VALORIZATION OF PLASTIC ELEMENT OF DECOMMISSIONED PHOTOVOLTAIC PANELS

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Abstract
The world is moving more and more toward the use of renewable energy sources, alternatives to fossil fuels, among which, for example, the power generation from solar energy by means of photovoltaic panels. The latter are typically made up of a series of solar cells connected together, called photovoltaic cells, which are semiconductors, generally of doped silicon, placed between two rigid plastic elements consisting mainly of EVA (Ethylene-vinyl acetate-$(C_2H_4)_n(C_4H_6O_2)_m$) and Tedlar (polyvinyl-fluoride-$(CH_2CHF)_n$)). The lifetime of photovoltaic panels is on average 22 years; after which they need to be disposed of. All PV panel components are recycled with the exception of plastic polymers in which the fluorine is a critical element in terms of energy valorization; it is, therefore, necessary to identify alternative techniques for reusing the plastic waste from decommissioned panels (PV plastic waste), avoiding their unsustainable disposal. In this context, thermochemical conversion processes and, in particular, pyrolysis offer a suitable solution. In this work, an investigation on the potential of pyrolysis in the valorization of PV plastic waste was performed by carrying out a preliminary batch test (2 repetitions) with the aim to study the composition of the output streams. The experiments were performed in a micro-reactor (26mm), under a pure nitrogen flow (60 Nl/h) at the final temperature of 580 °C (i.e., the temperature of complete material devolatilization). The characterization of the raw feedstock was carried out in terms of proximate and ultimate analyses as well as calorific value determination. The fluorine content was instead, measured using an ion chromatograph. All the gaseous, condensable, and solid products of the process were also analyzed. Preliminary results highlight that, in gaseous products, the most abundant compound was CO_2 followed by propylene and ethylene. The condensate streams from both experiments consists of an oily wax made up mainly of linear aliphatic hydrocarbons, both saturated and unsaturated, with a carbon number between C_8 and C_{12}; aromatic hydrocarbons were also identified (such as benzene, toluene, styrene, and phenols). No fluorinated compounds were detected in the condensed products, so this suggests that probably the most of fluorine in the PV plastic waste was confined either in the solid or the gas products. Therefore, future studies will focused on analysis of char and permanent gas to confirm the possible presence of fluorinated compounds.