

TEST OF THE POSSIBLE RELEASE OF PHOTOCATALYST POWDER FROM THE SUPPORT DURING THE EXPERIMENTS

-TECHNICAL REPORT-

The following report shows the experimental procedure performed in order to evaluate the possible release of the photocatalyst from the support during the tests, i.e. during the contact of the gas flow with the photocatalytic module (mod. FC-UNIT 3).

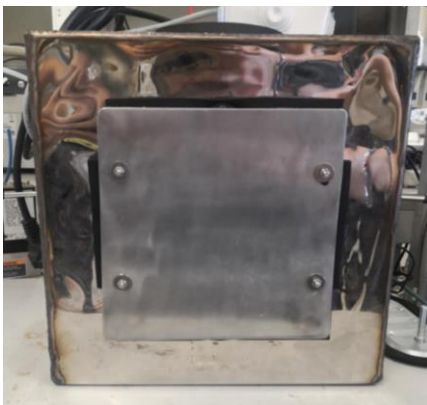
The tests were carried out under the intended test conditions.

Experimental set up.

The experimental set up includes:

- mass flow controllers to deliver the desired gas flow rate (60 NI / h) that will also be used in subsequent tests.
- Box to house the catalytic module. Specifically, the box supplied by Air Control has been replaced by another specifically made by the University of Salerno to reduce gas leaks from the walls of the box found during the leak tests. Specifically, the box created has the following dimensions: 13 cm x 13 cm x 13 cm.

Below is a photo of the box:



- Gas inlet and outlet pipes from the box.
 - Filter for the trapping of any catalytic particles present in the air coming from the box (a photo of the filter is shown below). The filter medium consists of a porous glass fiber membrane (housed in a steel system specially made for this purpose) capable of allowing the filtration of solid particles larger than $0.1 \mu\text{m}$.

