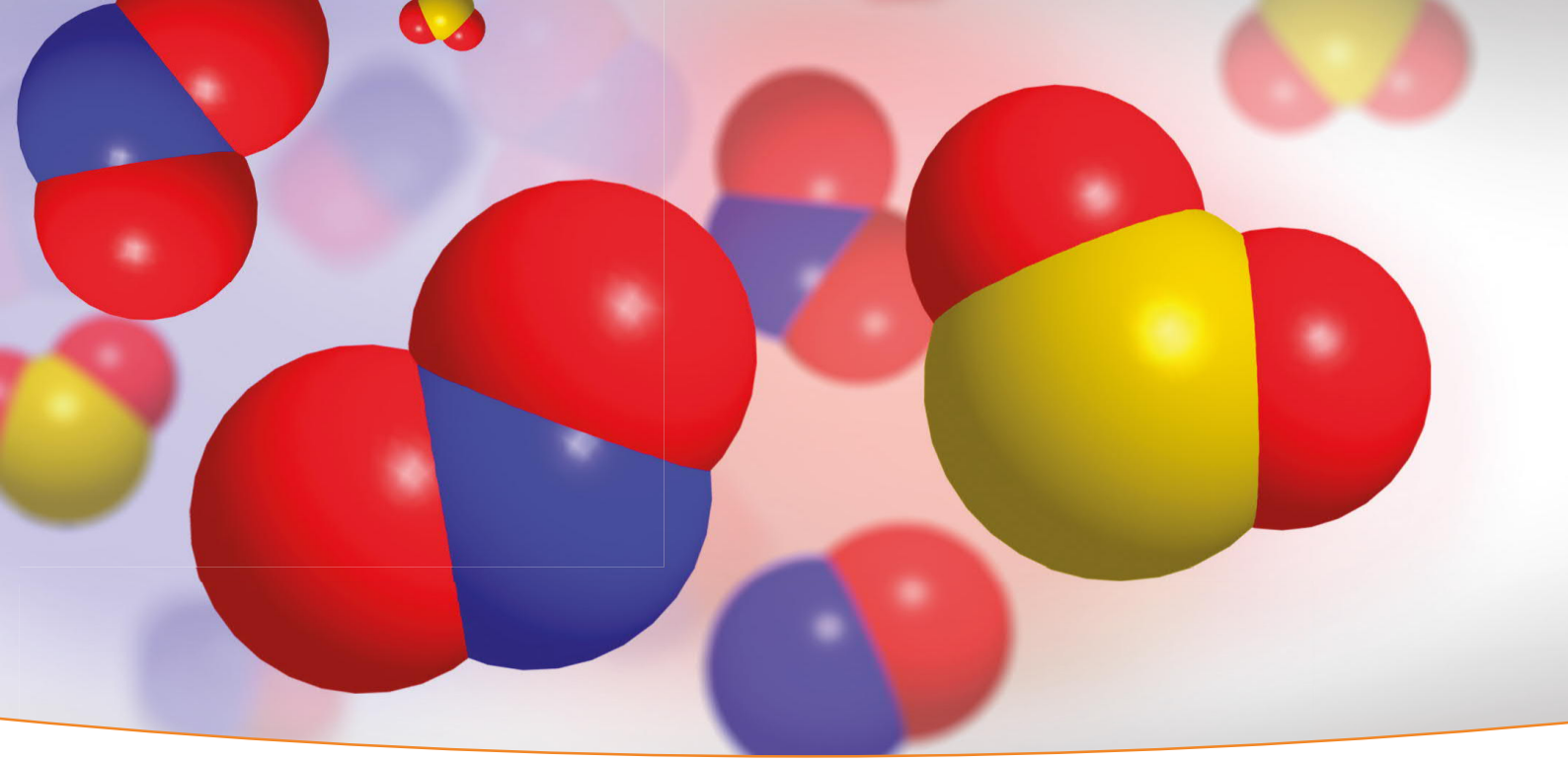

How to determine the depolluting efficiency of an outdoor coating?

