Generation of a controlled polluted atmosphere

Jean-François PETIT, Pauline BARBE, Equipment Technical Study Center of Paris and its Region (CETE IF), TRAPPES, FRANCE, Air Quality and Signalization Durability, jf.petit@developpement-durable.gouv.fr, pauline.barbe@developpement-durable.gouv.fr

Carine Cardella, Laurent Courthaudon, AlyTech, Juvisy-sur-Orge, France, gasmix@alytech.fr, www.alytech.fr

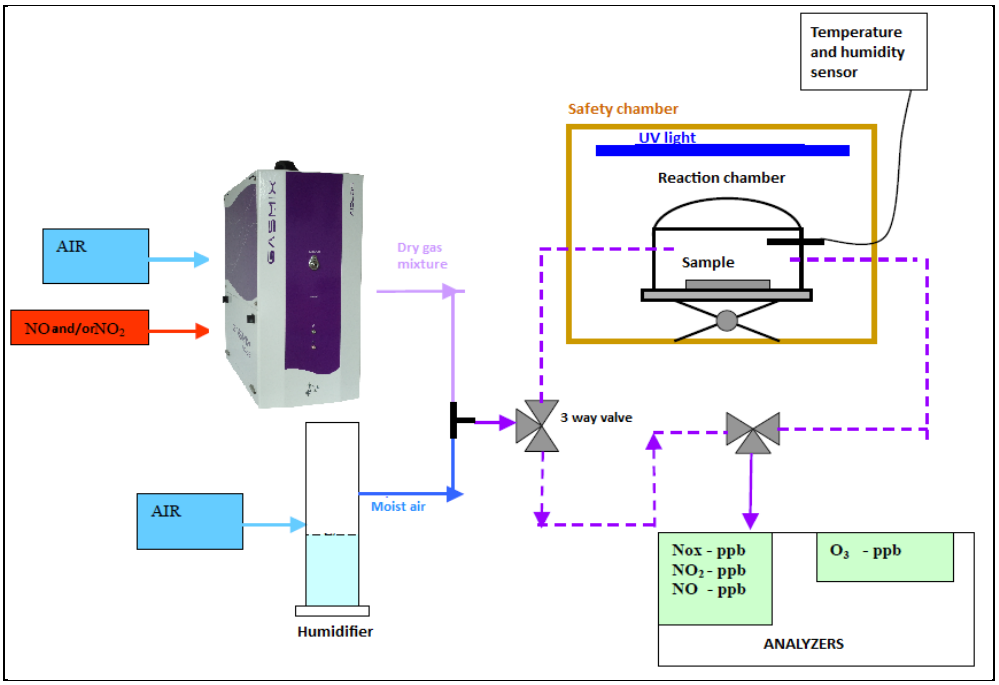
GasMix™, the AlyTech gas blender was used by the CETE IF to create an atmosphere in which the concentration of nitrogen oxides is well known and controlled, in order to evaluate the decontamination efficiency of a new long-life pavement.

CLEAN Project

The CLEAN project goal is to evaluate the decontamination efficiency of new long-life pavements: an innovative technical solution, called HPCM (High-Performance Cementitious Material), consisting of a thin layer of ultra-high performance fiber reinforced mortar with calcined bauxite aggregate embedded in the surface at the fresh state. This project is supported by the National Research Agency (ANR) and several public and private partners.
The purpose of the project is the conception and *in situ* experimentation of thin long-life pavement with an embedded decontaminating wearing course. This kind of pavement would be particularly interesting for highly trafficked roads to reduce their impact on air quality and their maintenance constraints.
The pavement developed in this project contains titanium dioxide (TiO_2). In the presence of UV light, TiO_2 degrades nitrogen oxide in nitrates (NO_3^-) which will be naturally eliminated by rain water.

