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Mg/Al hydrotalcites from the aluminum pickling process: value added chemicals for methyl orange adsorption in water matrices

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PURPOSE OF THE ABSTRACT

Industrial processes are among the main sources of hazardous by-products worldwide. In a circular economy perspective , it is essential to improve the valorization of by-products into value-added chemicals able to be used in the same process or in other applications. The use of by-products obtained from an industrial process as starting material for a different process represents the basis of an industrial symbiosis approach[1,2].
Currently, the EU extruded aluminum profiles industry generates several million liters per year of waste liquors from the pickling and etching baths and the major trend includes the disposal in landfills.
The aim of this work is the valorization of the industrial wastewater resulting from the alkaline pickling and satin-finishing process of aluminum profiles.
In order to improve the environmental sustainability of the entire system, this study proposes three different scenarios for the management of the waste stream: i) the disposal in landfill, ii) the recovery through a purification step and iii) the precipitation of aluminum as aluminum hydroxide, later used for the preparation of Mg/Al hydrotalcites.
The environmental sustainability of the investigated scenarios has been evaluated through LCA methodology (ISO 14040-14044). In addition, a break-even analysis was performed in order to identify the economic feasibility.
According to results from environmental and economic analyses, the recovery of the aluminum as hydroxide represents the more sustainable process. The as-obtained aluminum hydroxide was then used as starting material for the preparation of different Mg/Al hydrotalcites (layered double hydroxides, LDH) characterized by different Mg/Al molar ratios and interlayer anions (Cl-, Br-, I-, CO32-, OH-). LDH was then used as active adsorbents for methyl orange in water samples and the effect of several parameters (pH, total alkalinity, [MA], interferent anions, interlayer anions, Mg/Al) on MA adsorption was investigated.
The applicability of LDH was also extended to real samples with interesting results in terms of MA removal.

FIGURES

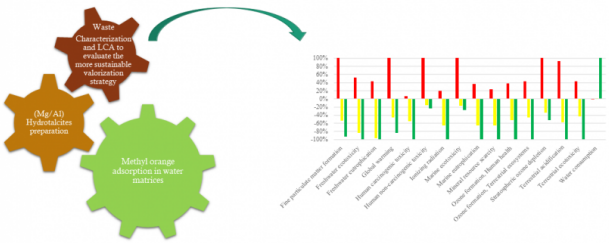

FIGURE 1

Figure 1. Valorization of the industrial wastewater resulting from the alkaline pickling of aluminum profiles.

Valorization of the industrial wastewater resulting from the alkaline pickling of aluminum profiles.

FIGURE 2

KEYWORDS

hydrotalcites | methyl orange | LCA | waste valorization

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