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Recovery of water from acid mine drainage

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ABSTRACT

The reaction rate of sulphate removal from acid mine drainage using barium carbonate was studied for various pH, calcium concentration, and $BaCO_3/SO_4^{2-}$ feed ratios in batch studies. Process synthesis concepts were used to investigate the interaction between the optimum regions for reactor operation and the experimental results. The effect of various process objectives on the optimal operating region were also investigated.

MATERIALS AND METHODS

Pre-treated AMD containing 2000 mg/l SO_4^{2-} was used as feed water in this study. $BaCO_3$ produced in the CSIR laboratories was used for SO_4^{2-} removal during batch studies.

Sulphate was determined in the filtered samples using a Hach DR/2010 data logging spectrophotometer. The pH for the samples was determined using a Metrohm 691 pH meter.

BACKGROUND

The CSIR patented Alkali Barium and Calcium (ABC) process uses the barium technology to remove sulphate from acid mine drainage (AMD) water and other industrial effluents. The sulphate removal process involves precipitation of sulphate present in mine wastewater mainly as $CaSO_4$ to generate $BaSO_4/CaCO_3$ sludge.

This work focused on the interaction between the optimum regions for reactor operation and the experimental results.

WATER QUALITY RESULTS

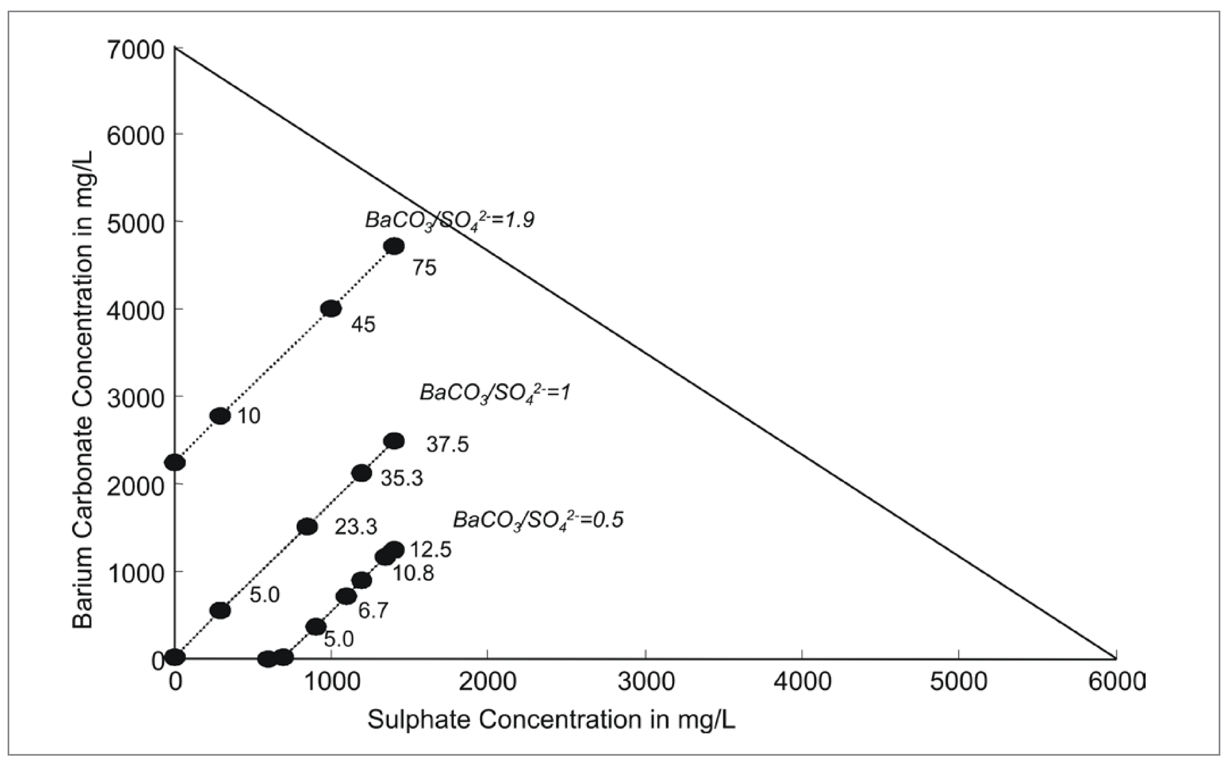

Figure 1:
Rate of Sulphate Removal at 25°C at various concentrations of sulphate and barium carbonate for three different feed ratios. The numbers indicate the rate of sulphate removal in mg sulphate/L.min. The feed ratio for each set of experiments is indicated on the associated line .

