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MONITORING UV FILTERS THROUGH THE USE OF VOLTAMMETRIC METHODS

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INTRODUCTION

Sunscreens are very useful since they protect the skin against radiations.
However, some chemical sun-blocking agents can be almost as damaging as UV radiation itself, making the effects of some sunscreens questionable, for these reasons it is very important to control their effectiveness, safety and to monitor their release into the environment, as they are now considered as contaminants of emerging concern (CEC).

METHODS

-*Analytical technique* –

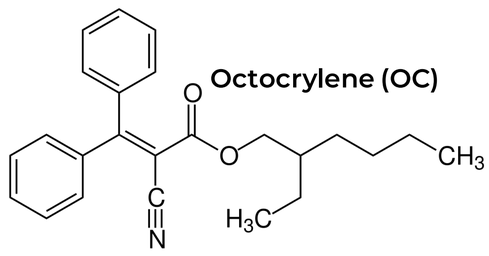
Carbon Paste Electrodes (CPEs) obtained mixing graphite powder and an aliquot of sunscreen were used as working electrodes. The redox anodic and cathodic profiles of the investigated sunscreens were recorded by square wave voltammetry (SWV). Subsequently, the resistance of products to exposure to sunlight was tested using a solar box. Voltammograms were recorded after different exposure times.
A glassy carbon electrode (GCE) was also used for check the presence of UV filters in different products.
0.5 g of each sample were mixed with 16mL of 0.04 M Britton Robinson buffer and 4 mL of ethanol.
The effect of the addition of 6mM cetyltrimethylammonium bromide (CTAB) to the solution the sensitivity of the analysis was demonstrated.
0.5 g of samples were added to 20 mL of seawater to test the applicability of the method on a real samples.
The analysis was performed by a PGSTAT 10 potentiostat (Eco Chemie, Utrecht, the Netherlands) coupled to a 663 VA Metrohm (Herisau, Switzerland) stand.
The potentiostat was interfaced to a personal computer and the software GPES 4.9 was used.

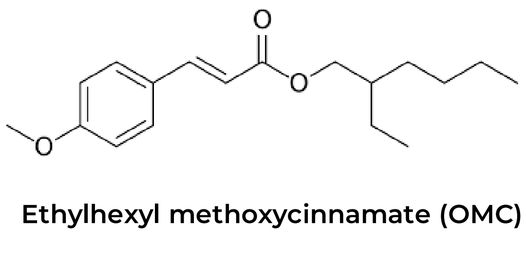
OBJECTIVES

The present work aims evaluating the applicability of voltammetry
- to check sunscreen quality and composition
- to check the presence of residues of sunscreen agent in seawater

-*Samples and analytes* –

UV filters octocrylene (OC) and ethylhexyl methoxycinnamate (OMC) were determined in different sunscreens purchased in pharmacies and supermarkets in the province of Turin.





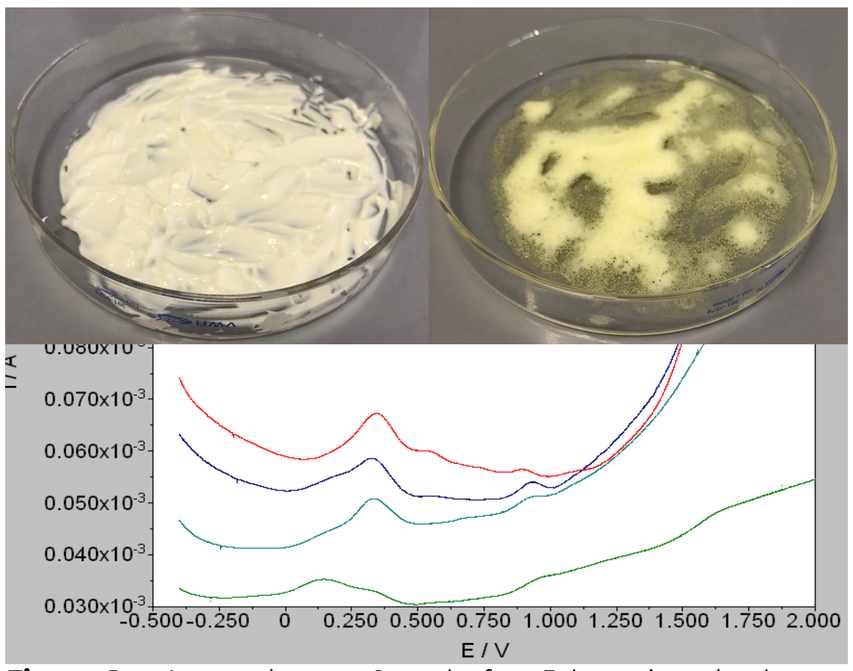


Figure 1 – A sample at t 0 and after 5 hour in solar box. Voltammograms of a sample after, - 0h, - 1h, - 3h, - 5h

STEPS OF INVESTIGATION

Before proceeding with the analysis of sunscreens, tests were carried out on standard solutions of OC in 20 mL of Britton Robinson buffer-ethanol 80:20 solution to assess the response and the performance of the technique.
The stability of the sunscreen was tested by analyzing it with voltammetry after increasing times of exposure to sunlight in a solar box. The use of CTAB to improve analytical performance of the method was tested.
Sunscreen in seawater sample was analyzed.
Comparison between different products were made.

