Air purification from organic pollutants by activated carbons and their in situ photoregeneration

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Extractor hoods represent one of the main technologies for purifying indoor air in in domestic environments, in research laboratories and in industrial processes. Suction hoods are divided into hoods that expel the air from work environments or hoods that recirculate the air after having filtered it for the removal of odorous and/or toxic substances. The filtration system of these hoods is based on the use of active carbons (AC) which, thanks to their large surface area, are able to stop the organic molecules by adsorption, allowing the air to pass through. This process is instantaneous and highly efficient. The main disadvantage is constituted by the exhaustion over time of the adsorbing capacities of the carbons, which reach total exhaustion within a few months. When the carbon filters exhaust their adsorbing capacity, it is necessary to replace them or regenerate them through heat treatments. These operations are not possible in situ and therefore the filters are generally replaced with new ones, by sending the exhausted ones to regeneration, with a significant economic and environmental cost.

The work aims to propose and develop a new filtration system, based on modified active carbons, which can be regenerated in situ after each use of the extractor hood, in order to maintain filtration efficiency for much longer times than current working times. This will allow for hoods with activated carbon filters that last much longer, air that is always purified at maximum performance and a reduction in the economic and environmental costs of the activated carbon regeneration process.

The idea is based on the combination of a very fast and efficient process (adsorption by activated carbons) with a second process able to destroy the previously adsorbed organic molecules by oxidizing them to CO2 and water (photocatalysis). Then, commercial activated carbon will be used as raw material for the production of a new titanium oxide modified carbon by an innovative synthesis procedure, already tested. this material will retain its original adsorbent capabilities in order to purify the air in the hoods fast and with high performance when the hood will work. At the end of the daily use of the hoods, an internal low power UV the lamp will be turned on for the time necessary to allow the photocatalytic degradation of the molecules adsorbed on the carbons. The time required by this process (1-2 hours) is not problematic for this application because it corresponds to the non-use time of the hood. At the end of the photocatalytic process the carbons will be completely regenerated and the adsorbed molecules transformed into harmless molecules such as water and carbon dioxide. The esults obtained with a laboratory-scale plant have confirmed the possibility of full or partial carbon regeneration for more than two 10 continuous carbon adsorption/regeneration cycles.