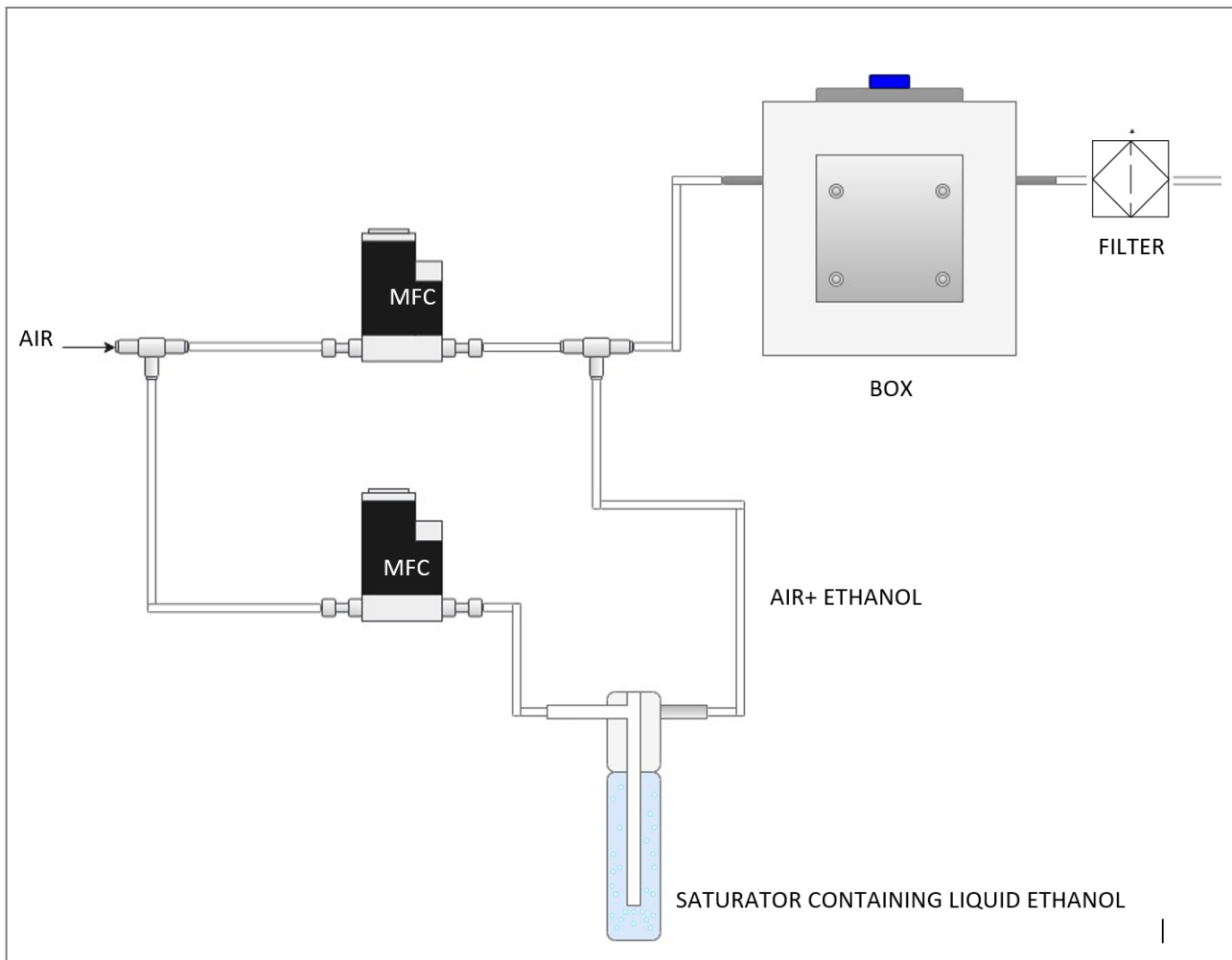


Figure: System to hold the filter



Figure: Filter used for testing.

A block diagram of the complete set up is also shown below:



Experimental procedure for the evaluation of the potential release of the photocatalyst particles from the support:

In order to evaluate the possible release of catalytic particles, a gas (air) flow rate of 60 NI/h was sent to the box, where the catalytic module was previously housed, for a time equal to 14 hours.

In particular, the outlet pipe was conveyed to an isokinetic filter which allows to collect any catalyst particles entrained by the gas at a flow rate of 60 NI/h. Specifically, before conducting the test, the filter was weighed. The value of the weight of the filter before the test was equal to 0.1326 g.

The air flow rate of 60 NI/h was chosen considering the maximum flow rate allowed by the analyzers that will be used for quantifying the concentration of CO₂ and organic compound (ethanol) that will be used in subsequent tests.

After 14 hours, the mass flow controller was closed. At this point we proceeded to measure the weight of the filter in order to evaluate any weight changes before and after the passage of the air stream, possibly due to the presence of deposited catalytic particles. In addition, the filter was subjected to a MicroRaman analysis using an excitation laser having a wavelength equal to 514 nm. The MicroRaman analysis was conducted to detect the possible presence of particles of titanium dioxide (TiO_2) present on the surface of the filter medium. From the evaluation performed it was possible to find that the weight of the filter did not undergo a substantial appreciable variation in relation to the sensitivity of the analytical balance used for the measurement. Furthermore, the MicroRaman analysis did not reveal the presence of phases other than those constituting the glass material of the filter medium (see figure below).

