VOCs Speciation From Steam Boiler Stacks of Industries Located in Naucalpan

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Activities developed at Naucalpan

- PM10, particle size characterization
  - Results presented in Boulder, October, 2006
- PAHs adsorbed in PM2.5
  - Results presented in Boulder, October, 2006
- VOCs in stacks gases
  - Results presented in Mexico City, May, 2007
Objective

To speciate VOCs in samples of steam stack gases of industries located in the Municipality of Naucalpan.
Speciation of VOCs is important:
- To identify sources of air pollutants
- To update emission inventories
- To study the dynamics of pollutants in the atmosphere
- To estimate possible risks of population exposure.
Several air quality studies for the Mexico City Valley have shown that most pollutants are generated at the north west area.

Naucalpan is located at the north west of the city and is the first largest municipality in number of industries and second in traffic load.
Analysis of COVs: Methods

- USEPA T014 for COVs.
- SW-846-010 for aromatics.
- VOST for olefins.
- Analysis: Gas Chromatography-Mass Spectroscopy with FID.
Equipment: Thermo iso-kinetics sampler
## Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teflon hose</td>
<td>SKC, 3/16, ¼ diameter</td>
</tr>
<tr>
<td>Tedlar Bags</td>
<td>SKC, Volume of 1 lt</td>
</tr>
<tr>
<td>Particle filter</td>
<td>SKC filter of cellulose ester of 37 mm, 0.8 microns pore</td>
</tr>
<tr>
<td>Moisture trap</td>
<td>CaOH / NaOH.</td>
</tr>
</tbody>
</table>
A: Capacity 50-350 C.C
B: The selection of industries was limited by the willingness to participate.

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Number of Factories (B)</th>
<th>Combustion Equipment (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>10</td>
<td>Steam boiler</td>
</tr>
<tr>
<td>Diesel</td>
<td>10</td>
<td>Steam boiler</td>
</tr>
<tr>
<td>CNG</td>
<td>15</td>
<td>Steam boiler</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>
# VOCs analyzed

<table>
<thead>
<tr>
<th>Alkanes</th>
<th>Aromatics</th>
<th>Olefines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane</td>
<td>3-methyl pentane</td>
<td>Benzene</td>
</tr>
<tr>
<td>Propane</td>
<td>2,3-methyl pentane</td>
<td>Toluene</td>
</tr>
<tr>
<td>n-Butane</td>
<td>2,2,4-tri-methyl pentane</td>
<td>Ethyl benzene</td>
</tr>
<tr>
<td>Iso-butane</td>
<td>n-hexane</td>
<td>o-xylene</td>
</tr>
<tr>
<td>2,2 di-methyl butane</td>
<td>Cycle-hexane</td>
<td>p-xilene</td>
</tr>
<tr>
<td>2,3 di-methyl butane</td>
<td>2-metil hexane</td>
<td>m-xilene</td>
</tr>
<tr>
<td>Isopentane</td>
<td>3-metil hexane</td>
<td>Isopropyl-benzene</td>
</tr>
<tr>
<td>n-pentane</td>
<td>n-heptane</td>
<td>1,3,5 tri-methyl benzene</td>
</tr>
<tr>
<td>Ciclopentano</td>
<td>n-octane</td>
<td>1,2,4 tri-methyl benzene</td>
</tr>
<tr>
<td>2-methyl pentane</td>
<td>n-nonane</td>
<td>N-propyl-benzene</td>
</tr>
</tbody>
</table>
Average Diesel VOCs Emission Profile

VOC's

- Ethylene
- Acetylene
- Propene
- Propane
- iButane
- 1-Butene
- i-Butylene
- 1,3-Butadiene
- AnButane
- c2Butene
- i-Pentane
- 2-Methyl-1-Butene
- n-Pentane
- 2-Methylcyclopentane
- 1,3-Cyclopentadiene
- 1-Methyl-2-Pentene
- 2-Methyl-2-Pentene
- 2,3-Dimethylpentane
- 3-Methylpentane
- n-Hexane
- Benzene
- 1,2-Propylene
- 1,3-Propylene
- 1,4-Butadiene
- 2-Methyl-1,3-Cyclohexadiene
- 2-Methylcyclohexane
- 2,3-Dimethylcyclohexane
- 3,4-Dimethylcyclohexane
- n-Heptane
- Toluene
- n-Nonane
- Ethylbenzene
- m,p-Xylene
- o-Xylene
- n-Octane
- n-Decane
- 1,3,5-Trimethylbenzene
- 1,2,4-Trimethylbenzene
- 1,2,3-Trimethylbenzene
- 2,4,5-Trimethylbenzene
- 2,3,4-Trimethylbenzene
- 1,2,4,5-Tetrakis(1,2-methylbenzene)

ppbC
LPG VOCs Emission Profile for 3 industries
Average CNG COVs Emission Profile
Conclusions

- Results of Diesel COVs speciation are consistent and uniform within samples.

- Speciation of LPG VOCs samples are inconsistent, except for one sample. Alkanes with 5 or more carbons and aromatics were detected.

- Speciation of CNGs VOCs are consistent, but it is not the expected profile.

- It is convenient to analyze more sample gases of CNG and LPG combustion to verify the results.