Seasonal inputs of polyethoxylated compounds to a Mediterranean coastal lagoon through surface watercourses

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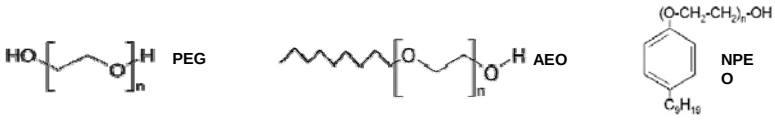
Introduction and objectives:

► Synthetic surfactants are among the chemicals that are produced and consumed in the largest volumes in the world (more than 10 million tons per year), due to their variety of applications, mainly as key ingredients in detergents and cleaners but also as additives in paints, pesticides, personal care products, etc. In spite of the high removal efficiences of surfactant residues in sewage treatment plants (STP), significant amounts of these chemicals reach aquatic ecosystems via direct discharges of treated or non-treated wastewaters, or indirect discharges through rivers, where they are present dissolved or associated with particulate material. Therefore, particular attention has been given to the environmental analysis of anionic and non-ionic surfactants (90% of the overall production).



► Our main objective in this work was to detect the presence and compare the distribution of the most world-wide used non-ionic (alcohol polyethoxylates, AEOs, and nonylphenol polyethoxylates, NPEOs) surfactants, and an important group of nonionic synthetic water-soluble polymers of ethylene oxide, polyethylene glycols (PEGs), which are also used in a wide range of applications (e.g., antifreeze agents, cosmetics) as well as the main precursors / degradation products of AEOs, in waters and sediments from Mar Menor Lagoon (SE Spain). Under our knowledge, some of the data shown here are among the first even reported on the environmental distribution of PEGs in aquatic systems.

Results and discussion:

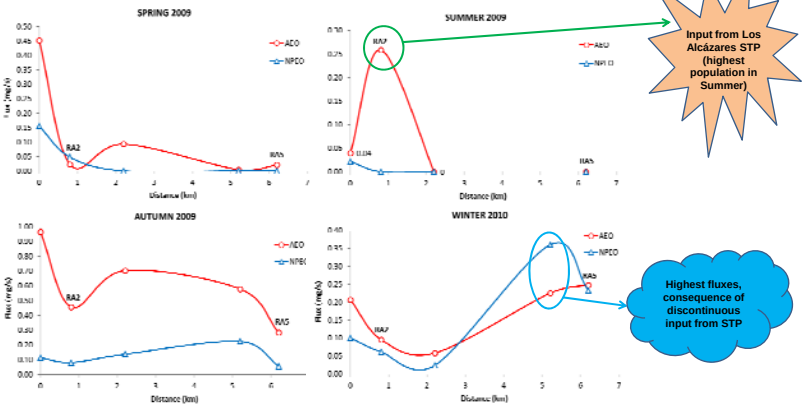


Fig. 3 – Nonionic surfactant fluxes (mg/s) through several points along Zone A

► Fluxes (Fig. 3) were low for both non-ionic surfactants (<1 mg/s), showing significantly higher values for AEOs in autumn and for NPEOs in winter. Levels of NPEOs and AEOs show a downstream decrease as a result of dilution, sorption and/or degradation.

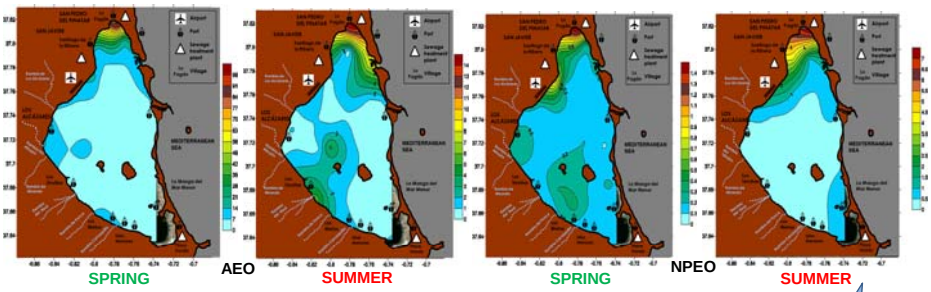


Fig. 6 – Distribution of AEOs (ppb) and NPEOs (ppb) in surface waters of Mar Menor lagoon

References and acknowledgments:

1) Lara-Martín PA, González-Mazo E, Brownawell BJ (2011) J. Chromatogr. A 1218, 4799.

2) Traverso-Soto JM, Lara-Martín PA, León VM, González-Mazo E (2013) Talanta 110, 171.

