Assessing Photocatalytic Asphalt Mixtures: Practical and Laboratory Methods for Measuring Air Quality

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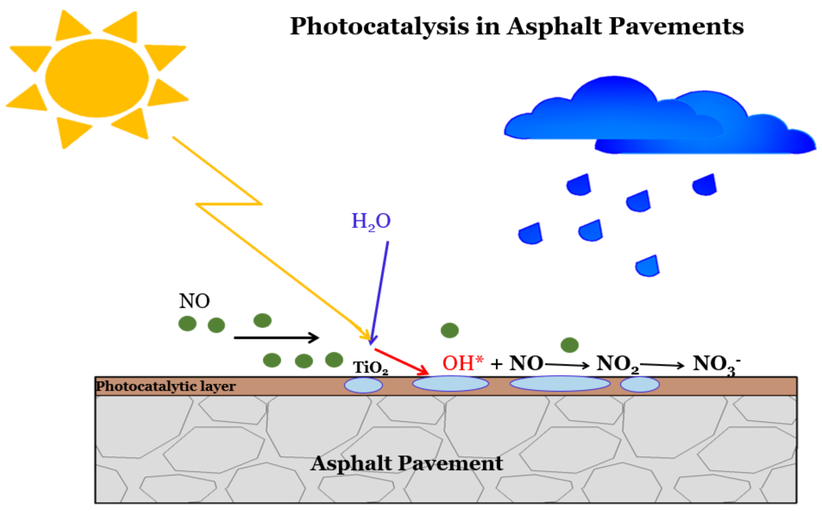
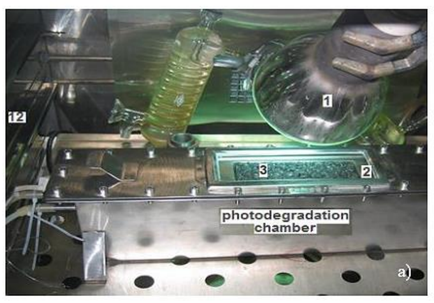
1) Introduction

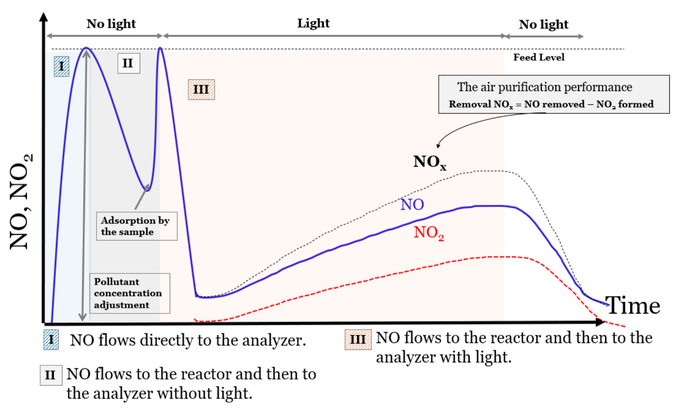
Asphalt mixtures with photocatalytic properties are being explored as a potential solution to reduce air pollution in cities. These mixtures, when enhanced with nano-TiO_2, can help decrease the levels of various pollutants, produced by vehicles and others, that can lead to issues like acid rain and public health risks.



2) Gas Degradation – ISO 22197



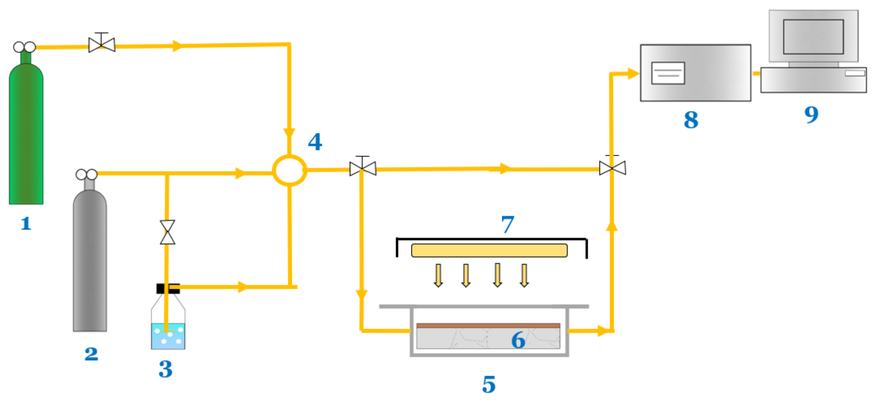
Pollutant concentration reduction



Pollutant Gases:

