Electrodialytic technology as effluent treatment for reuse in construction materials

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Nowadays, keeping water resources clean and safe is one of the biggest challenges in water management systems. Water crisis is increasing due to the population growth, improvement of lifestyle, climate changes and also because of the lack of appropriate water resource management. Therefore, it is crucial to reduce tap water consumption in all activity sectors, including the high volume in building industry. In this industry potable water is usually used since it is recommended by most specifications and its chemical composition is known and well regulated. However, in order to create a balance between the resource and the demand, other alternatives are needed to re-cycle non-fresh water and promote the "zero-waste circular economy".

Effluents from wastewater treatment plants have a potential to replace water in construction sector due to their characteristics. On the other hand, effluents may contain a complex mixture of anthropogenic and natural compounds that are not removed by conventional treatments and, consequently, different types of impurities are present, making difficult to draw a sound conclusion concerning their utilization in concrete mixtures.

To handle with these barriers, a clean water technology before the reuse is required. Electrodialytic (ED) process is a remediation technique applied to contaminated matrices. The main principle is that when a low level direct current is applied between a pair of electrodes, the generated electric field induces transport processes and physicochemical changes in the applied matrix. These changes lead to species transport by coupled mechanisms, acting as the "cleaning agent", by which the contaminants move out of the matrix towards one of the electrode compartments. The ED process has proved to be efficient for the removal of organic or/and inorganic contaminants, such as heavy metals and salts.

In this work the viability to use ED treated effluent in construction materials (e.g. mortars) as an alternative to tap water was assessed, thus promoting water management.

The ED process was optimized to remove or immobilize the heavy metals and salts from effluents collected from different wastewater treatment plants. Effluents were characterized before and after the ED process. The treated effluent was then used in the production of mortars. Characterization of cement was performed by X-ray diffraction, SEM-EDX and laser diffraction to understand the influence in the replacement of tap water by ED treated effluent. Materials tests were conducted (e.g. permeability, workability, compressive strength) as well as environmental safety tests (e.g. concentration levels and leaching of heavy metals and salts).

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