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Sampling areas and methodology:

► Zone A – El Albujón Watercourse and its main tributary (Murcia, SE Spain) **(Fig. 1):** the input of organic pollutants into the Mar Menor lagoon through El Albujón Watercourse was characterized by sampling surface water every 3 months (2009-2010) at 5 points (RA) **(Fig. 1).** One extra campaign was performed in January 2010 (Winter) to determine the daily variation of pollutant input at the El Albujón watercourse mouth **(RA5),** sampling thrice per day (early morning, midday and late afternoon) for a week. Water flow was also determined in each point, and the surfactants fluxes were estimated.

► Zone B - Mar Menor (Murcia, SE Spain) **(Fig. 2):** 18 surface water samples were taken in April of 2009 (spring) and July of 2009 (summer). Aditionally, 18 surface sediment samples (0-5 cm) were taken in spring of 2009 by means of a Van Veen grab. A Mediterranean sampling point was used as reference.

► Analysis: after extraction and purification by solid phase extraction (SPE), AEO, NPEO and PEG were identified and quantified by HPLC-ToF-MS and/or HPLC-MS according to Lara-Martín et al., (2011) and Traverso-Soto et al., (2013).

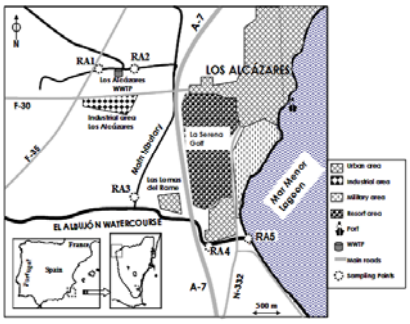

Fig. 1 - Zone A: El Albujón Watercourse and its main tributary.

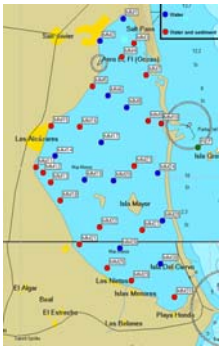

Fig. 2 - Zone B: Mar Menor lagoon.

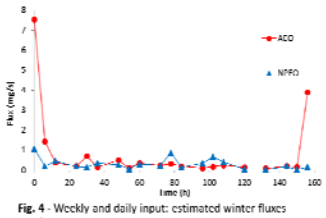

Fig. 4 - Weekly and daily input: estimated winter fluxes (mg/s) at El Albujon Watercourse mouth (RA5)

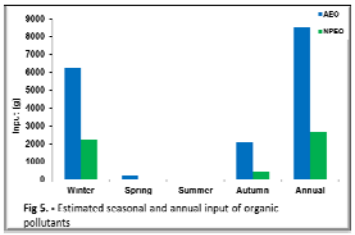

Fig 5. - Estimated seasonal and annual input of organic pollutants

► Significant daily and weekly variations **(Fig. 4)** of AEO fluxes at watercourse mouth. During the week studied, the highest levels were detected for AEOs (4 mg/L; 7.5 mg/L) in Winter.

► Two general patterns **(Fig. 5)**: a) Higher input of AEOs than NPEO throughout the year; b) AEOs and NPEOs are not detected in spring and summer (probably due to high temperatures, dilution, degradation, etc.).

► **Mar Menor Lagoon samples:** AEO and NPEO concentrations **(Figs. 6 and 7)** were usually below 50 ppb, although significantly higher values were found in most contaminated stations near the shore (closer to wastewater discharges, settlements, docks, airports,…).

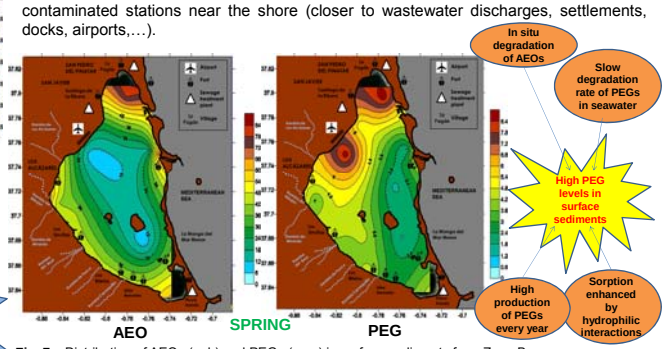

Fig. 7 – Distribution of AEOs (ppb) and PEGs (ppm) in surface sediments from Zone B

Low levels of AEOs and NPEOs in Mar Menor Lagoon related to degradation and/or their very efective removal in STP

► In spite of their higher polarity, PEGs **(Fig. 7)** were only found in sediment samples at higher concentrations than AEOs (up to 8.5 ppm), following the same distribution pattern.