Effects of solids accumulation on treatment performance and hydraulics in horizontal treatment wetlands

a\*Sacco A., b Barresi S., b Licciardello F., b Cirelli G.L.,

a International Doctorate in Agricultural, Food and Environmental Science – Di3A – University of Catania, Via S. Sofia 100, 95123, Catania Italy

b Department of Agricolture, Food and Environment (Di3A) – University of Catania, Via S. Sofia 100, 95123, Catania Italy

\*Sacco A. - E-mail address: alessandro.sacco@unict.it Phone number: 392-6601705

E-mail address: giuseppe.cirelli@unict.it (Cirelli G.L); salvo.barresi92@gmail.com (Barresi S.); feliciana.licciardello@unict.it (Licciardello F.)

**Keywords: Treatment wetland, clogging, porous medium, accumulated solids**

**Abstract.** Although clogging is one of the crucial issues that attracted increasing attention in the scientific community, there are still several gaps in its genesis process and assessment. Void pores clogging in horizontal flow (HF) treatment wetlands (TWs) may severely impact water permeability, making the substrate prone to be clogged by solids accumulation, biofilm growth, and root filling causing hydraulic malfunction and expansive management costs. This study aims to evaluate the behaviour of three full-scale HF-TWs regarding treatment performances and accumulated solids nature and build-up process in relationship to the hydraulic conductivity variation of the filter medium. The first HF unit (HF1) planted with Phragmites australis, has been operating for eight years working as a tertiary system for conventional wastewater (WW). The other two (HF2A, HF2B) planted with Canna indica, are one year old and treat diary WW. In the HF1, the total solid (TS) concentration varied between 920 and 7381 g ∙ m-3 with an average value of 3154 (CV= 74.1%). The volatile solids (VS) concentration ranged from 173 to 1157 g ∙ m-3 with an average value of 456 g ∙ m-3 (CV= 61.1%). The VS fraction accounted for 20% of the TS concentration. The minimum and the maximum value ratio was 8.0 and 6.7 for TS and VS, respectively. The HF1 showed more spatial variability of hydraulic conductivity and solid accumulation in the porous media rather than HF2A and HF2B. The average concentration values of TS, PRB and VS in HF1 were higher than those observed in HF2A and in HF2B, and dead plants played an important role in determining the solid organic accumulation. Independently of the operational time and plant species, spatial variability of PRB concentration was high, highlighting a significant heterogeneity in the root distribution along the porous medium. As expected, in HF1, the inlet zone was mainly hit by the interception and sedimentation of solids and it was characterized by a severe hydraulic conductivity reduction. At the same time, HF2A and HF2B did not show significant differences in the spatial distribution of solid accumulated which recalcitrant material are predominant. Despite the different development of solid accumulation processes, all the systems efficiently removed the principal chemical and physical pollutants.

\*Corresponding author.