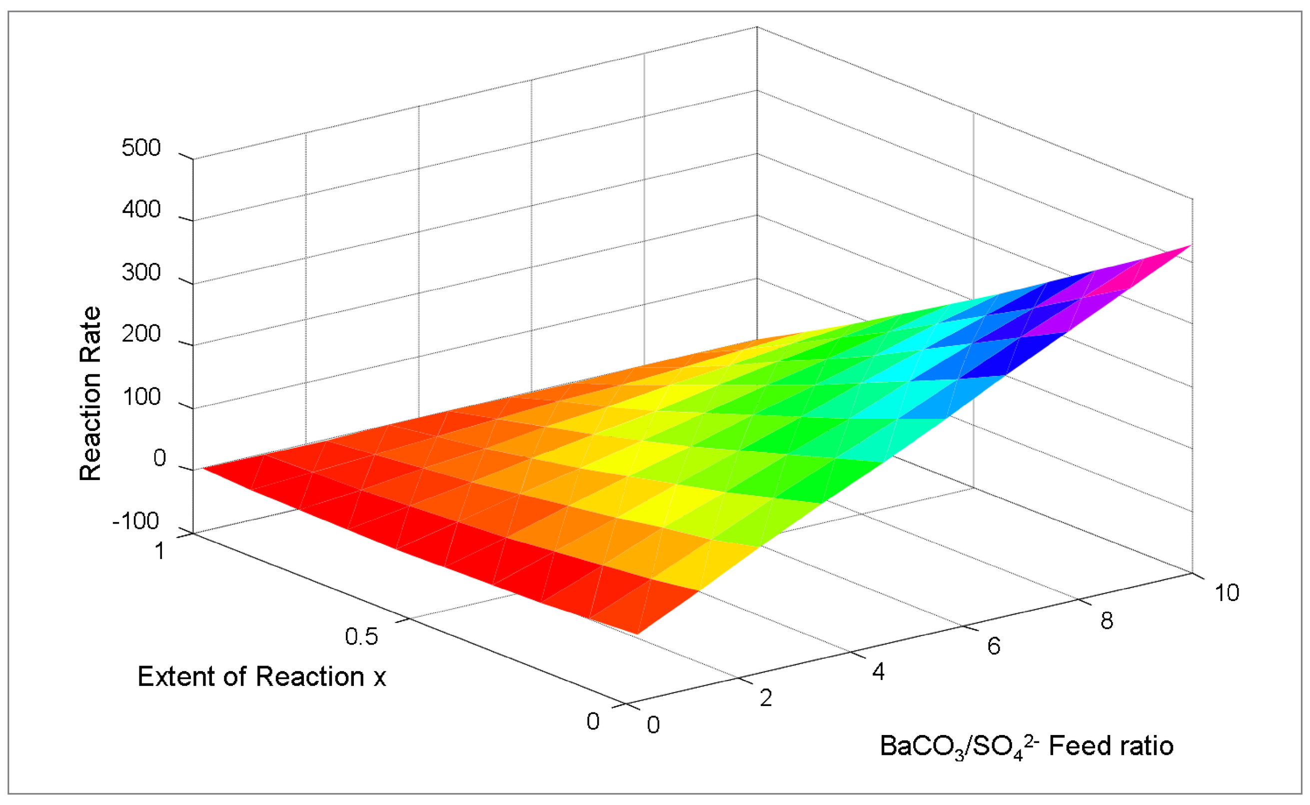

Figure 2:
Surface Reaction Rate (Sulphate Removal) as a function of the extent of reaction and the $BaCO_3$/Sulphate feed ratio

