

Supplementary Information

Efficient Leaching Process of Rare Earth, Alkali and Alkaline Earth Metals from Phosphogypsum based on Methanesulfonic Acid (MSA) as Green & Eco-friendly Lixiviant

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Supplementary figures captions

Fig. S1. Chemical structures of (a) MSA and (b) PTSA.

Fig. S2. Effect of S/L ratio on the leaching efficiency of REEs and metals impurities using (a) MSA, (b) PTSA and (c) HCl (operating conditions : 2 M, 120 min, 25 °C and 500 rpm).

Fig. S3. Effect of temperature on the leaching efficiency of REEs and metals impurities in the range 25-80 °C using (a) MSA, (b) PTSA and (c) HCl (operating conditions : 2 M, 1/8, 120 min, 500 rpm).

Supplementary figures

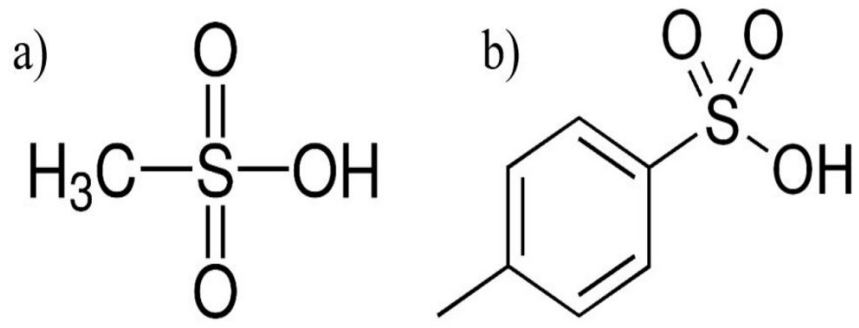
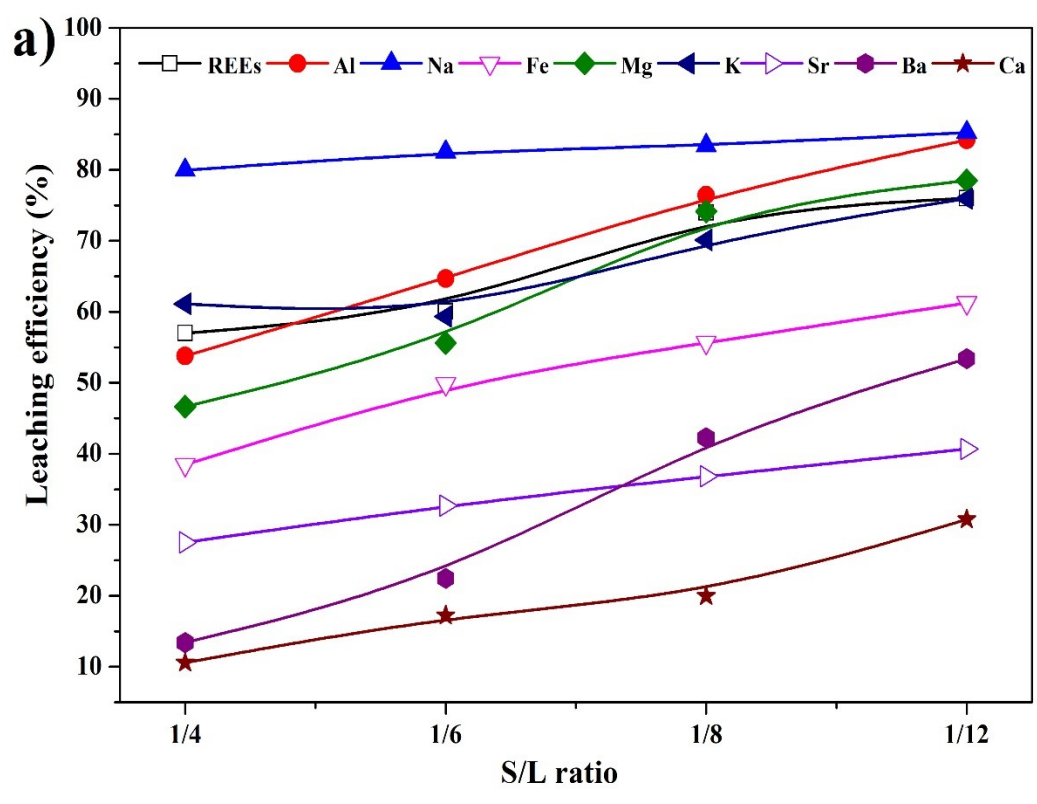


Fig. S1. Chemical structures of (a) MSA and (b) PTSA.



