Title: Enhanced Ethanol-Type Fermentation from Sulfate-Laden Organic Wastewater through Yeast Supplementation and Increased Organic Loading Rate

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Abstract: Establishing a direct interspecies electron transfer methanogenic pathway via ethanol-type fermentation offers an efficient strategy for energy recovery from sulfate-rich organic wastewater. This study rapidly established ethanol-type fermentation by integrating yeast addition and an elevated organic loading rate (OLR), thereby providing a self-sufficient ethanol substrate to enhance sludge conductivity. The results demonstrate that, with an OLR of 7.5 kg COD/m^3/d, yeast addition enabled rapid establishment of ethanol-type fermentation. In addition, hydraulic retention time (HRT) significantly influenced ethanol production, which peaked at 1882.8 mg COD/L in the yeast group under an HRT of 12 h and OLR of 16 kg COD/m^3/d. Crucially, yeast supplementation increased the abundance of cysteine synthase (*cysC*) and sulfite reductase (*cysJ* and *cysI*), boosting sulfate reduction efficiency from 34% to 88% under acidic conditions (pH about 4.3–4.8). Overall, the addition of yeast can rapidly establish ethanol fermentation and enhance sulfate reduction, especially at lower pH values. These findings provide a feasible strategy for the industrial treatment of sulfate-rich organic wastewater, aiming to enable efficient energy recovery alongside synergistic pollutant removal.

Key words: Peptides and proteins Ethanol Fermentation Anions Redox reactions

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