



FILMTEC Membranes

Water Chemistry and Pretreatment: Calcium Sulphate Scale Prevention

Calcium Sulphate
Scale Prevention

For the determination of the calcium sulfate scaling potential, a complete feed water analysis is required.

Calculation *g*

1. Calculate the ionic strength of the concentrate stream (I_c) following the procedure described in [Scaling Calculations General \(Section 2.4.1\)](#):

$$I_c = I_f \left(\frac{1}{1-Y} \right) \quad \text{Eq. 5}$$

2. Calculate the ion product (IP_c) for CaSO_4 in the concentrate stream:

$$IP_c = \left[(m\text{Ca}^{2+})_f \left(\frac{1}{1-Y} \right) \right] \left[(m\text{SO}_4^{2-})_f \left(\frac{1}{1-Y} \right) \right]$$

where:

$(m\text{Ca}^{2+})_f = M \text{Ca}^{2+}$ in feed, mol/L

$(m\text{SO}_4^{2-})_f = M \text{SO}_4^{2-}$ in feed, mol/L

3. Compare IP_c for CaSO_4 with the solubility product (K_{sp}) of CaSO_4 at the ionic strength of the concentrate stream, Figure 2.6. If $IP_c \geq K_{sp}$, CaSO_4 scaling can occur, and adjustment is required. For a safe and conservative pretreatment design, adjustment should be made if $IP_c > 0.8 K_{sp}$.

Calculation Example (continued from [Scaling Calculations General \(Section 2.4.1\)](#)):

$$I_c = 0.178$$

$$IP_c = \left[4(5 \times 10^{-3}) \right] \left[4(5 \times 10^{-3}) \right] = 4 \times 10^{-4}$$

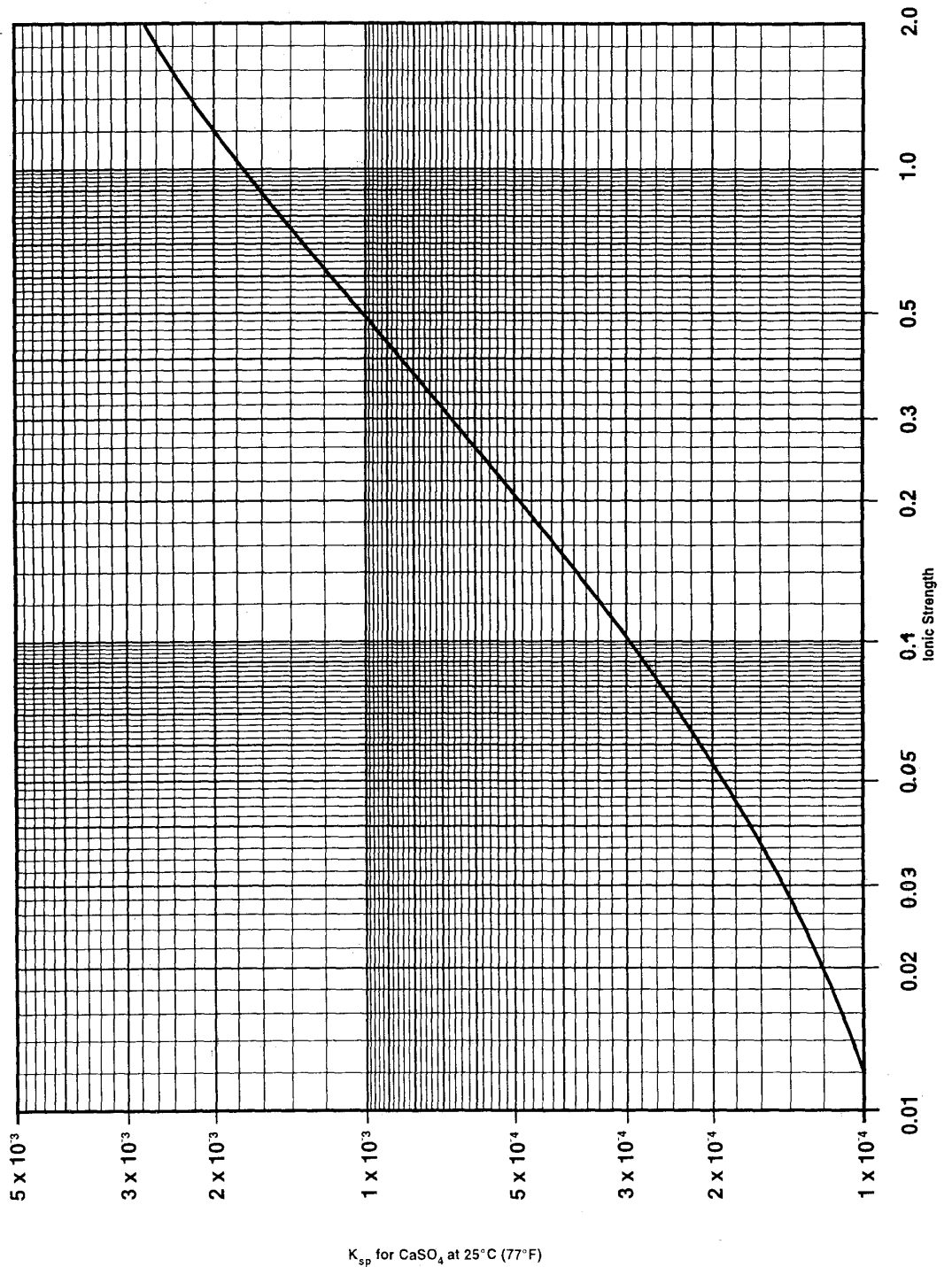
$$K_{sp} = 4.4 \times 10^{-4} \quad (\text{from Figure 2.2})$$