Testing of the efficiency of outdoor depolluting materials

Executive Summary

There are various substances in the air that are considered pollution, when they have harmful or poisonous effect. Air pollution is considered a major underlying factor in poor living standard in city life. In industrial environment air quality is a major safety concern. In 1970s photo catalytic titanium dioxide was introduced to the coating market and later to be used in many different coating applications. This development was a great breakthrough in producing paints with depolluting behavior for indoor and outdoor applications which could turn the air pollutants to the inert substances and reduce the air pollution considerably. The commercial benefits of such developments are enormous. But how to measure the efficiency of depolluting coatings? This article is prepared to demonstrate how analytical scientists in Expert Capability Center Deventer (ECCD) of Nouryon are solving analytical challenges, by case study of analytical setup to test the efficiency of outdoor depolluting materials.

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How to determine the depolluting efficiency of the coating?

The conventional method to measure depolluting efficiency in coating is headspace gas chromatography or methods described in ISO 22197-1:2016. Nevertheless, test institutes having such experimental set up perform only routine analyses with no room for method development and testing pollutants different to NO_X.

Therefore, analytical scientists in ECCD have developed a sophisticated set up able to measure efficiency of depolluting coatings in outdoor applications simulating exposure to, for example, NO_X, SO_2, or formaldehyde.

How to develop a setup to measure depolluting effficiency of the coating for outdoor applications?

1) Identification of the chemical/physical characteristics of air pollutants and the technology of the depollution coating.

For outdoor depolluting application nitrogen or sulfur oxides, NO_x (NO & NO_2 & NO_3) or SO_x are the target air polluting compounds with large impact on environment, infrastructure, and human health.
The technology that has been incorporated to change NO_x to nitrates and nitrites is a catalyst incorporated into the coating (Figure 1).

2) How to choose the right analytical method?

As air pollutants are often volatile compounds the best way to measure them would be GC and to do a lot of measurements in time and with short time intervals, an ultra-fast GC system has been chosen which could receive a gas injection every 0.3 min. For NO_x chemiluminescence detector was used. FID, HID or MS detector was more suitable for the other compounds of interest.

3) How to do the analyses?

The coating sample on the substrate should be exposed to the air flow with controlled concentrations of NO_x, humidity and sunlight for 6 hrs.
The sample was first washed with deionized water to regenerate the catalytic behavior of the coating. For the purpose of the experiment the flow cell and gas mixing chamber (to control the air humidity) were internally designed and made and the detector was precalibrated (Figure 2).

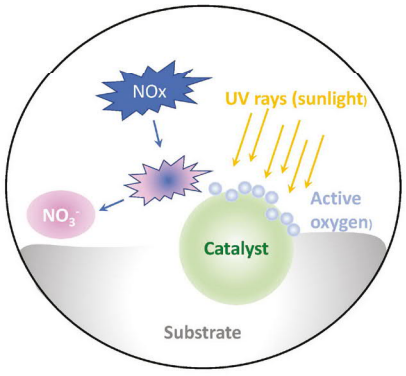
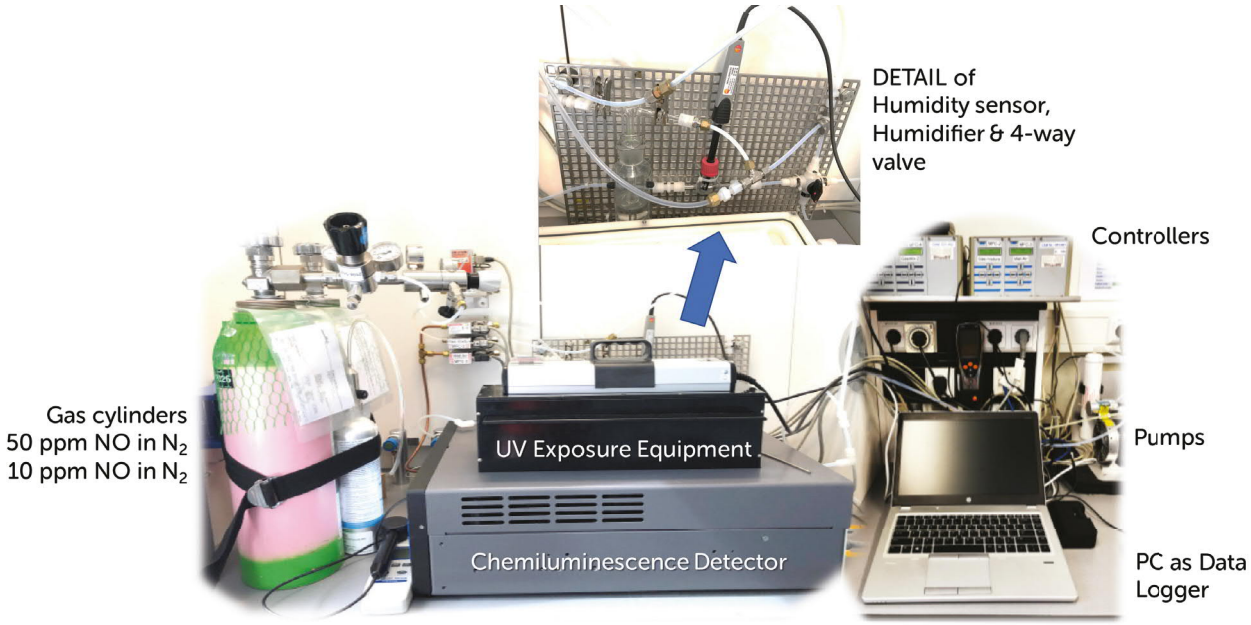


