Supporting Information

Thermomorphic Hydrophilicity Base-Induced Precipitation for Effective Descaling of Hypersaline Brines

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Number of Tables: 1

Number of Figures: 3

Table S1. Precipitation equilibria of hydroxide minerals, complexation equilibria of calcium and magnesium with hydroxide and chloride, and dissociation equilibrium of water.

Reaction	log *K*	Reference
$Ca(OH)_{2(s)} \leftrightarrow Ca^{2+} + 2OH^-$	−5.30 at 25 °C −5.20 at 15 °C	Snoeyink and Jenkins (1980)
$CaOH^+ \leftrightarrow Ca^{2+} + OH^-$	1.30 at 25 °C	Snoeyink and Jenkins (1980)
$CaCl^+ \leftrightarrow Ca^{2+} + Cl^-$	0.40 at 25 °C	Benjamin (2002)
$Mg(OH)_{2(s)} \leftrightarrow Mg^{2+} + 2OH^-$	−11.20 at 25 °C −11.22 at 15 °C	CRC handbook of chemistry and physics (1977)
$MgOH^+ \leftrightarrow Mg^{2+} + OH^-$	2.60 at 25 °C	Snoeyink and Jenkins (1980)
$MgCl^+ \leftrightarrow Mg^{2+} + Cl^-$	−4.40 at 25 °C	Brezonik and Arnold (2011)
$H_2O \leftrightarrow H^+ + OH^-$	−14.00 at 25 °C −14.34 at 15 °C	Snoeyink and Jenkins (1980)

Snoeyink, V. L.; Jenkins, D., Water chemistry. Wiley: New York, 1980; p xiii, 463 p.
Benjamin, M. M., Water chemistry. McGraw-Hill: Boston, 2002; p xix, 668 p.
CRC handbook of chemistry and physics. In CRC Press: Cleveland, Ohio, 1977; p volumes
P.L. Brezonik and W.A. Arnold (2011) Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems

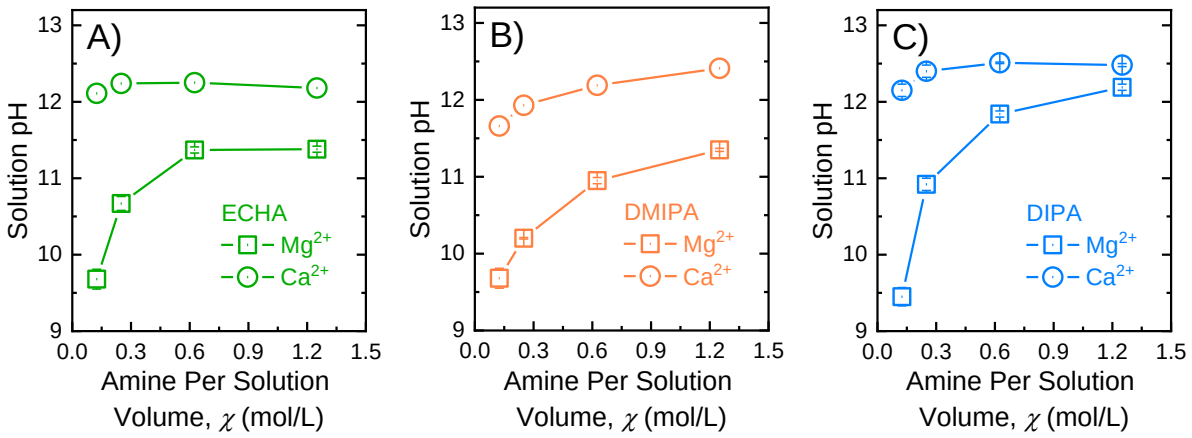

Figure S1. Solution pH after induced precipitation of hydroxide minerals as a function of the amount of amine added to the feed solution for (A) ECHA, (B) DMIPA, and (C) DIPA. The basic amines were added to 100 mM $MgCl_2$ or $CaCl_2$ feed solution (square and circle symbols, respectively) at amine to solution ratios, χ, of 0.125, 0.25, 0.625, 1.25 mol/L to induce mineral scale precipitation at T_L = 15 °C for 1 h. Data points and error bars are mean and standard deviation, respectively, from duplicate experiments.

