

Mass transfer characteristics and biological effect of flue gas during microalgae culture

Bo Wang¹, Wen Wang², Yu Xu¹, and zhongliang sun³

¹Yantai University

²State Nuclear Power Automation System Engineering Company

³Henan University

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Abstract

Not only carbon dioxide (CO₂) but also air pollutants, such as sulfur oxides (SO_x) and nitrogen oxides (NO_x), are present in flue gas, and their reasonable and effective utilization is conducive to reducing the cost of microalgal biomass production. By utilizing simulated flue gas, the absorption characteristics of different components in transfer units were explored. The results showed that the presence of SO₂ decreased the absorptivity of CO₂, which reduced the concentration of the available carbon source for microalgal cells in the culture medium at the same pH value. Moreover, the presence of high-concentration oxygen (O₂) in flue gas could improve the absorptivity of nitric oxide (NO). *Scenedesmus dimorphus* was cultured by using sulfur- or nitrogen-deficient culture media. The results showed that SO_x and NO_x in flue gas did not significantly influence the growth and biochemical compositions of microalgal cells when these gases were dissolved in water. Based on the above results and the metabolic kinetics of microalgal cells for nutrient elements, an adjustment strategy for the initial gas source when culturing microalgae with flue gas is proposed: (1) flue gas should be partially desulfurized so that the SO_x and CO₂ concentrations after desulfurization satisfy a certain relationship with the components; and (2) denitrification should not be performed because flue gas can be oxidized before utilization to increase the rate of utilization of NO.

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