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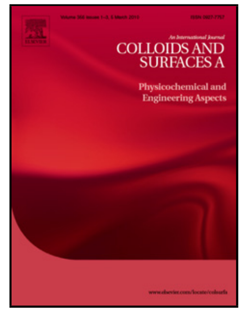

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Innovative insight for sodium hexametaphosphate interaction with serpentine

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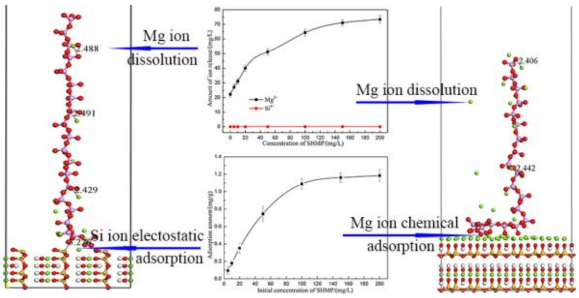
Graphical Abstract



ABSTRACT Serpentine, as a common magnesium silicate mineral found in many ores around the world, is usually dispersed/depressed with the dispersants/depressants by adsorbing on the surface of serpentine. Therefore, in this work, the interaction mechanism of the dispersant of sodium hexametaphosphate (SHMP) was investigated in detail though solution chemistry calculations, Fourier transform infrared spectroscopy (FTIR) analyses, zeta potential measurements, adsorption and ion release tests, and molecular dynamics (MD) simulations. Results indicated that anionic components of $H_2PO_4^-$ and HPO_4^{2-} in SHMP, as the predominant and effective species, adsorbed on the Mg and Si sites of the serpentine surfaces, which occurred on the Si site through the electrostatic interaction and on the Mg site through the chemical adsorption. As a result, the surface charge of serpentine was reversed from positive to negative at all pH region examined. In addition, ion release tests confirmed that SHMP dissolved some Mg ions for forming soluble complexes from the serpentine surface into the solution. Thus, the negative charge of it was further enhanced, which would lead to much stronger repulsion between negatively charge valuable minerals (e.g., pentlandite) and serpentine. Thus, the serpentine would be well dispersed with the valuable minerals.

Keywords**:** sodium hexametaphosphate; chemical adsorption; electrostatic adsorption; surface metal ions; serpentine

1. Introduction

Serpentine ($Mg_3Si_2O_5(OH)_4$) is one of the common MgO-containing silicates occurred in such ores, sulfide ores bearing nickel or copper, magnesite ores and brucite ores and so on, which significantly interferes with the concentration of valuable minerals (*e.g.* pentlandite, chalcopyrite, molybdenite, magnesite and brucite) when they are beneficiated by froth flotation [1-5]. Serpentine is easily floated into the concentrate through attachment to the valuable minerals or air bubbles for the formation of "slime coatings" or "bubble-macrofibers aggregates" and results in the recovery of MgO-containing minerals [6-8]. In addition, these aggregates or coatings normally decrease the hydrophobicity of valuable minerals, such as pentlandite [9]. When it is heavily coated by serpentine