

Low volume and persistent low concentration VOC filtration testing

The filter was tested in its capacity to remove several commonly encountered VOC substances. With each, except for natural gas, a large necked bottle containing at least 1L of liquid compound was placed adjacent to the air filter at room temperature inside a barrel liner enclosure. The volume of the enclosure was approximately double that of the filter itself. Natural gas was piped into the enclosure at a constant rate to maintain ~2ppm concentration when the filter was not in operation. At room temperature, the liquid VOC would readily vaporize and the concentration of gaseous compound would quickly reach a constant value within the enclosure. At this point, the filter would be turned on to its highest setting (from outside the enclosure so as to not disturb the equilibrium). The bottle would remain open to continue to vent inside the enclosure. In the case of natural gas, the supply pipe would remain open to the enclosure. Gas concentration was measured with a chemical sniffer calibrated against isobutanol that is sensitive to measurements of less than 10ppb (0.01 ppm). Estimated error of readings due to instrument error / air turbulence inside enclosure was 0.05 ppm for natural gas (due to greater turbulence and relatively low concentration of the chemical versus the other tests), and 0.02 ppm for the remaining substances.

Exceptions

Some VOC's proved extremely difficult to measure in this way, perhaps due to limitations in our ability to measure their concentrations rapidly enough for each experiment. Natural gas was extremely difficult to work with due to the nature of its supply, ammonia proved difficult to measure in concentration as did ethyl alcohol; hence the 'results' for the latter two compounds are not included here.

Tests

There were two variants of the test:

- 1) Full filter (UV / TiO catalyst and activated charcoal)
- 2) Activated charcoal only

For 1, a later modification added a subset to this variant: a. originally supplied 'wire' catalyst, b. later supplied 'mesh' catalyst.

- a) A latticed sheet ('wire')
- b) Contained TiO deposited into a synthetic material (presumably to increase the solid to atmospheric surface area)

Results and Conclusions

Notes for each of the four successfully run compounds follow as to do the composite results (n=3 for each except natural gas where n=1).

Petrol

UV turned on again for 'charcoal' only measurement at t=305, t=600 reading = 0.13 ppm. i.e. The final concentration VOC for charcoal only run was lowered further, only after the UV light was turned on again. Hence, although there is little difference between the three measurements, it is apparent that the UV / catalyst did reduce the petrol VOC load by a small but significant amount.

*Because measurements were made for the later supplied catalyst material, at a time after those for the charcoal only and 'wire' catalyst, it is likely that the activated charcoal's effectiveness had reduced somewhat. Therefore it is significant that the final concentration of petrol vapors was lowest for the new catalytic material despite this. It also explains the slower rate of filtration (due to depleted charcoal).

Natural Gas

Measurement of continuous gas supply limited to +/- 0.05 ppm due to fluctuating readings (prob. due to turbulence vs. relatively low concentration).

One additional measurement of, none persistent gas load, filtration capability of the filter:

Gas supplied to enclosure until concentration reached 2.0ppm and then the gas supply turned off and filter turned on high, 0.000 ppm was achieved in under 5 seconds.

'wire' catalyst experiments not conducted due to difficulty in performing this test.

Cyclohexane

See * marked note for petrol above regarding apparent depleted charcoal retarding effectiveness of 'mesh' catalyst.

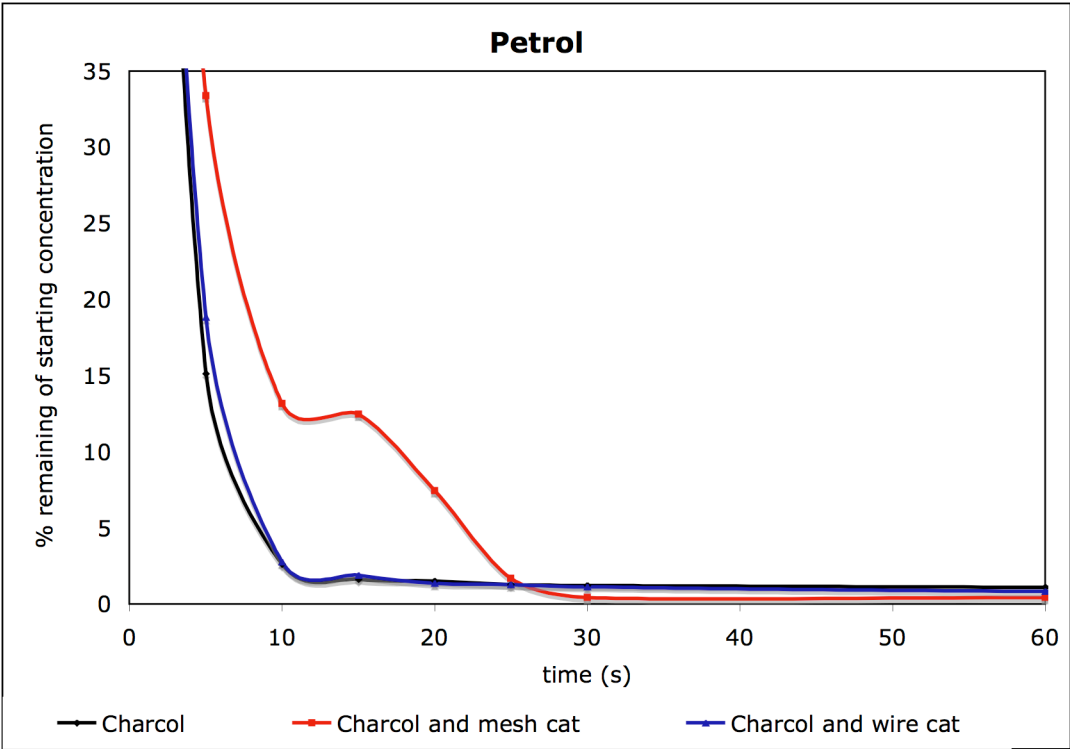
Although it seems to be of some effect, there is no significant difference between activated charcoal only and UV / catalyst assisted filtration.

