Removal of viruses in fresh water by low pressure reverse osmosis : application to the water production for human consumption

H. Taligrot[a], M. Monnot[a], S. Wurtzer[b], L. Moulin[b], P. Moulin[a]*

[a] Aix Marseille Univ., CNRS, Centrale Marseille, M2P2, EPM, Marseille. Europôle de l'Arbois, Bat. Laennec, Hall C, Avenue Louis Philibert, 13100 Aix-en-Provence, France.

[b] Eau de Paris, 39 Avenue Jean Jaurès, 94200 Ivry-Sur-Seine, France.

*Corresponding author: hugo.taligrot@univ-amu.fr, (+33) 612859551

Abstract:

Drinking water production must comply with sanitary quality objectives for the consumers. In fact, regulations are increasingly restrictive, with over fifty quality criteria defined by the World Health Organisation, including pathogens. Nowadays, elimination of these pathogens is currently achieved by chemical disinfection processes using chlorine or ozone. However, membrane processes, a growing innovative technology for 30 years, is proposed to remove pathogens, including ultrafiltration (UF) and reverse osmosis (RO) thanks to the steric exclusion and other mechanisms. The ultrafiltration process allows a retention of about 3–3.5 logarithm of viral abatement while the dense membranes used in reverse osmosis allow much higher retentions. The aim of this work is to evaluate performances of the low-pressure reverse osmosis (LPRO) process to retain viruses in fresh water. Objectives are to estimate the retention of viruses by the LPRO membranes as a function of the initial virus concentration, the type of viruses and the operating conditions. First, preliminary experiments were carried out for UF and LPRO with MS2 bacteriophage, a viral model, at different initial concentrations varying from 1×10^{3} GU.L^{-1} to 7×10^{8} GU.L^{-1}. Results showed that retention increased with the feed concentration, probably due to the viral agglomeration. As expected, whatever the initial concentration, the LPRO membranes allow a higher virus retention than UF, with maximum retention around 5 log. Experiments will be carried out with enterovirus, adenovirus, and virus mixes at the same concentrations to observe the effect on retention of the virus type and the interaction between them. Experiments will also be made at very low concentration to mimic natural contamination. To do this, a concentration method is being tested to allow detection of very low concentration of viruses. This method allows concentration of 400 L of LPRO permeate into 200 µL with an important efficiency (more than 80%).

Keywords: Membrane filtration, drinking water production, virus, low pressure reverse osmosis, concentration method.