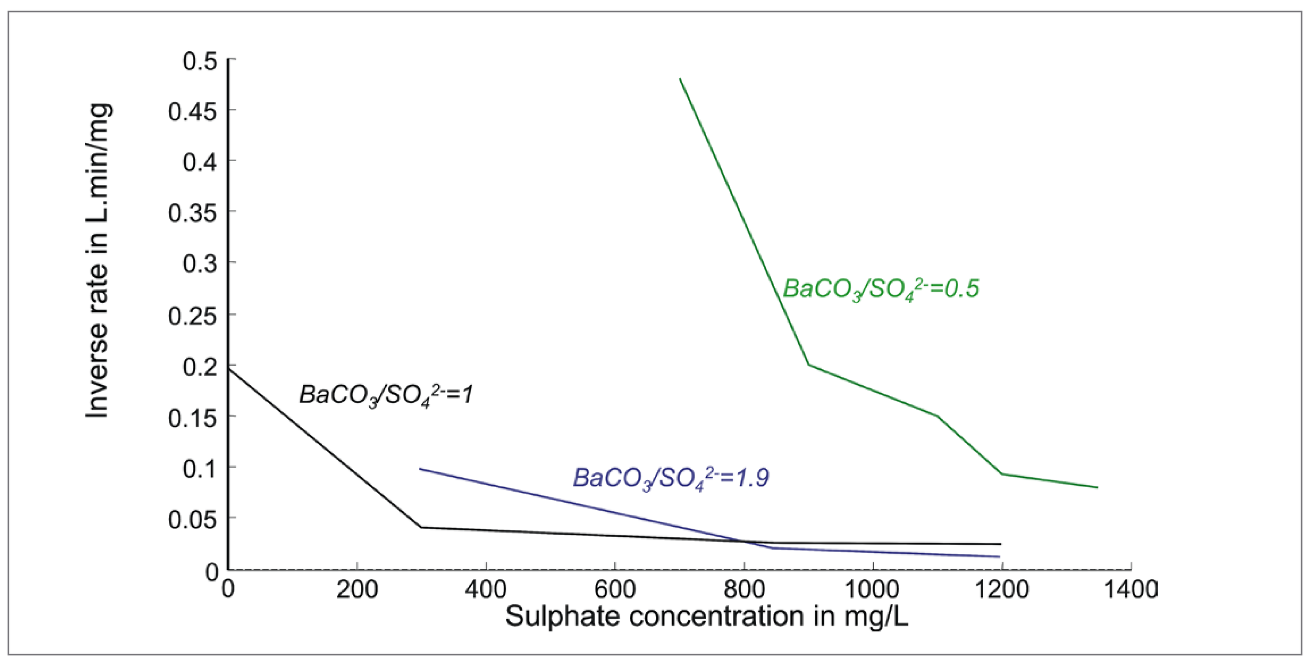

Figure 3:
Plot of $1/rSO_4^{2-}$ versus Sulphate Concentration at 25o C. Each curve corresponds to a different feed ratio of $BaCO_3/SO_4^{2-}$ as indicated in the legend. The dimensions of the rate of SO_4^{2-} removal are mg SO_4^{2-}/L.min

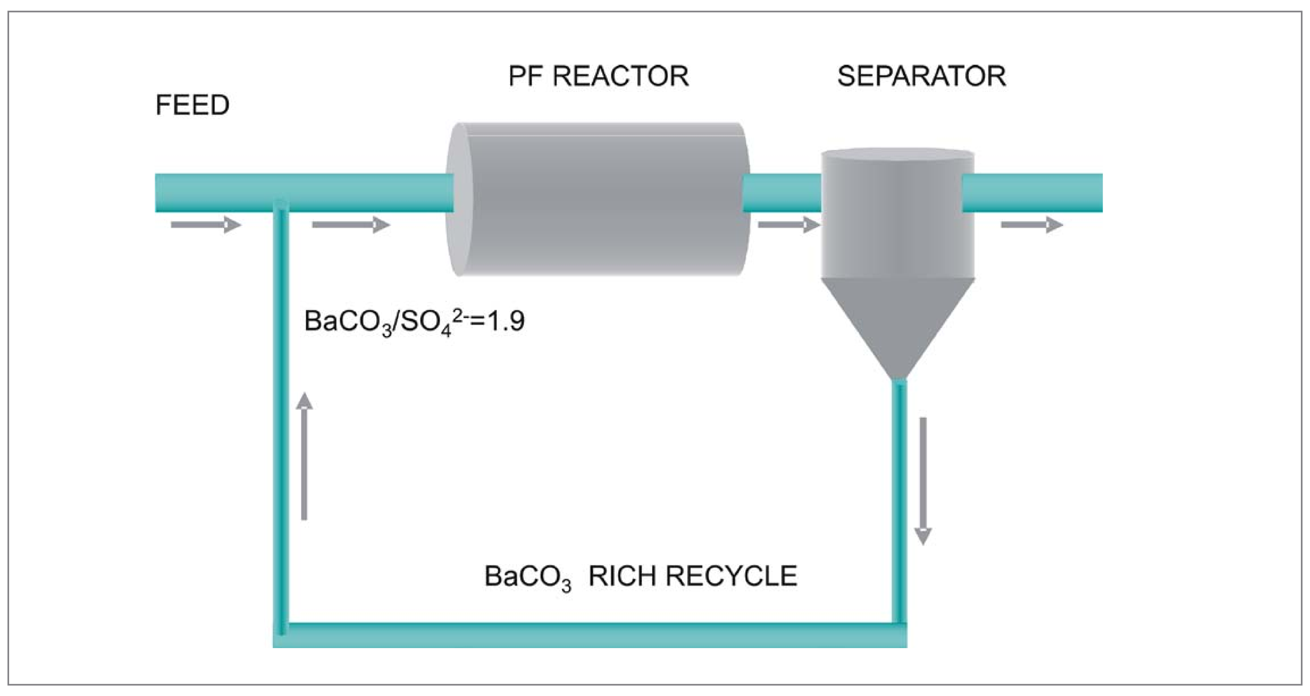

Figure 4:
Process Configuration for removing a given amount of sulphate in the smallest reactor

CONCLUSION

The optimal region for the operation and design of a sulphate removal reactor in the barium process differs for different objectives. Therefore, one need to be certain about what one is optimizing and set as system parameters. The influence of the system parameters on the optimal operating region needs to be understood. This can only be done if the kinetics and process design are done iteratively. It would be desirable to integrate the experimental program with the process design. Probably one of the most important results in this work is that implementing the optimal reactor operating conditions results in a process with somehow large excess feed. Hence, one should not optimize the reactor configuration independently of the process in which the reactor is going to be used.