ORIGINAL PAPER

Kinetic modeling of carbon and nutrients removal in an integrated rotating biological contactor-activated sludge system

A. Akhbari · A. A. L. Zinatizadeh ·
P. Mohammadi · Y. Mansouri · M. Irandoust ·
M. H. Isa

Abstract In this study, kinetics of biological carbon, nitrogen, and phosphorous removal from a synthetic wastewater in an integrated rotating biological contactor-activated sludge system was investigated. The experimental data obtained from varying four significant independent factors viz., hydraulic retention time, chemical oxygen demand for nitrogen to phosphorus ratio, internal recirculation from aerobic to anoxic zone and disks rotating speed were used for the process kinetic modeling. In order to obtain the bioprocess kinetic coefficients, Monod, first-order and Stover–Kincannon models were employed. As a result, Monod and Stover–Kincannon models were found to be the appropriate models to describe the bioprocess in the rotating biological contactor-activated sludge system as the determination coefficient for the first-order model obtained less than 0.79. According to the Monod model, growth yield, microbial decay rate, maximum specific biomass growth rate, and half-velocity constant coefficients were found to be 0.712 g VSS/g COD, 0.008/d, 5.54/d and 55 mg COD/L, respectively. From Stover–Kincannon model, the maximum total substrate removal rate constant and half-velocity constant were determined as 15.2, 10.98, 12.05 g/L d and 14.78, 7.11, 6.97 mg/L for chemical oxygen demand, nitrogen and phosphorus removal, respectively. The kinetic parameters determined in this study can be used to improve the design and operation of the biological contactor-activated sludge system in full scale.

A. Akhbari
Sama Technical and Vocational Training College,
Islamic Azad University, Kermanshah Branch, Kermanshah, Iran

A. A. L. Zinatizadeh (✉)
Water and Wastewater Research Center (WWRC),
Department of Applied Chemistry, Faculty of Chemistry,
Razi University, Kermanshah, Iran
e-mail: zinatizadeh@razi.ac.ir

P. Mohammadi
Department of Environmental Health Engineering-Kermanshah,
Health Research Center (KHRC), Kermanshah University
of Medical Science, Kermanshah, Iran

Y. Mansouri
Young Researchers Club, Ilam Branch, Islamic Azad University,
Ilam, Iran

M. Irandoust
Department of Analytical Chemistry, Faculty of Chemistry,
Razi University, Kermanshah, Iran

M. H. Isa
Department of Civil Engineering, University Teknologi
Petronas, 31750 Tronoh, Perak, Malaysia

List of symbols

RBC	Rotating biological contactor
AS	Activated sludge
TKN	Total Kjeldahl nitrogen, mg/L
MLSS	Mixed liquor suspended solids, mg/L
COD	Chemical oxygen demand, mg/L
TN	Total nitrogen, mg/L
VSS	Volatile suspended solid, mg/L
SRT	Solid retention time, d^{-1}
OLR	Organic loading rate, g/L d
Y	Growth yield coefficient, g VSS/g COD
k_d	Microbial decay rate, d^{-1}
μ_{max}	Maximum specific biomass growth rate, g VSS produced/g VSS present d
k_s	Half-velocity constant, mg/m^3