Use of GasMix™

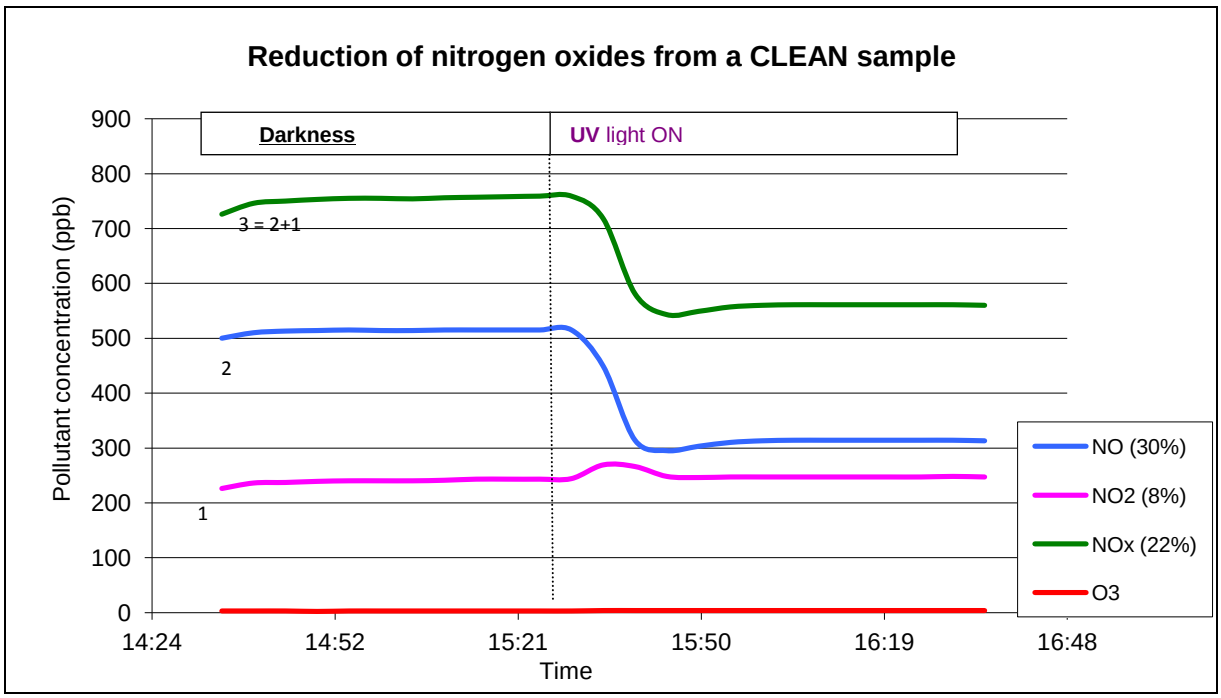
During the two year project, CETE IF had to deal with more than 30 samples of different formulations, including, both test tubes from laboratory and cores taken from test sites.
The aim was to compare the decontamination efficiency of each sample and to evaluate the consequences of the material ageing on this efficiency.
These experiments have been realized thanks to the following set-up:



This set-up allowed the generation of an atmosphere with a chosen nitrogen oxide concentration and a controlled hygrometry degree. The aim was to approach environmental conditions.
To better understand the decontamination behavior of the long-life pavement relatively to the environment, different gas mixtures have been tested:

- air/Nitrogen monoxide (NO) mixture
- air/dioxide of nitrogen (NO_2) mixture
- air/NO/NO_2 mixture

Furthermore, a large range of concentrations have been produced for each mixture. It seems that the decontamination efficiency depends on the relative concentration of the different nitrogen oxides in the air samples.
The graph below is a typical example of the obtained results:



Graph of the evolution of the nitrogen oxide concentration versus time. The left part is before the light exposure and the right side during the UV exposure. In brackets is the reduction of the observed pollutant.

Conclusion

GasMix™ permitted to evaluate the efficiency of decontamination from different long-life pavements. This has been realized in a wide range of pollution conditions, underlining the UV light significance.
In the case of a mixture as shown in the example, the decontamination is more efficient for NO than for NO2.
The large range of tested concentrations and all the produced gas mixtures fully justified the investment of a gas blender.
The same set-up was also used to assess the reliability of ultra-compact pollutants sensors.

Contacts :

CETE IF
Jean-François PETIT, Pauline BARBE
12, rue Teisserenc de Bort
78190 Trappes
FRANCE
+331 34 82 13 51
jf.petit@developpement-durable.gouv.fr
pauline.barbe@developpement-durable.gouv.fr

AlyTech
Centre Hoche, 3 rue Condorcet, 91260 Juvisy/Orge
+331 69 56 07 17
FRANCE
gasmix@alytech.fr