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THE SIGNIFICANCE OF INTERFACIAL WATER STRUCTURE IN SOLUBLE SALT FLOTATION

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ABSTRACT

It had been proposed in previous research that the selective flotation of alkali halides is due to the adsorption of oppositely charged collector colloids by heterocoagulation. Now, more extensive research, reported in this dissertation, reveals that such an explanation for soluble salt flotation is probably of little significance. The flotation response of alkali halide and oxyanion salts, as well as double salts with both cationic (dodecyl amine hydrochloride, DAH) and anionic (sodium dodecyl sulfate, SDS) collectors, seems rather to be determined by water structure at the brine/salt interface, regardless of the sign of the surface charge and whether or not precipitation of the collector colloid occurs. This conclusion has been supported by microflotation, surface charge, surface tension, contact angle, viscosity, and vibrational spectroscopy studies. These experimental results clearly show that flotation of salt particles from their saturated brines is determined by the way in which the dissolved salt influences the structure of water at the interface. If the salt promotes the disruption of the hydrogen bonded interfacial water molecules, i.e., the salt is structure breaking, then flotation is possible regardless of which collector is used.

In addition to identifying the importance of the interfacial water structure in the flotation of soluble salts, the thermodynamic stability of soluble salts with respect to their crystal hydrates has been examined. The importance of the thermodynamic stability of the salt has been shown to be a critical factor which must be taken into consideration in

the analysis of soluble salt flotation systems.

Finally an effort to study the spectroscopic characteristics of interfacial water at the brine/salt interface was made. Spectroscopic techniques included Fourier transform infrared internal reflection spectroscopy (FTIR/IRS), Raman and sum frequency generation (SFG). Clear spectroscopic evidence for variation in the structure of interfacial water was not obtained. Nevertheless some of the spectroscopic results support this analysis of soluble salt flotation. As part of this experimental effort, however, the importance of the anomalous dispersion effect of water in the FTIR/IRS analysis of interfacial water was established. This important contribution reveals that spectral changes of water in FTIR/IRS experiments cannot be attributed to changes in the interfacial water structure, but rather due to optical effects.