Kinetic Model and Simulation of the Adsorption-Biofilm Theory for the Process of Biopurifying VOC Waste Gas

Sun Peishi, Huang Bing, Huang Ruohua, Yang Ping (Institute of Environment Science & Eng., Kunming University of Science and Technology, Kunming 650093, E-mail: sunps@ynmail.com)

Abstract: For the process of biopurifying waste gas containing VOC in low concentration by using a biological trickling filter, the related kinetic model and simulation of the new Adsorption-Biofilm theory were investigated in this study. By using the lab test data and the industrial test data, the results of contrast and validation indicated that the model had a good applicability for describing the practical bio-purification process of VOC waste gas. In the simulation study for the affection of main factor, such as the concentration of toluene in inlet gas, the gas flow and the height of biofilm-packing, a good pertinence was showed between calculated data and test data, the interrelation coefficients were in 0.80 - 0.97.

Keywords: adsorption-biofilm theory; kinetic model; simulation study; purification of VOC waste gas
\( \text{O}_2 \) is dissolved in water.

(4) Dissolution of \( \text{CO}_2 \) in water, \( \text{H}_2\text{O} \).

(5) Dissolution of \( \text{CO}_2 \) in water, \( \text{H}_2\text{O} \).

\[ c_{\text{in}} = c_{\text{out}} = c_1 \]

(1) \( q \) (mg/(L\cdot h))

\[ q = B \left( \frac{mg}{(L\cdot h)} \right) \]

\[ A \cdot \frac{dc_e}{dH} - \frac{L \cdot dc_i}{A \cdot dH} = \frac{b \cdot A \cdot c_e}{1 + A \cdot c_e} \]

\[ c_{\text{gout}} + \frac{1}{A} \ln c_{\text{gout}} = \frac{1}{A} \ln c_{\text{gin}} + c_{\text{gin}} - \frac{b \cdot A \cdot \text{Hc} \cdot H}{Q \cdot \text{Hc} - L} \]
(2)\[ c_b < 3.0 \text{mg/L} \]  
\[ b = 238.89 \text{mg/(L} \cdot \text{h}) \]  
\[ \lambda = 0.2878 \]  
\[ b = 112.36 \text{mg/(L} \cdot \text{h}) \]  
\[ \lambda = 0.000178 \]  
\[ r = 0.97 \]  
\[ 1.27\% \]

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\[ c_{\text{gin}} \]  
\[ Q \]  
\[ H \]  
\[ c_{\text{gout}} \]  
\[ H\% \]  
\[ B \]  
\[ 5 - 9 \]

Fig. 3 Comparing the result calculated by model with experimental result for bio-elimination capacity of toluene (lab test data)

Fig. 4 Comparing the result calculated by model with experimental result for purification efficiency of toluene (industrial test data)

Fig. 5 Comparing the result calculated by model with experimental result for purification efficiency

Fig. 6 Comparing the result calculated by model with experimental result for bio-elimination capacity of toluene
Fig. 7 Comparing the result calculated by model with experimental result for purification efficiency

Fig. 8 Comparing the result calculated by model with experimental result for bioremoval capacity of toluene

Fig. 9 Comparing the result calculated by model with experimental result for concentration of toluene at the different height of bio-packing layer