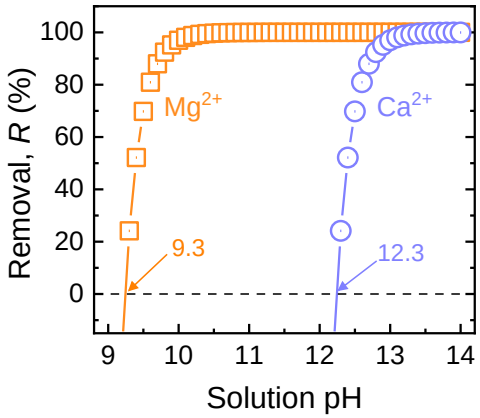

Figure S2. Calculated removals of Mg^{2+} and Ca^{2+} as a function of solution pH, by assuming that all precipitates are hydroxide minerals $Mg(OH)_{2(s)}$ and $Ca(OH)_{2(s)}$, and using solubility product constant, K_{sp}, of $10^{-11.24}$ and $10^{-5.19}$, respectively, at 15 °C.

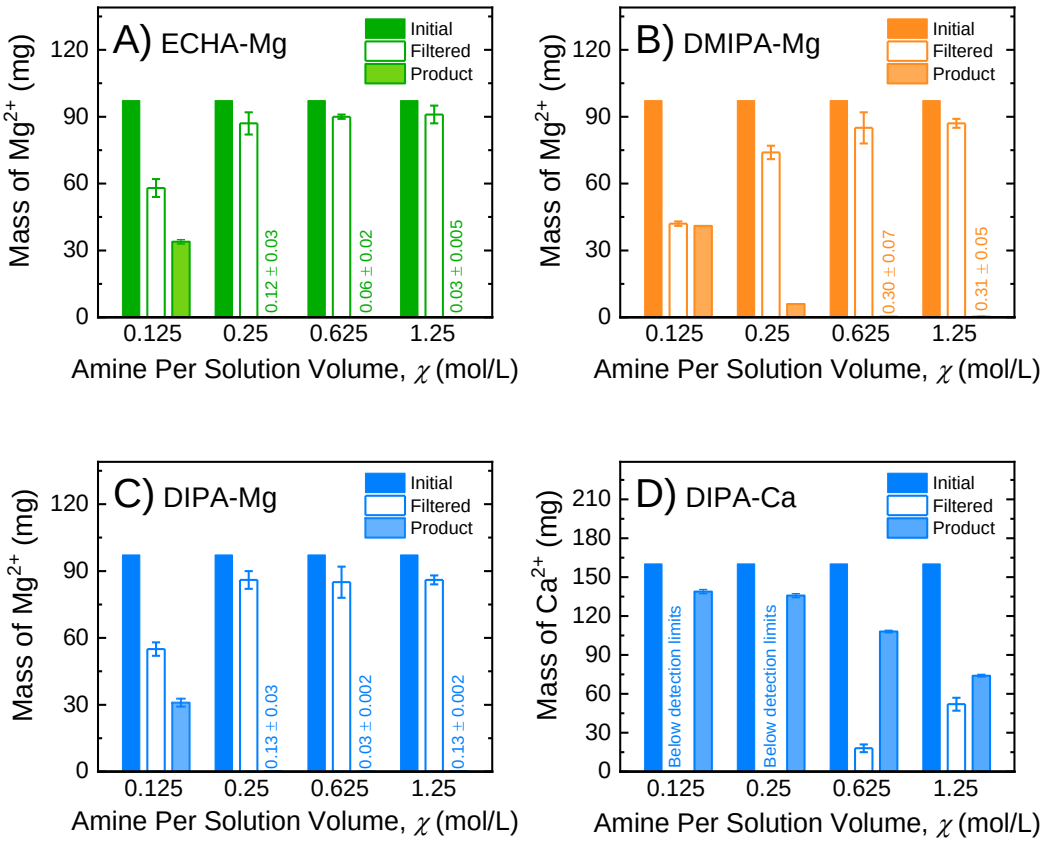

Figure S3. Mass of magnesium and calcium in the filtrate and product water after induced precipitation for different amounts of thermoresponsive amine bases, ECHA, DMIPA, and DIPA, added to feed solutions of 100 mM $MgCl_2$ or $CaCl_2$. Filtered mass of Mg^{2+} and Ca^{2+} (empty columns) are determined from weight of the precipitates sieved off with a microporous membrane. Mass in the product water (light shaded columns) is measured using ion chromatography. For comparison, the initial mass of Mg and Ca are indicated by dark shaded columns. Data points and error bars are mean and standard deviation, respectively, from duplicate experiments.