Dirt, Dust, and Deleterious Gases

The Interaction of NO_x with Road Dust and Humic Acid

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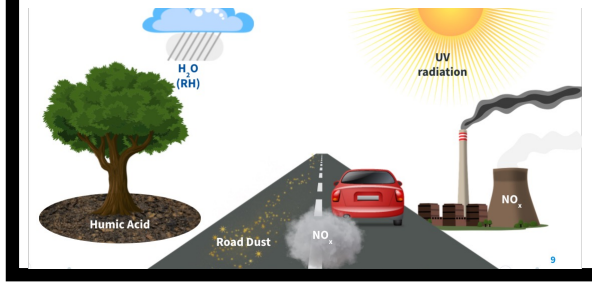
1. Introduction & Big Picture

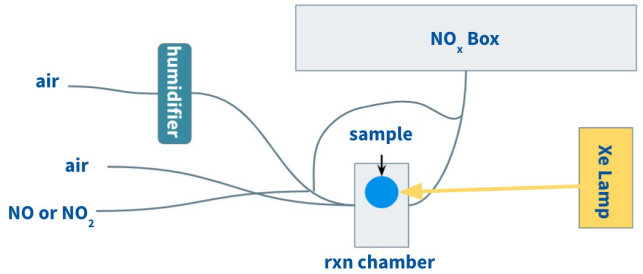
Developing an understanding of the heterogeneous chemistry of NO_x (NO_2 + NO) with surfaces is vital. NO_x is a precursor to ozone, and is also partially responsible for urban smog, acid rain and other harmful pollution events[1,2]. Road dust is the most important human-generated source of fine particulate matter, composed of organic and inorganic materials. Humic acids are the most available organic species on the surface of the earth. Thus, road dust chemistry may resemble a combination of TiO_2 (inorganic) and humic acid (organic).



Previous work has shown that TiO_2 photocatalyzes reactions of NO_x. **Do road dust and humic acid also have this effect on NO_x?**

2. Experimental method

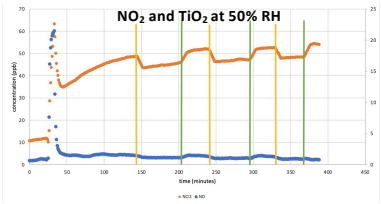
1. Flow zero air with NO_x to detector, bypass chamber
2. Divert NO_x into chamber
3. Turn on Xe lamp
4. Turn off Xe lamp
5. Divert NO_x out of chamber



3. Results

A) TiO_2

Light induces photocatalysis and changes in NO_x concentrations when either NO_2 and NO were added to TiO_2. Here we show NO and NO_2 decreasing with illumination.

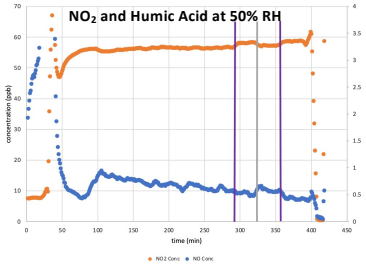


B) Humic Acid

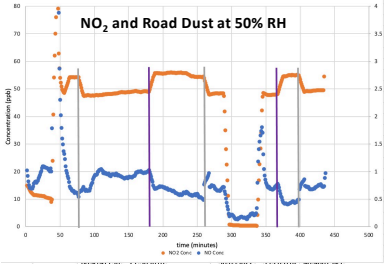
Light has no effect on NO_x, but adsorption occurs.

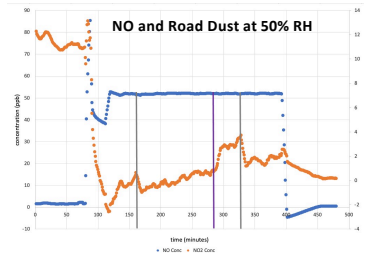
NO_2 main gas: small changes in NO_x

NO main gas: no changes in NO_x



C) Road Dust – Collected from Huron Street



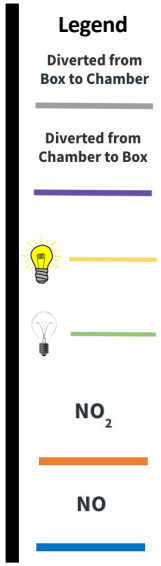


Light has no effect on NO_x, but adsorption occurs.

NO_2 main gas: changes in NO were opposite to changes in NO_2

NO main gas: only changes in NO_2 concentration

Road dust is composed of organic and inorganic material. **Results may resemble a combination of TiO_2 and humic acid behaviour.**



4. Conclusion

- Road dust and humic acid adsorb NO_x, but no photochemistry occurs
- Future work will involve understanding whether these reactions scale with mass and surface area, and what the product of these reactions are

	TiO_2	Humic Acid	Road Dust
Photochemistry?	✓	✗	✗
Adsorption?	✗	✓	✓
Which Gas?	NO_2 & NO	NO_2	NO_2 & (NO)
ΔEffect?	**Largest**	Smallest	Medium

References

1. Chen, H.; Nanayakkara, C. E.; Grassian, V. H. Titanium Dioxide Photocatalysis in Atmospheric Chemistry. *Chem. Rev.* **2012**, *112*, 5919-5948, dx.doi.org/10.1021/cr3002092

2. Jones, S. H.; Hosse, F. P. R.; Yang, X.; Donaldson, D. J. Loss of NO(g) to painted surfaces and its re-emission with indoor illumination. *Indoor Air* **2020**, *00*, 1-8, DOI: 10.1111/ina.12741