

How do fixed-bed biofilm reactors (biofilters) used for wastewater treatment clog?

B. Laborie*, J.-M. Choubert*, J.-P. Canler* and E. Paul **

* Irstea, UR MALY | 5 rue de la Doua, BP 32108, 69616 Villeurbanne Cedex, France (E-mail : bastien.laborie@irstea.fr - +33 6 32 90 01 89)

** Université de Toulouse, INSA, UPS, INP, LISBP | 135 Avenue de Rangueil, F-31077 Toulouse, France

Introduction

Biofilters are used in the field of wastewater treatment for particle filtration and biological pollutants transformation (Fig. 1).

Biofilm growth and the accumulation of particles gradually decrease the porosity and increase the head loss of biofilters, making backwashing a daily maintenance routine.

Backwashes consist in alternative phases of water and air injection, and under normal operating conditions, they are applied every 12 to 36h.

CLOGGING occurs when backwashing fails to bring the filters' porosity and head loss back to its initial conditions (Fig. 2). Soda cleaning is the only effective workaround when the filters' head loss gets unacceptably high.

To mitigate the impacts of this phenomena, the use of both preventive solutions and clogging indicators is required.

Objectives

To identify factors leading to clogging of full scale biofilters

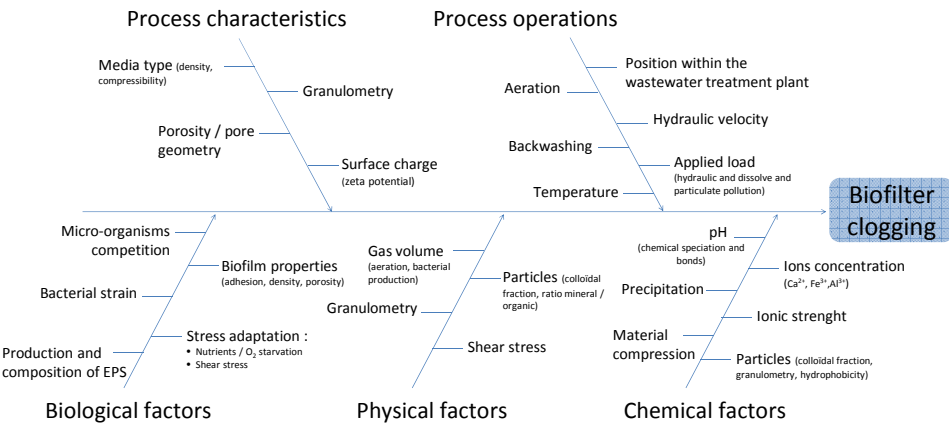
To develop a full-scale methodology to study biofilter clogging

Methods

A review of 70+ scientific publications dealing with different processes (biofilters, membranes, infiltration tanks) and at different scales (laboratory, pilot and full-scale) was carried out to study causal factors leading to clogging.

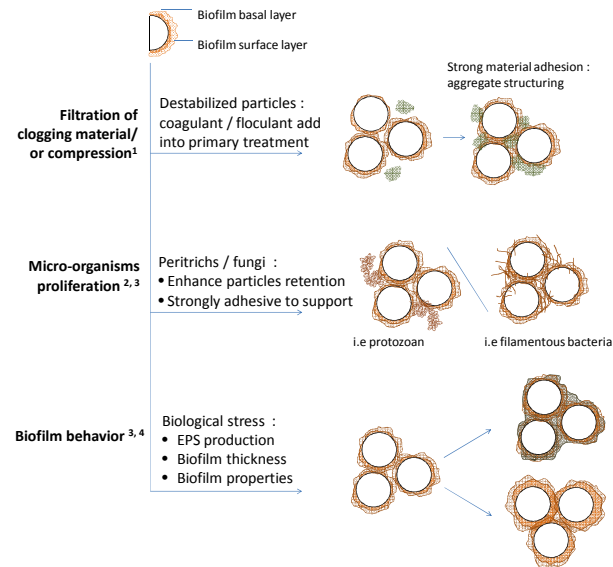
Results

Causal tree of factors involved into clogging development



Different combinations of process characteristics and operation strategies can make full-scale biofilters more prone to clogging, and contribute to the aggregation of organic matter in the porosity.

Clogging theories



Experimental strategy to study aggregate structuration before clogging

The strategy design aims to :

1. Describe processes involved into on-site aggregates structuration
2. Link biofilm adhesion with its composition and key operational conditions

The proposed methodology allows studying clogging at 3 different scales :

1. **Full scale** : linking operating conditions of full-scale biofilters clogging occurrence and porosity evolution
2. **Granular bed scale** : colonisation heterogeneity and bed porosity
3. **Aggregate structuration** : porosity, biofilm adhesion and composition and type of micro-organisms

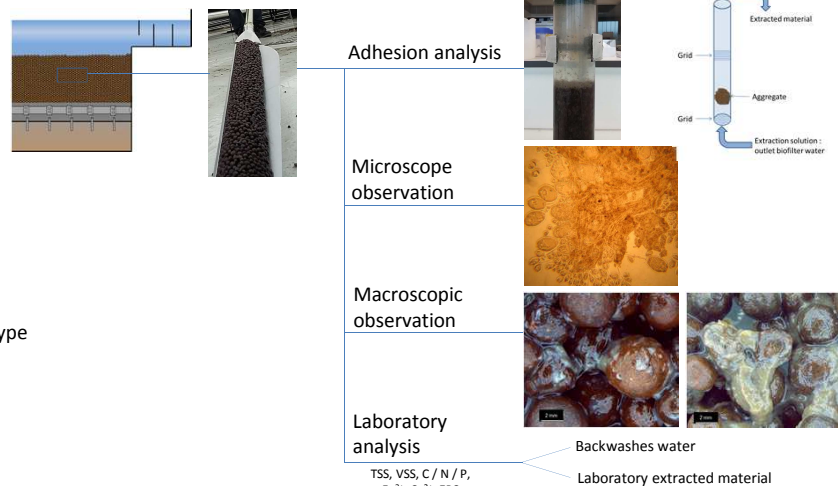


Figure 3 : Description of the strategy to study the structuring of aggregates

ACKNOWLEDGEMENTS: this work has been carried out in the framework of the MOCOPEE project <http://www.mocopee.com/>



References

- 1- Ahn, Won-Young et al. 2008. « Effects of background cations on the fouling of polyethersulfone membranes by natural organic matter: Experimental and molecular modeling study ». *Journal of Membrane Science* 309 (1-2)
- 2- Rocher, Vincent et al. 2015. « Nitrite Accumulation during Denitrification Depends on the Carbon Quality and Quantity in Wastewater Treatment with Biofilters. » *Environmental Science and Pollution Research International* 22 (13)
- 3- Le Bihan, Yann, et P Lissard. 2000. « Monitoring biofilter clogging: biochemical characteristics of the biomass ». *Water Research* 34 (17)
- 4- Lauderdale et al. 2010. « Low-phosphorus supplementation enhances biofiltration hydraulic performance and treatment ». In, 4. *Proceedings of the Water Environment Federation.*