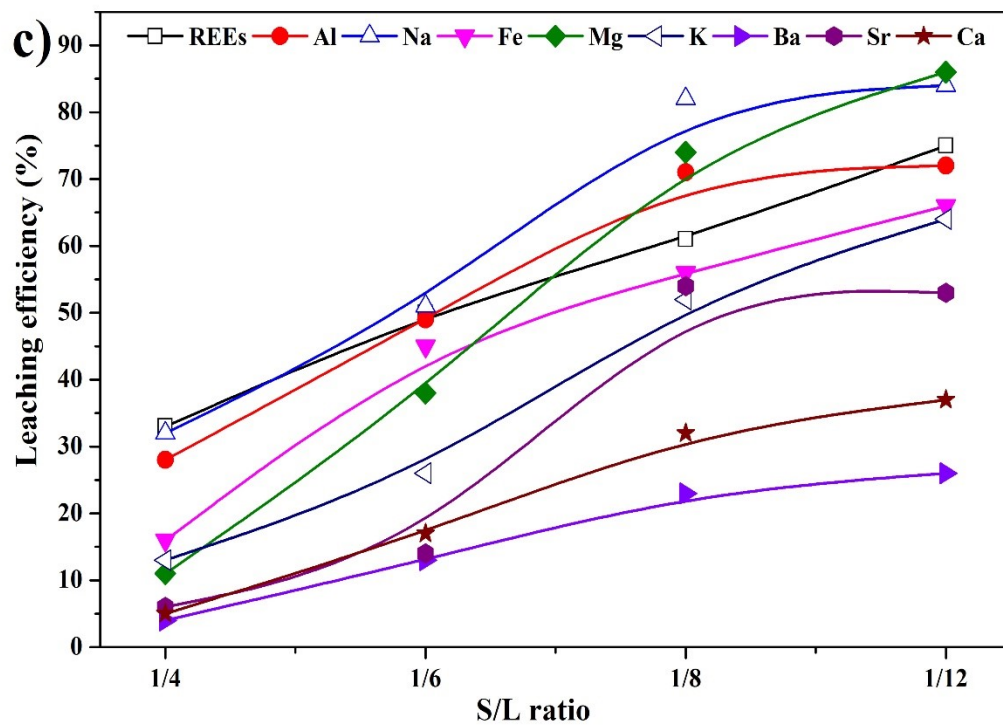
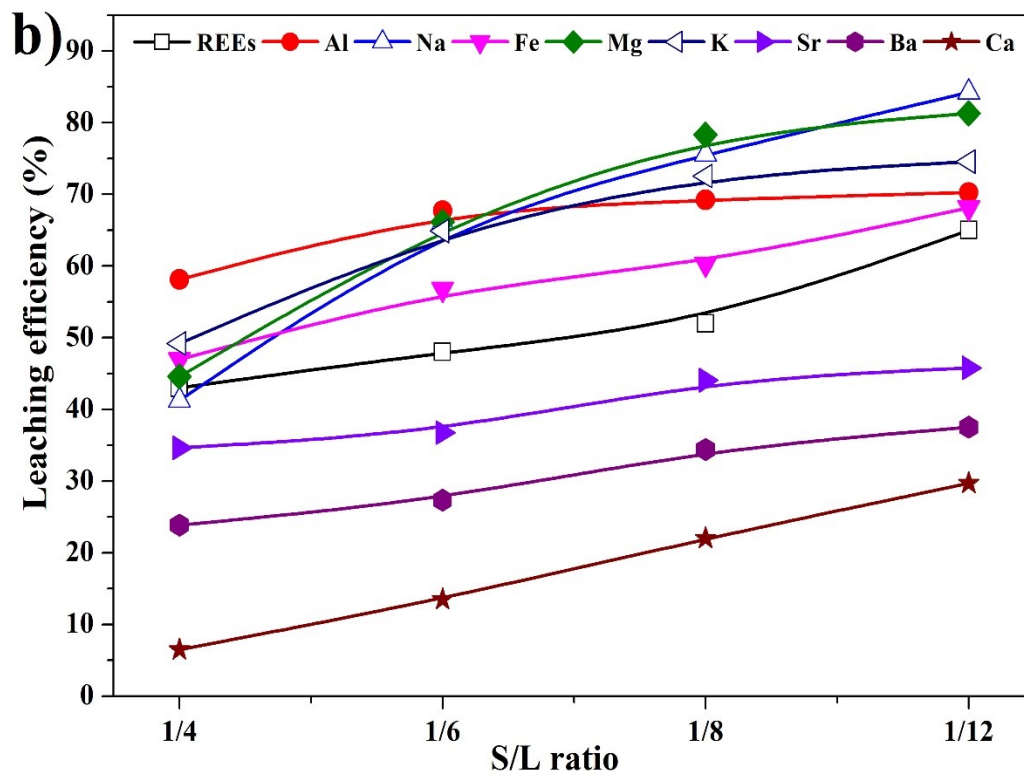
