4.87×10^{-17}	16.3
Iron(II) sulfide	FeS	25	8×10^{-19}	18.1
Iron(III) hydroxide	Fe(OH) ₃	25	2.79×10^{-39}	38.6
Iron(III) phosphate dihydrate	FePO ₄ ·2H ₂ O	25	9.91×10^{-16}	15
Lead carbonate	PbCO ₃	25	7.4×10^{-14}	13.1
Lead fluoride	PbF ₂	25	3.3×10^{-8}	7.5
Lead sulfate	PbSO ₄	25	2.53×10^{-8}	7.6
Magnesium ammonium phosphate	MgNH ₄ PO ₄	25	2.5×10^{-13}	12.6
Magnesium carbonate	MgCO ₃	12	2.6×10^{-5}	4.58
		25	6.82×10^{-6}	5.17
Magnesium fluoride	MgF ₂	18	7.1×10^{-9}	8.15
		25	5.16×10^{-11}	10.3
Magnesium hydroxide	Mg(OH) ₂	18	1.2×10^{-11}	10.9
		25	5.61×10^{-12}	11.25
Magnesium phosphate	Mg ₃ (PO ₄) ₂	25	1.04×10^{-24}	24
Manganese hydroxide	Mn(OH) ₂	18	4.0×10^{-14}	13.4
		25	2×10^{-13}	12.7
Strontium carbonate	SrCO ₃	25	5.6×10^{-10}	9.25
Strontium sulfate	SrSO ₄	17.4	3.8×10^{-7}	6.42
Zinc carbonate	ZnCO ₃	25	1.46×10^{-10}	9.84

FILMTEC™ Membranes
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