Fast pre/post catalyser gas measurement with an Airsense 2000 analyzer

Frequent requests regarding the maximum measurement speed of V+F CIMS analyzers for dynamic analysis of pre / post catalyser engine exhaust gases are the subject of this application note.

Basics about measurement speed :

The minimum measuring time of our MS is 10ms per channel i.e. molecular mass. In the engine exhaust gas matrix the typical sensitivity is 5000 pulses per ppm and second. For a good stability a minimum measuring time of 50ms (250 pulses per measurement and ppm) is useful.

The T_{90} time is in standard analyzers 50ms and can be optimized to reach 15ms. With this information it is obvious to think about an assembly for fast pre / post catalyser measurements.

Limits of fast measurement :

1. Different ionisation (source) gases

   Changing source gases in one setup needs 600ms for one switching cycle.

2. Long and polluted sample lines and huge filters can increase the T_{90} time up to 1200ms.

Setup :

For this experiment a standard AIRSENSE 500 analyzer with two independent probe inlets was used. Each probe inlet was connected to a lamda-1 AUDI engine. Two heated 2 m 1/4 inch tubings with 7 micon sintered stainless steel filters on the pre/post catalyser connections was used as sample lines. A rotary pump with a flow of 1.2 m3/h was connected to the bypass. In the analyzer setup a set of molecules was logically connected with each sample line.

The following cycle times could be reached :

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Minimum switching time between sample lines	200 ms
Typical switching time between sample lines	250 ms
Measuring time per molecule (pre catalyser)	30 ms
Measuring time per molecule (post catalyser)	50 ms

experimental assembly : AUDI engine, AIRSENSE 500

Results :

In the first diagram the startup of the catalyser can be seen (some CH - molecules and O2, SO2, NO2).

- ?? Engine idle with only 3 injection valves operating.
- ?? Switching times pre/post catalyser : 250 ms
- ?? Cycle time for 14 molecules pre/post catalyser : 1300 ms
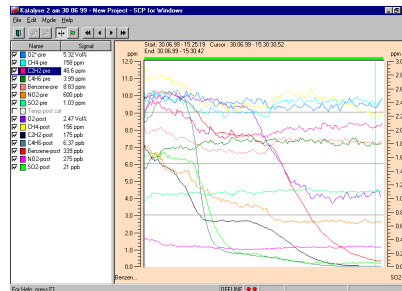
In the next diagram only O2 and Benzene were analyzed :

- ?? Cycle time : 600 ms
- ?? Startup of the 4th injection valve , duration 20 s
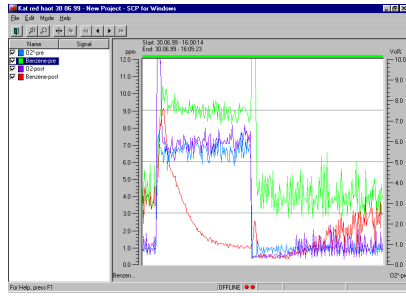
With higher graphical resolution it is possible to see the regulating cycles of the lambda sensor

(24 measurements in 15 s) :