Metals concentrations and removal along the SBR Wastewater Treatment Plant of Torres Vedras, Portugal

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The concerns on metals in municipal Wastewater Treatment Plants (WWTPs) discharges are mainly related with its contents in sludge, which can prevent its application in land and so the recycling of valuable nutrients, and with the more restrictive limits foreseen for final effluents, due to the recent guidelines introduced by the European Water Framework Directive (EUWFD) [1]. The last upgrade of the EUWFD [2] lists 45 priority pollutants, whose emissions to the environment must cease (priority hazardous substances) or be reduced in order to meet the Environmental Quality Standards (EQS) and so achieve a good status for all surface waters in the future. Four metals were classified as priority substances, Cd, Hg, Ni and Pb, the top two also classified as hazardous. Other metals as As, Cu, Cr and Zn are also frequently included in the additional list of substances that may become classified as priority in the near future [3]. The literature review shows that the understanding of metals behaviour and fate throughout WWTPs is a crucial issue face to the more stringent discharge quality requirements for the final effluent and final sludge. Relevant data have been published in recent decades, but the findings still remain insufficient and quite contradictory in many fields [4][5], thus the need of more research is consensual, particularly by considering data collected from full scale WWTPs [5].

The present work is part of a larger one concerning Torres Vedras WWTP (SBR, low load, F/M=0.08 d^{-1}, SRT=8.7 d) (*Águas do Tejo Atlântico*), carried out with the final aim of establishing a simulation model that allows predicting the behaviour and fate of eight metals along the treatment. Experimental data were obtained from two sampling campaigns (Spring/Summer and Autumn/Winter) involving an exhaustive collection of composite samples in all flows of the liquid and solid phases of the treatment system. Metals determinations in the matrices were conducted according to in-house accredited methods at LNEG, carefully followed by actions of validation and quality control. Here, we present the results obtained in the characterization of As, Cd, Pb, Cu, Cr, Hg, Ni and Zn through the treatment system, namely its total and soluble concentrations in all the matrices and the removal/concentration ratios of total metals relative to the influent wastewater. Also, results for the metals overall removal efficiencies in the liquid phase of treatment are shown, and the quality of final effluent and sludge face to the current legal limits and to the future more restrictive scenarios are assessed.

The comparative analysis of the obtained total concentrations for As, Cd, Pb, Cu, Cr, Hg, Ni and Zn, in the raw wastewater (1.9, 0.3, 10.2, 58.7, 2.5, 0.7, 4.0 and 161.9 µg/L, respectively), final effluent (1.5, 0.3, 5.5, 7.0, 0.9, 1.0, 2.1 and 29.3 µg/L, respectively) and final sludge (5.6, 0.9, 28.9,170.9, 18.7, 0.6, 16.1 and 600.4 mg/kg d.w., respectively) with those reported in the literature [4][5], shows that they are all within the lower limit of the range of results found in other WWTPs worldwide. Metals overall removal efficiencies are about 80% for Cu and Zn, 64% for Cr, 45-50% for Pb and Ni and 20% for As; for Hg a negative removal is observed (-43%). Results for final effluent and sludge show compliance to the current legal limits. Regarding the EQS introduced by the EUWFD for priority metals, the final effluent only shows no compliance for Hg. Concerning the very stringent limits already set by some countries for final sludge, there is no compliance for Cu and Zn.

References

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