Desalination and Water Treatment
www.deswater.com

41 (2012) 79–87
March

1944-3994/1944-3986 © 2012 Desalination Publications. All rights reserved
doi: 10.1080/19443994.2012.664681

Taylor & Francis
Taylor & Francis Group

On modeling chronic detachment of periphyton in artificial rough, open channel flow

Myriam Graba[a,b,c,*], Ahmed Kettab[a], Sabine Sauvage[b,c], José Miguel Sanchez-Pérez[b,c]

[a]*Ecole Nationale Polytechnique/Laboratoire des Sciences de l'Eau, 10 Avenue Hassen Badi, El Harrach, Alger., Algerie*
Tel. +213 (0) 7 70 51 92 38/+33 (0) 6 62 35 38 71; Fax: +213 (0) 34 21 51 05; email: myriam.graba@univ-tlse3.fr
[b]*Université de Toulouse; INP, UPS; EcoLab (Laboratoire d'Ecologie Fonctionnelle et Environnement), Avenue de l'Agrobiopôle, 31326, Castanet Tolosane, France*
[c]*CNRS; EcoLab, 31326, Castanet, Tolosan, France*

Received 13 April 2011; Accepted 15 January 2012

ABSTRACT

Periphyton communities, which are native to river beds, serve as a functional indicator of river health but remain one of the least-studied communities despite the significant increase in the examination of aquatic microbial communities in recent years. In this study, we tested the relevance of three formulations of the chronic detachment term in a simple model for the biomass dynamics of periphyton. Numerical simulations of the periphyton biomass dynamics were performed by using three different descriptors for the flow conditions: the discharge Q, the friction velocity u_*, and the roughness Reynolds number $k^+ = u_* k_s / v$ (where v is water kinetic viscosity and k_s is the Nikuradse equivalent sand roughness). Comparisons of numerical simulation results with experimental data from literature revealed chronic detachment to be better simulated by taking the roughness Reynolds number as the external variable of detachment. These results support the idea that transport phenomena that occur in the near-bed layer, e.g. chronic detachment of periphyton matter or vertical transport of nutrients and pollutants in submerged aquatic canopies, are not related to a single turbulence descriptor such as the friction velocity u_*. Its description requires at least two descriptors, here the friction velocity u_* and the Nikuradse equivalent sand roughness k_s, which depend on the initial form and dimensions of the colonized substratum, and its changes owing to the thickness, resistance, and composition of the epilithic matter.

Keywords: Periphyton; Open-channel flow; Roughness; Friction velocity; Biomass dynamics; Turbulent boundary layer

*Corresponding author.