Figure 1: Photocatalytic system: the catalyst is energized by UV and accelerates the decomposition of organic particulates and airborne pollutants such as nitrous oxide (NO_x)

Figure 2: Air purification performance setup



Amount of NO_X formed and removed is calculated from graphs as given in Figure 3.

As can be seen in Figure 4 on NO_x example the setup designed and built in ECCD is able to quickly screen depollution performance of the coatings towards various pollutants.

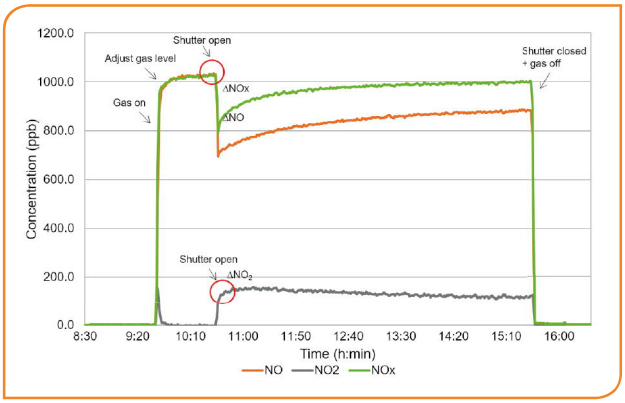


Figure 3: Air purification performance example of test output

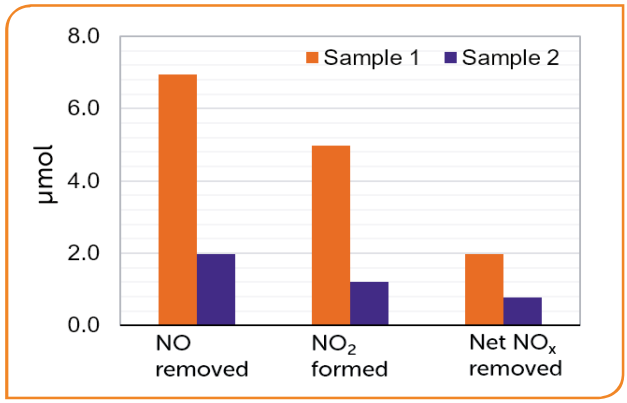


Figure 4: Comparison of different coating performances

Conclusion

The conventional method for determining depolluting coating efficiency is hindered by limited flexibility. The ECCD was successful in developing a practical setup to measure coating depollution efficiency in outdoor applications. This new method can be applied to screen a wide variety of pollutants and depolluting materials.

References
1) https://www.concretedecor.net/decorativeconcretearticles/vol-5-no-4-augustseptember-2005/self-cleaning-concrete/

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