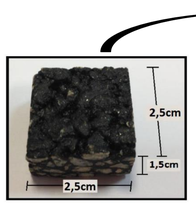
- ✓ NO_x
- ✓ C_2H_4O
- ✓ $C_6H_5CH_3$
- ✓ CH_4S

Schematic diagram of the test setup (ISO 22197-1)



1. NO source **2**. air compressor **3**. humidifier **4.** gas mixer **5.** reactor **6.** paving slab **7.** Light source **8.** NO_x analyzer **9.** Computer.

3) Dye Degradation



Asphalt mixture sample

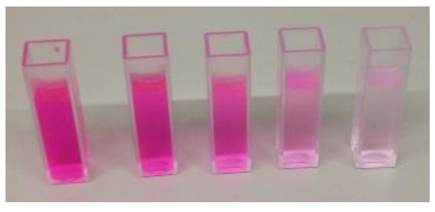
Rhodamine B Solution → Immersed sample

Dyes:

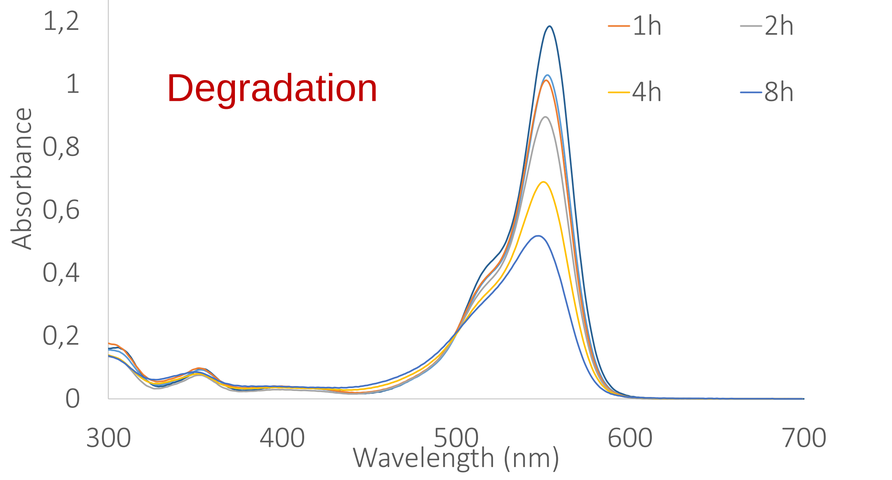
- ✓ Rhodamine B
- ✓ Methylene Blue
- ✓ Methylene Orange

Sunlight simulation

Dye degradation



Reduction of Concentration



Beer-Lambert law

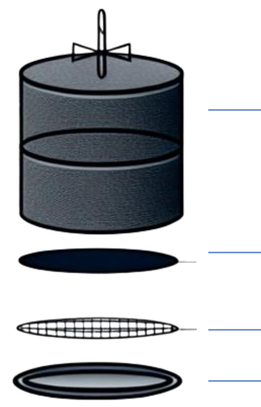
$$A = \varepsilon l C$$

$$\frac{A}{A_o} = \frac{C}{C_o}$$

$$\eta(\%) = 100 \times \frac{A_o - A}{A_o}$$

4) Passive Sampling

Support with samplers



Passive Sampler
Cellulose filter
Steel screen
Sampler cover

Acrylic box with samplers

Micro coolers and sensors monitoring environment

5) Monitoring Stations

- ✓ Air quality monitoring systems are equipped with automatic analyzers;
- ✓ They track atmospheric pollution and assess the effectiveness of air quality regulations;
- ✓ These systems record concentrations of pollutants, including suspended particles and gases like sulfur dioxide and nitrogen oxides.

Air quality monitoring station

6) Conclusion

This study offered guidance on evaluating the effectiveness of TiO_2-treated asphalt roads in reducing environmental harm from pollutants.
The technique with the reactor under the ISO 22197 is a precise laboratory process for calculating photocatalytic efficiency. Passive sampling is a more cost-effective method, while air quality monitoring stations, though expensive, provide valuable data with various parameters. Passive sampling needs continued research to validate this method. Finally, dye degradation is an indirect method to evaluate the air depollution.

7) Acknowledgements

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