USE OF SUSTAINABLE ACTIVATED CARBON FOR TREATING INDUSTRIAL LIQUID AND GAS STREAMS

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1 INTRODUCTION

The project *"Demonstrator system of activated carbon production from Valencian waste for application in energy and environment"*, CircularCarbon, funded by the Valencian Institute for Business Competitiveness (IVACE) and co-funded by the European Regional Development Fund (ERDF), carried out by the Instituto Tecnológico de la Energía (ITE) and the Instituto de Tecnología Cerámica (ITC-AICE), seeks to use pruning waste, currently disposed of at landfills, for generating **sustainable activated carbons (SACs)** with different uses. The project features three different research lines:

I. Production of SACs from waste material,

II. Feasibility study of the use of SACs for making electrodes of solid-state lithium batteries as energy storage systems and,

III. Analysis of the **environmental application** of SACs for treating wastewater and gas streams of industrial origin.

This communication includes the results obtained in line III in the ceramic sector, with the collaboration of KERABEN of the Victoria Ceramics Spain group, and in the petrochemical sector, with the BP Oil Spain refinery in Castellón.

2 RESULTS OBTAINED

The application of SACs in the ceramic sector has included boron removal, a difficult element to treat owing to its high solubility in wastewater and, in the case of gases, the removal of volatile organic compounds (VOCs) in the emissions generated at high temperature during the ceramic tile firing stage.

The application in the petrochemical sector has focused on the removal of light hydrocarbons and phenols (oils and greases).

Application for industrial wastewater treatment:

Flexible reactors capable of monitoring volume flow rates, velocities and bed heights were designed, which allow the treatment efficiency of sustainable activated carbons obtained from waste material to be studied.

The use of activated carbon (AC) obtained from pine-pruning waste was validated as a functional alternative with greater efficiency than commercial activated carbons for boron removal from ceramic industry wastewater.

The use of this SAC was also validated for removal of light hydrocarbons (oils and greases) found in petrochemical industry wastewater.

Application	Industry	Normalised adsorption capability, (mg/g AC)	
		Commercial AC	CircularCarbon-SAC
Boron removal	Ceramic	0.03	0.10
Removal of oils and greases (light hydrocarbons)	Petrochemical	1.28	1.71

Application for treatment of industrial gas streams:

A demonstrator was designed, with the following characteristics:

- **portable**, for use in the laboratory with synthetic gases or in industrial facilities with real gas streams.
- **flexible**, as it allows use of adsorbents with differentiated characteristics in terms of form and composition (different types of adsorbents (zeolites, polymers, silica gel) or of carbonaceous materials (activated carbons, biochar, composites, etc.).
- **adaptable**, for studying compounds of different nature (organic or inorganic) as a function of the analysis system coupled to the demonstrator.
- **modular** and adaptable to different volume flow rates and temperatures of the gas stream to be studied.

The study methodology followed allowed adsorbent behaviour to be characterised *in situ*.

Application	Industry	Normalised adsorption capability, (mg/g AC)	
		Commercial AC	CircularCarbon-SAC
Removal of formaldehyde	Ceramic	1.12	5.77

3 CONCLUSIONS

Wastewater treatment:

- In both cases, the sustainable activated carbon (SAC) had a greater adsorption capacity than the commercial AC. In the case of boron, the capacity was observed to be low, so that impregnation with citric acid, tartaric acid, or mannitol is recommended.
- Ash content did not influence the SAC capacity in any of the applications.

Gas stream treatment:

- The adsorption capacity of the hydrocarbons analysed by the monitoring system was minimal in both studied carbons (commercial and sustainable).
- In the case of formaldehyde, the adsorption capacity was significantly higher than the of the other organic compounds. The capacity of the sustainable activated carbon (SAC) was 417% higher than that of the commercial AC.