Formaldehyde

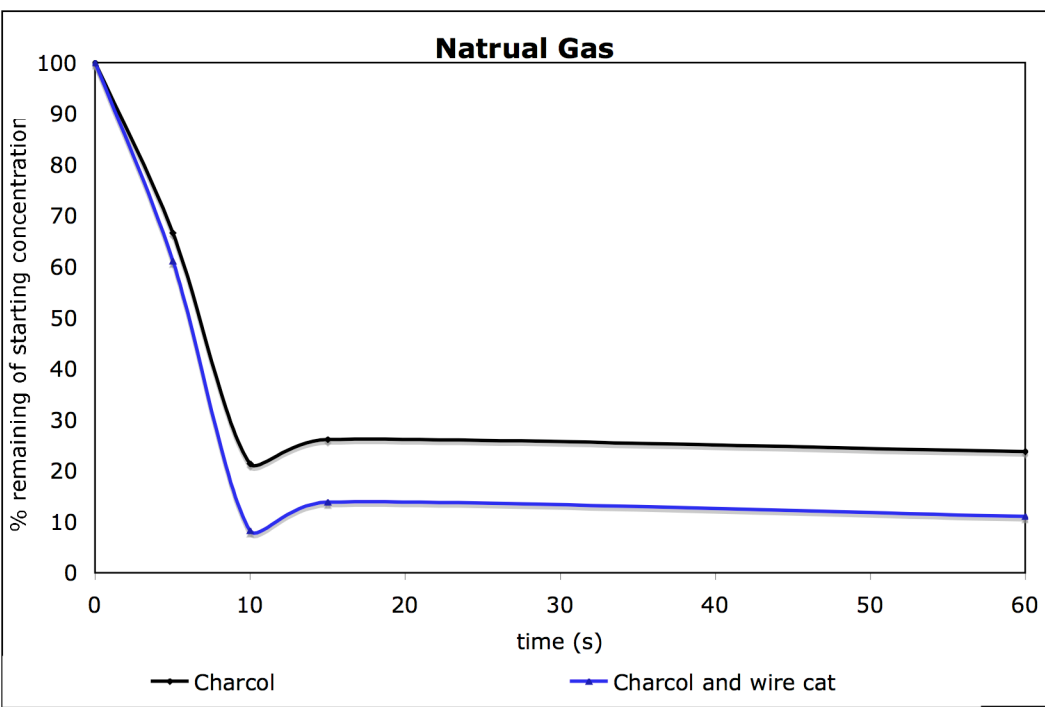
Measurements for all three tests were made at the same time hence should be directly comparable. There is a clear advantage to UV / catalyst assisted filtration for this compound and a marginal advantage to the mesh version of the catalyst.