$$IP_c = 0.9 K_{sp} \quad \text{therefore adjustments are required.}$$

Adjustments for CaSO_4 Scale Control

- If the IP_c for CaSO_4 is less than $0.8 K_{sp}$, a higher recovery can be used with respect to CaSO_4 scaling. Reiteration of the calculations at higher recovery can be used to determine the maximum conversion with respect to CaSO_4 scaling.
- If the IP_c for CaSO_4 is greater than $0.8 K_{sp}$, a lower recovery must be used to prevent scaling. Reiteration of the calculations at lower recovery can be used to determine the allowable recovery with respect to CaSO_4 scaling.
- If the maximum allowable recovery is lower than desired, [strong acid cation exchange resin softening \(Section 2.3.4\)](#) or [weak acid cation exchange resin dealkalization \(Section 2.3.5\)](#) can be used to remove all or part of the Ca^{2+} . This will permit higher recovery of the reverse osmosis system with respect to CaSO_4 scaling.
- Lime softening with lime or lime plus soda ash (see [Liming Softening, Section 2.3.6](#)) will decrease the Ca^{2+} concentration and thus permit higher recovery with respect to scaling by CaSO_4 .
- Addition of a scale inhibitor to the feed stream permits operation of the RO system above the K_{sp} value, when adequate scale inhibitor is added according to the scale inhibitor manufacturer's instructions.

Figure 2.6 K_{sp} for CaSO_4 versus ionic strength ⁹



K_{sp} for CaSO_4 at 25°C (77°F)

FILMTEC™ Membranes
 For more information about FILMTEC membranes, call the Dow Liquid Separations business:
 North America: 1-800-447-4369
 Latin America: (+55) 11-5188-9222
 Europe: (+32) 3-450-2240
 Pacific (ex. China): +800-7776-7776
 China: +10-800-600-0015
<http://www.filmtec.com>

Notice: The use of this product in and of itself does not necessarily guarantee the removal of cysts and pathogens from water. Effective cyst and pathogen reduction is dependent on the complete system design and on the operation and maintenance of the system.

Notice: No freedom from any patent owned by Seller or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other governmental enactments. Seller assumes no obligation or liability for the information in this document. **NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.**

