HORIZONTAL SUBSURFACE WETLAND FOR DAIRY FARM WASTEWATER TREATMENT: A SUSTAINABLE MODEL BASED ON CIRCULAR ECONOMY

Schierano, M. C.[1,*],Gutierrez, G.[1], Panigatti, M.C. [1], Maine, M.A[2]., Boglione, R[1]., Griffa, C[1]., Taverna, M. [1]

[1] *Grupo de Estudios de Medio Ambiente. Universidad Tecnológica Nacional. Facultad Regional Rafaela. Santa Fe, Argentina.*
[2] *Instituto de Química Aplicada del Litoral (IQAL, CONICET – Universidad Nacional del Litoral). Santa Fe, Santa Fe, Argentina.*
*celeste.schierano@frra.utn.edu.ar

In Argentina, dairy farm is a primary sector which requires high water quantity and generates high volumes of effluent. Its treatment is essential for the environment protection. Circular economy is an approach that describes how several natural resources, most classified as wastes, can be used as inputs to produce value-added products and services. In this way, Constructed Wetlands (CW´s) have potential for sustainable wastewater management based on circular economy concept, due to the fact that they can treat water towards particular reuse purposes.

This paper focuses on a robotic dairy farm that treats effluents through stabilization ponds. However, effluent quality could be improved to be reused in the same facilities for cleaning purposes. CW's could be a suitable alternative for this goal. Both laboratory and pilot scale experiments were performed in order to evaluate CW´s efficiency. Laboratory experiments were conducted using batch microcosms and real effluents (March 2017-December 2017). Reactors were filled with light expanded clay aggregate (LECA) and planted with *Typha domingensis*. Mean removal efficiencies obtained (after a residence time of 7 days) were 78.3% por chemical oxygen demand (COD), 95.6% for total suspended solids (TSS), 95.9% for ammonium, 17.1% for nitrates and 77.7% for total phosphorus (TP). Total coliform and fecal bacteria decreased seven and eight orders of magnitude, respectively. In January 2018, a pilot scale horizontal subsurface CW (2 m width, 6 m length and 0.7 m depth) was built next to stabilization ponds. CW was planted with *T. domingensis* and river gravel was used as substrate due to at that moment, LECA was not available at a convenient cost. 20 samples were collected and analyzed weekly from March -December 2018. Satisfactory removal efficiencies were obtained: 48.0% for COD, 71.5% for TSS, 41.2% for ammonium, 35.8% for nitrates and 27.6% for TP. Both, total and fecal bacteria decreased one order of magnitude. High evapotranspiration rates were obtained, which represented a problem in terms of available volume of effluents for reuse. In summer season, river gravel warms due to high ambient temperatures and contributes to evapotranspiration rates increase.

In September 2020, a full-scale horizontal subsurface CW was built. For this purpose, pilot scale wetland dimensions were extended to 4 m width (same length and depth), followed by a channel (1 m width, 16 m length and 0.7 m depth). This channel flows to a dumpsite where treated wastewater is pumped back to dairy facilities. Both CW and channel were filled with river gravel (0.5 m) and Arqlite® (0.1 m). This is an innovative material obtained entirely from plastic waste. It can replace traditional substrates, providing a reduction in weight, cost and evapotranspiration rates. It also contributes to circular economy, transforming plastic waste into a valuable product. Macrophytes were currently collected from natural environments and will be planted gradually within the next weeks. The monitoring period of CW is expected to begin in July 2021. The reuse and recycling of wastewater is a promising environmental solution based on circular economy, specially in dairy production, one of the most important primary activities in Argentina.

BIO:

Dr. Maine is a senior scientist with more than 25 years of experience in the study of contaminant dynamics in treatment wetlands. She is the President of the Pan-American Wetland Network. She has published more than 70 journal articles, book, book chapters, 200 presentations in Scientific meetings.