Using a sulfur autotrophic fluidized bed reactor for simultaneous perchlorate and nitrate removal from water: S disproportionation prediction and system optimization

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Abstract

A sulfur autotrophic fluidized bed reactor was established to overcome mass transfer problems and shorten the co-reduction time for perchlorate and nitrate from aqueous solution. Response surface methodology (RSM) was used to predict the subsequent extent of sulfur (S) disproportionation based on three variable parameters, namely the hydraulic retention time (HRT), co-existing nitrate concentration (C_〖inf 〗[?][[[[NO〗_3^−N〗) and recirculation ratio (R). The extent of sulfur (S) disproportionation was determined by sulfate generation and alkalinity consumption. RSM results show that a long HRT and high R promoted whereas co-existing nitrate inhibited sulfate production from S disproportionation. For complete perchlorate and nitrate reduction (>98.45%) with relatively low sulfate generation (236.07 mg/L), the optimal HRT, C_〖inf 〗[?][[[[NO〗_3^−N〗 and R were 0.50 h, 10 mg/L and 14, respectively. High-throughput sequencing revealed that Chlorobaculum was associated with S disproportionation while the abundance of Sulfurovum, an effective denitrification/perchlorate reducing bacteria, decreased over the height of the reactor.

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