The effect of lithological factors on the separation efficiency of hot alkaline water-based extraction for oil sand bitumen

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Introduction: The efficiency of hot alkaline water-based separation for oil sand bitumen was controlled not only by external factors (water temperature, slurry water PH, multivalent cations, additives etc.), but also by internal factors (mineral composition, particle size etc.). In order to get optimized process parameters, the influence of lithological factors on the bitumen separation in thermal alkaline solution should be considered. Based on previous research on external factors, a series of artificial oil sands were made in different proportions of mineral composition and particle size and then aged in lab to compare the recovery results. Subsequent hot alkaline water-based separation experiments were conducted on compatibity experiments

Experiments: The artificial oil sands were made similar to the oil sand in Inner Mongolia in lithology, and then aged in lab to compare the influence of different aging time on the efficiency of hot alkaline water-based separation for oil sand bitumen. The total bitumen was separated into upfloated bitumen (asphalt 1), emulsified bitumen (asphalt 2) and residual asphalt (asphalt 3). The results indicates that 20 days aging time is best time for the recovery rate of asphalt 1 (69.34%)and total bitumen (89.65%), which is closed to the recovery rate of the natural oil sand samples in Inner Mongolia (asphalt1: 66.3%; the total bitumen: 97.1%). A series of artificial oil sands in different proportions of mineral composition and particle size were prepared and then conducted hot alkaline water-based separation experiments for 20 days to quantitatively study the influence of lithological factors on the efficiency of bitumen recovery.

Results: Figure 1(a) shows that the particle size differences of minerals can influence obviously on the recovery of asphalt 1 and slightly on the total bitumen. Figure1(a)-figure(d) shows that with the increasing clay minerals content, the efficiency for bitumen separation decreased gradually. Namely, the recovery rate of asphalt 1 and the total bitumen reduced, while the recovery rate of asphalt 3 increased. It indicated that increase of clay minerals content would reduce the separation efficiency of oil sands. In addition, the content of montmorillonite had a big impact on the recovery of oil sands. Keeping contents of other

minerals constant, the recovery rate of asphalt would reduce in following order: montmorillonite>illite>chlorite. The reason is related not only to the differences of specific surface area between different clay minerals, but also to the differences of chemical adsorption of asphalt on different mineral grains.

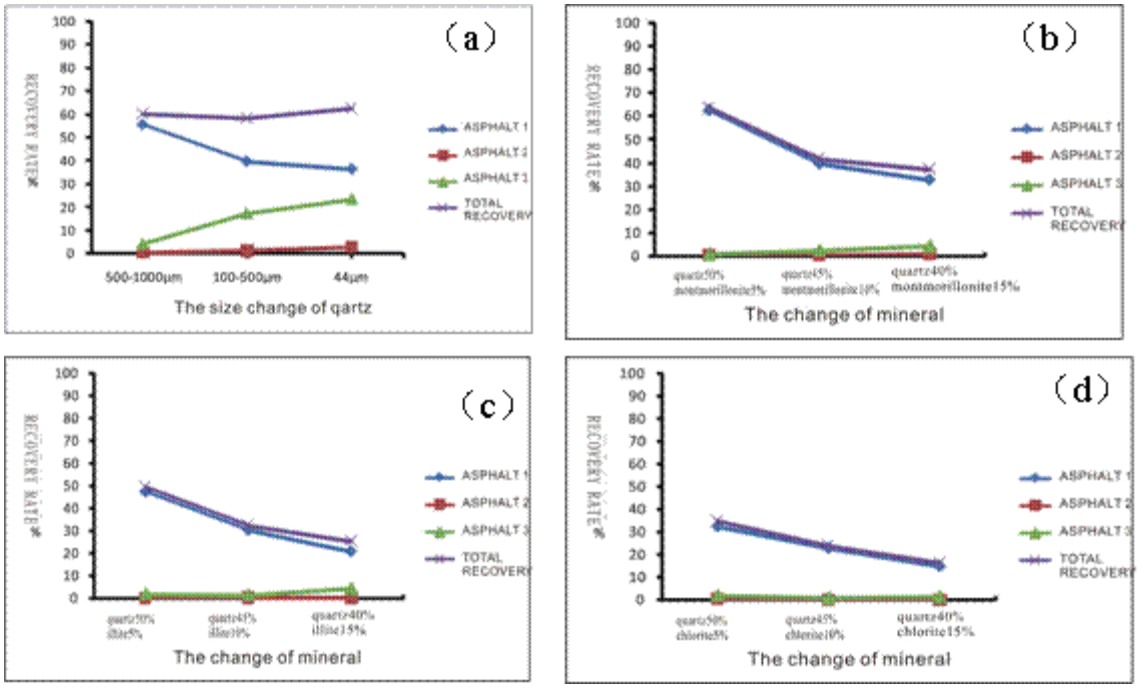

Figure1. *The relationship between the recovery rate and the change of lithology*

Conclusion: Differences in the mineral composition, particle size, and content of clay minerals would significantly influence efficiency of hot alkaline water-based separation for oil sand bitumen. When a large amount of particle (size less than 44μm) exist in oil sands or the content of clay minerals (especially montmorillonite) in oil sands is more than 15%, the separation efficiency of hot alkaline water-based extraction for oil sand bitumen is very poor. Hot alkaline water-based extraction method is not suitable for oil sands with the above mineralogical characteristics.

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