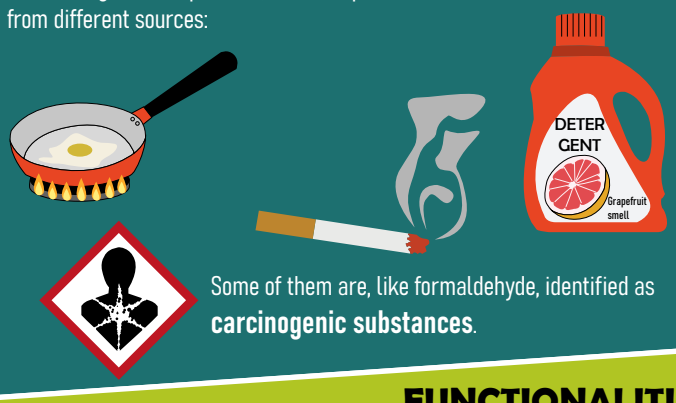
Safe(r) by design photocatalytic paint to reduce air pollutants

VOCs, AN INCREASING CONCERN

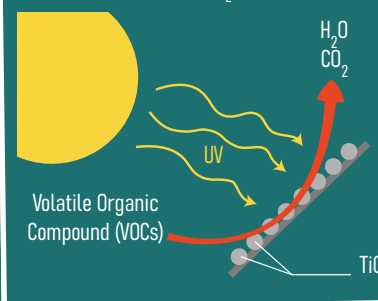
Volatile Organic Compounds (VOCs) are present in **indoor air** and come from different sources:



Some of them are, like formaldehyde, identified as **carcinogenic substances**.

A PROMISING INNOVATION

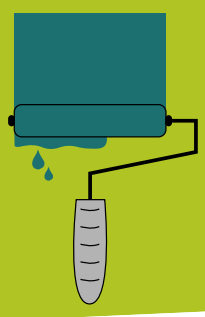
Remediation is possible thanks to a **photocatalytic process** using **titanium dioxide** (TiO_2) nanoparticles (NPs):



Airborne pollutants such as VOCs can be **transformed into harmless compounds** (H_2O and CO_2).

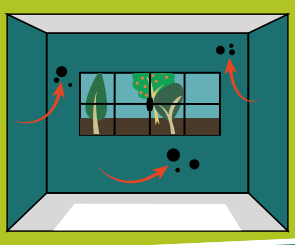
FUNCTIONALITIES OF TiO_2 IN PAINTS

This is a **promising technology** to reduce in and outdoor **airborne pollutants**.



- ✓ Optimizing **mechanical** and **rheological properties**
- ✓ Enabling photocatalysis for **indoor and outdoor air treatment**

However the **risks** associated with exposure during the life cycle of paints are becoming a **major concern**. Thus, **paint stability** is a **key parameter** to avoid NPs release.



OBJECTIVE

Developing, by a **safe(r) by design approach**, a **paint** containing **photocatalytic TiO_2 nanoparticles to clean ambient air**, taking into consideration safety aspects at every step of the life cycle.

SOME RESULTS OF THE PROJECT

In **preliminary formulations of the paint**, **TiO_2** was so effective that in addition to transforming VOCs, it also **damages the organic paint matrix itself.** This degradation leads to the **release of potentially toxic TiO_2 NPs and other VOCs** in the environment.

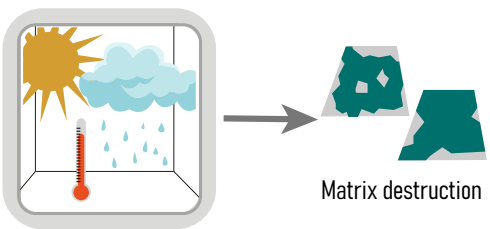
A TiO_2 paint on organic matrix

Therefore, **two hypotheses** were tested to avoid organic matrix degradation :

- **coating TiO_2** to improve its dispersion in paint and limit matrix degradation
- **grafting TiO_2** on cellulose nanocristal (CNC) to limit its release and matrix degradation

TiO_2 grafted on CNC Coated TiO_2

Two paints have been developed with **coated or grafted TiO_2**. After putting them on a support, they were **aged in a climatic chamber** with controlled parameters (light, temperature, humidity) to mimic their fate in the environment.



Matrix destruction

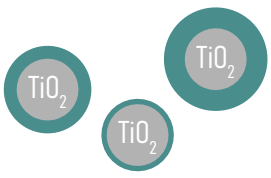
These techniques did not allow to develop a safe paint yet, paints **do not remain stable** after aging.

Whatever the technique, coated or grafted TiO_2, the organic paint matrix is still damaged by TiO_2. Thus potentially toxic particles may be released in the environment. Therefore, further experiments have been performed, **by substituting the organic matrix with mineral one**.

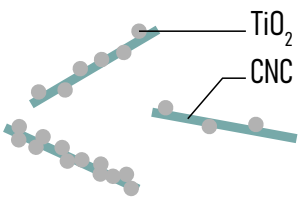
A TiO_2 paint on mineral matrix

The same TiO_2 incorporation strategies have been used with the mineral matrix:

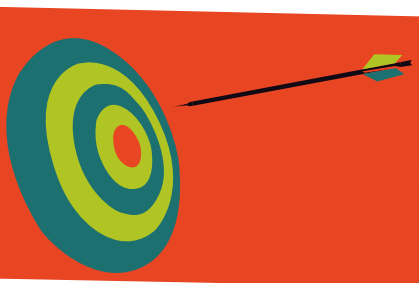
- Different **coating thicknesses** have been tested.



- Different **quantities of TiO_2** on CNC have been tested.

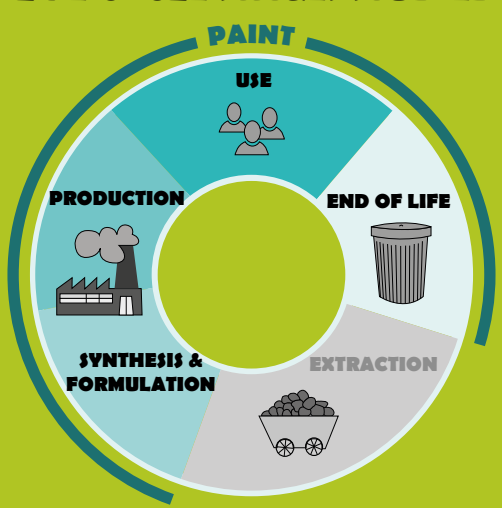


In each experiment these paints are **more stable** than those based on an organic matrix. **They can transform VOCs in harmless compounds** but their efficiency still **needs to be optimized**.



Paints with TiO_2 are **an attractive innovation** to clean ambient air, the above experiments show promising developments.

LIFE CYCLE STAGES STUDIED



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