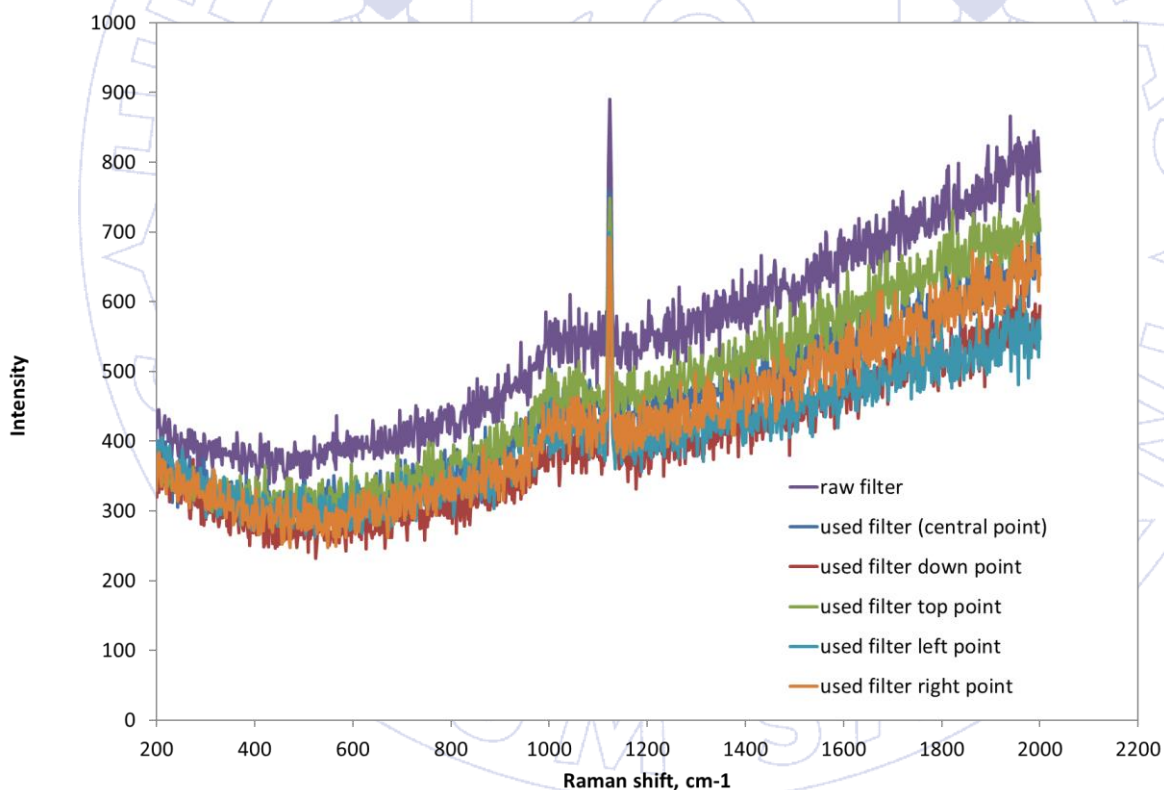
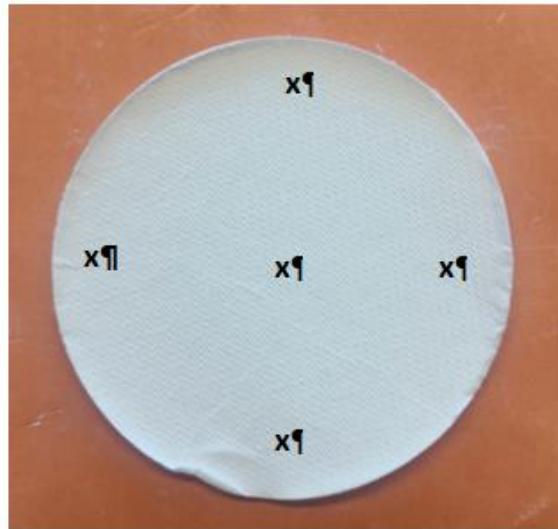
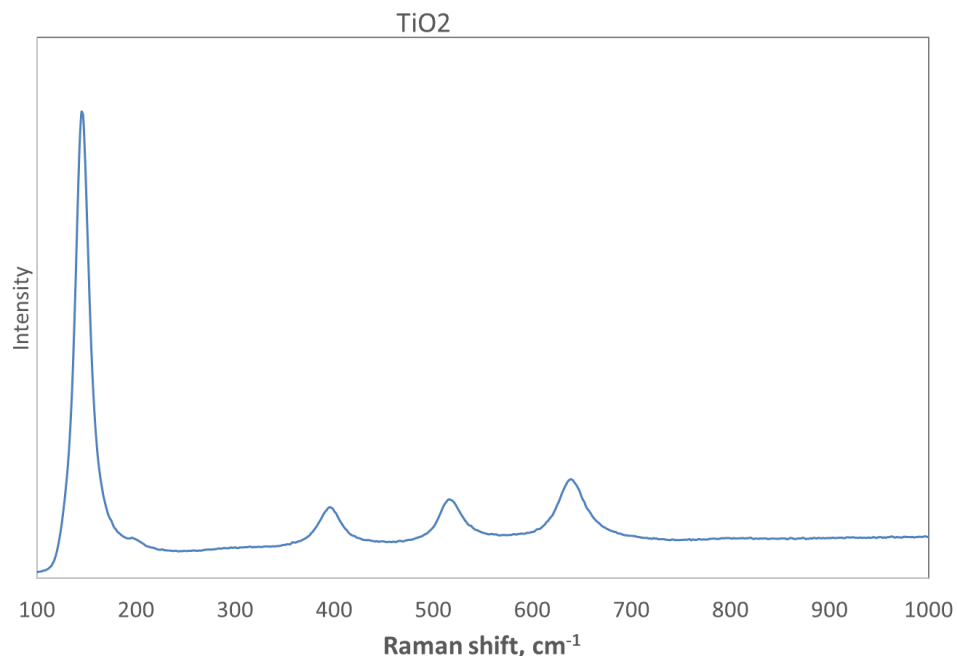


Figure: Raman spectra of the raw filter and of the post-use filter.

It should be emphasized that the MicroRaman analysis on the post-use filter was conducted on different points of the surface. In particular, the points are indicated in the following figure:



If the presence of TiO_2 catalyst particles entrained by the support was found, the Raman spectrum should have returned a signal like the one shown in the following figure:



This spectrum was obtained from the Raman analysis of the photocatalyst present in the tested module. As it is possible to observe, from the Raman analysis carried out on the filter after the passage of the air stream, the presence of the characteristic signals of TiO_2 is not found.

From these analyses it can be seen that, under the used operating conditions, no entrainment of the catalytic particles from the support was found.

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