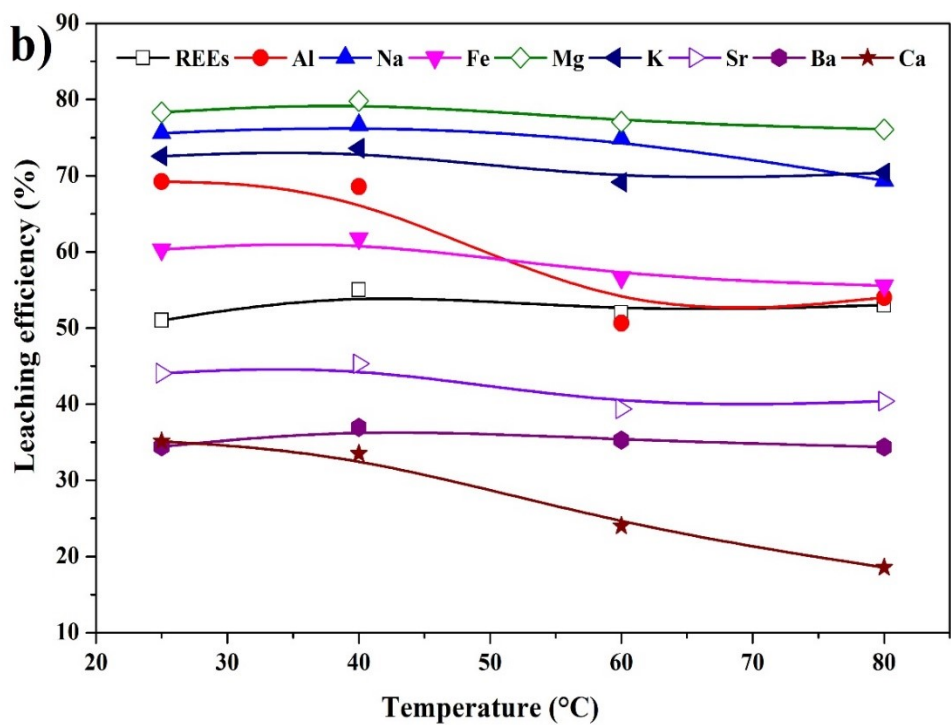
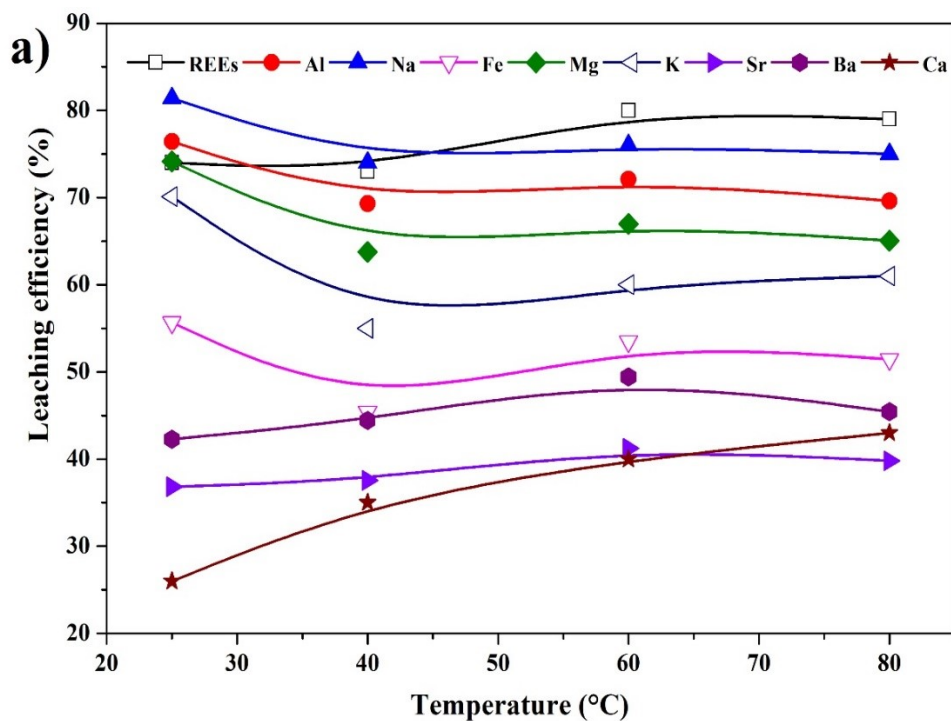