Graphs

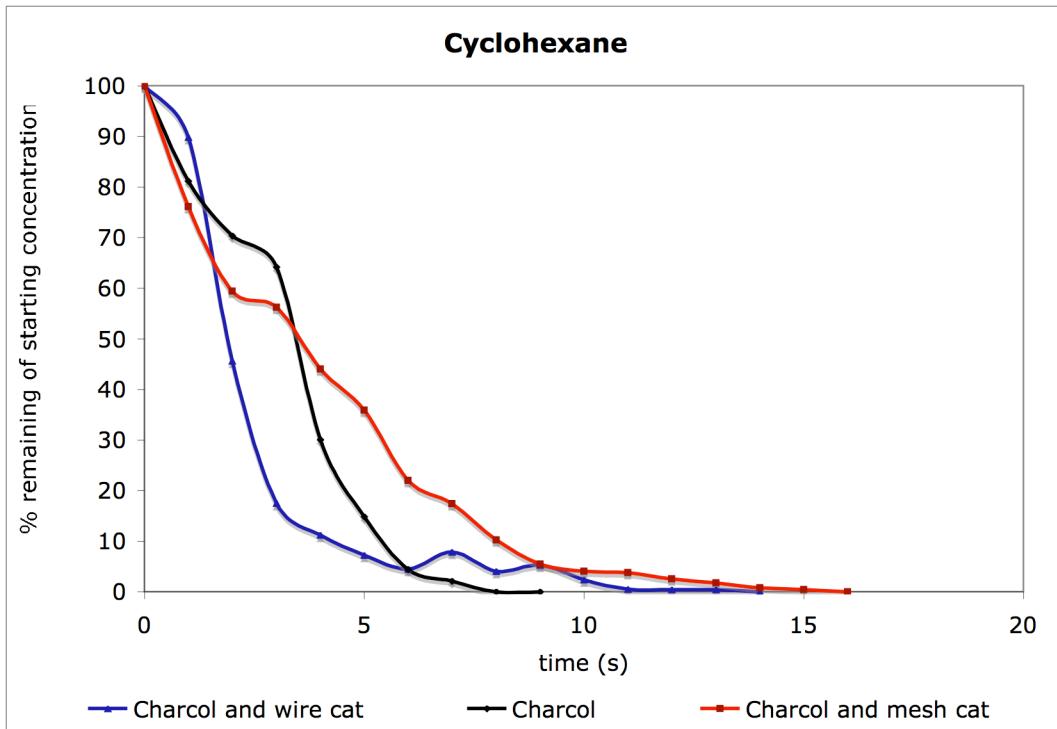
Data presented in graphs following, concentration of VOC is presented as percentage of t=0 seconds concentration because this varied between each experimental run. Because the volume of enclosure was relatively small and the concentration of VOC would reduce at the t=0 starting concentration to 0.00 ppm within a few seconds, it was assumed that the small variation in starting concentration was relatively insignificant to the results.



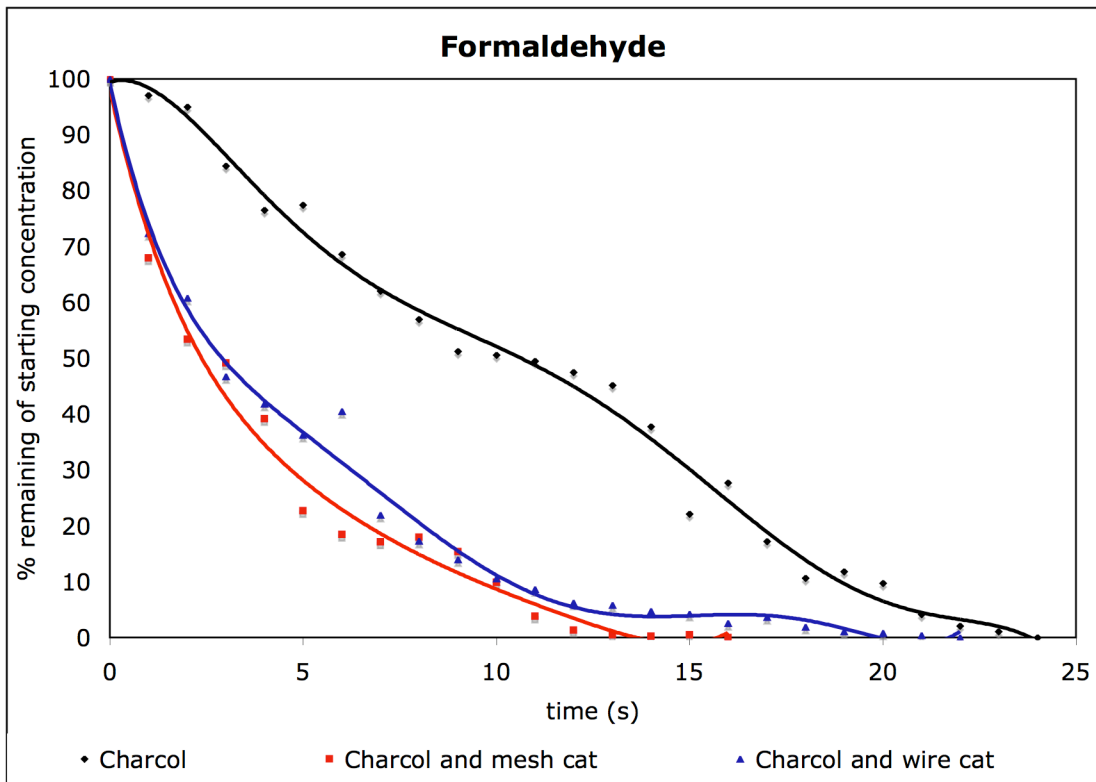
Starting concentration was 20-40ppm



Starting concentration was ~2ppm



Starting concentration was 14-47ppm



Starting concentration was 10-60ppm