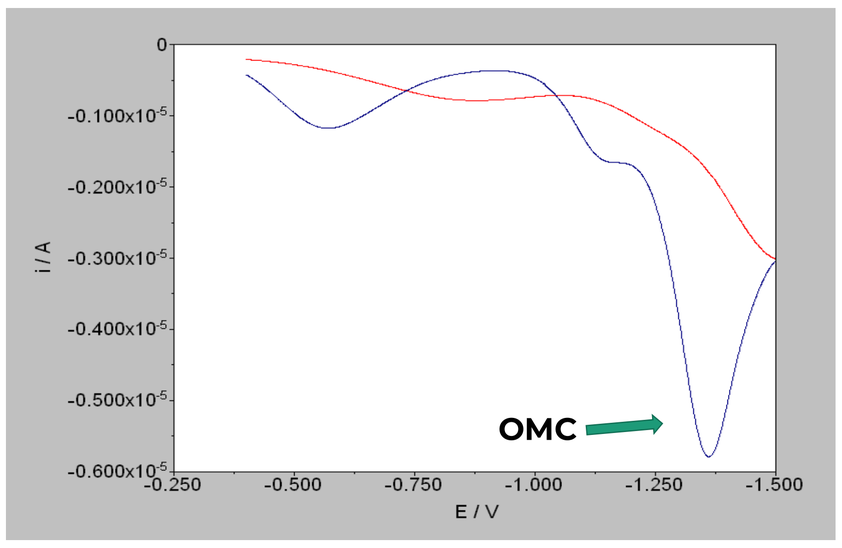


Figure 2 – Voltammogram of a sunscreen containing OMC in presence of CTAB (--) and without CTAB (--)

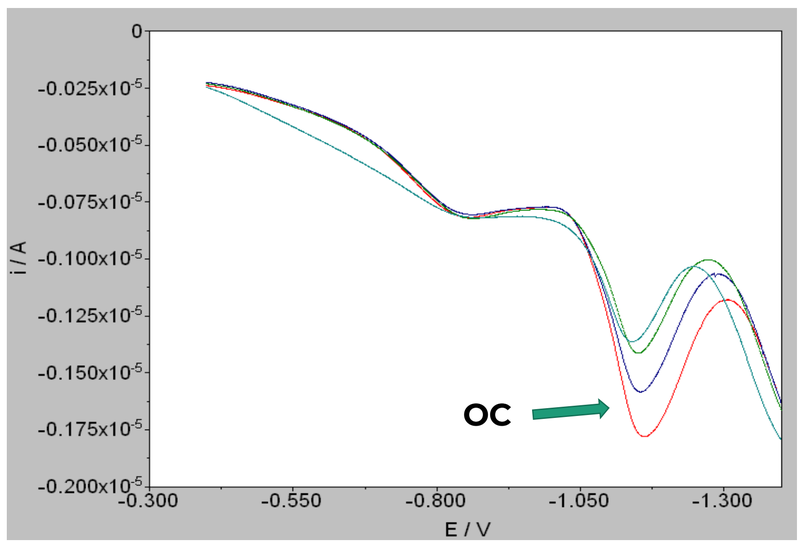


Figure 3 – Determination of OC in sample of seawater with three additions of OC standard

RESULTS

The results obtained so far have allowed us to see how the concentration of UV filters decreases after several hours of exposure to the solar box and that this can be determined by SWV using CPE. Figure 1 shows the modification of a product after 5 hours in solar box and the relative voltammograms.
CTAB has proven to be an excellent supporting electrolyte for this type of analysis, thanks to the increase of the response sensitivity (Figure 2). Tests by dissolving samples in seawater (Figure 3) have allowed us to understand that it is possible to apply SWV with GCE to monitor the residues of this substances in water ecosystems.
Voltammetry has proved to be an excellent technique also to compare different products containing different UV filters (Figure 4) to assess their quality and stability, for human safety purposes. In conclusion, the technique showed good potentialities for sunscreen analysis thanks to its low costs, ease of use and the possibility of carrying out measurements even on site.

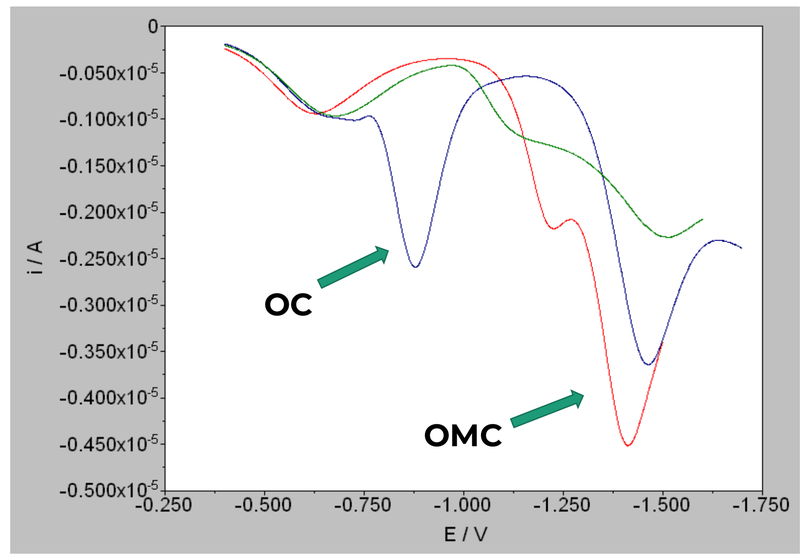


Figure 4 – Voltammogram of three different commercial sunscreens, -- OMC and OC, -- OMC, -- without UV filters

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