Fig. S2. Effect of S/L ratio on the leaching efficiency of REEs and metals impurities using (a) MSA, (b) PTSA and (c) HCl (operating conditions : 2 M, 120 min, 25 °C and 500 rpm).



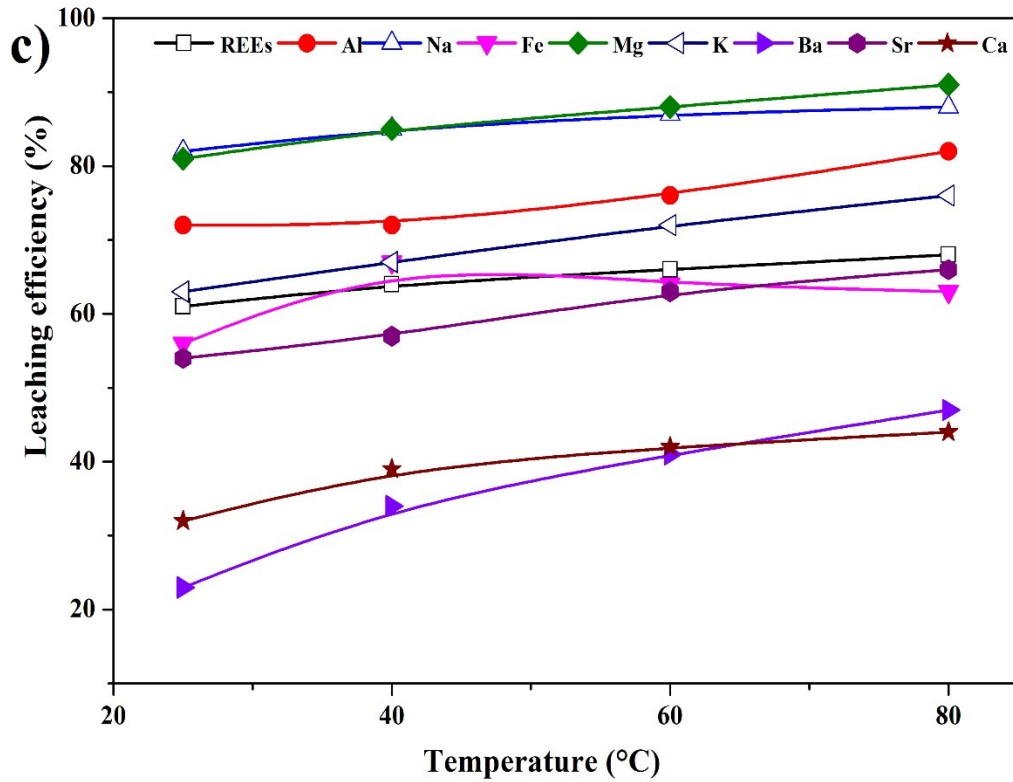


Fig. S3. Effect of temperature on the leaching efficiency of REEs and metals impurities in the range 25-80 °C using (a) MSA, (b) PTSA and (c) HCl (operating conditions : 2 M, 1/8, 120 min, 500 rpm).