AUTOTRAC 101 FOR PERFLUOROCARBON TRACER

In buildings and in the environment there are problems which are hard to assess with a single tracer gas. Some typical applications for multi gas tests are listed on the back side.

Although Sulphur Hexafluoride (SF_6) is for most applications the best tracer gas, the search for tracer gases with similar positive features yielded Perfluorocarbon tracers. Perfluorocarbon tracer are artifical carbon/fluor compositions, which do not exist in nature. They are

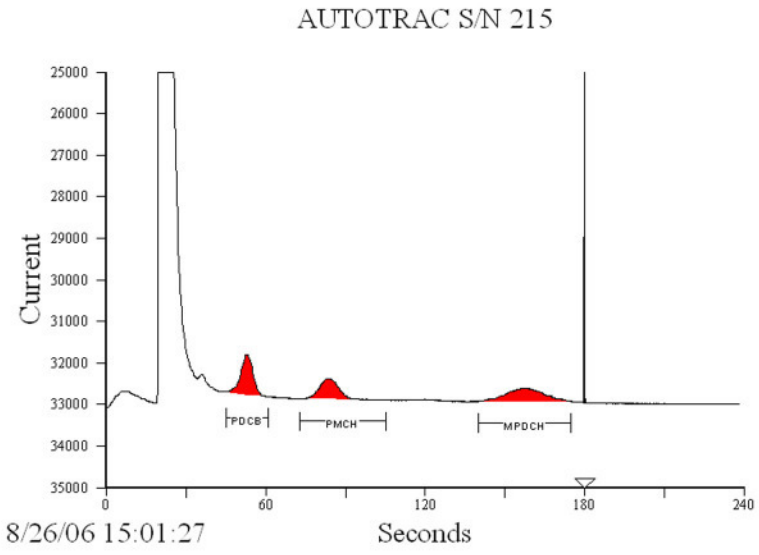
- non toxic
- non corrosive
- non ignitable
- non flammable up to 450°C
- non radioactive
- chemically and thermally stable
- with negligible back ground concentration
- and detectable down to the ppt range (10^{-12})

For the evaluation of suited PFT for tracer gas measurements the most important criteria are a good separation of concentrations within gas chromatography analysis, the detection limit and the price. Whereas pure SF_6 with a vapour pressure of 21 bar at 20°C contained in a gas bottle immediately vaporizes from the bottle the vapour pressures of the PFTs are below 1 bar and the PFT therefore is in a liquid state. They need to be vaporized for injection into the ambient. This is of advantage, because no big gas bottle containers need to be transported. For normal applications often only small amounts are necessary and easy to handle.

ABREVIATION	DESCRIPTION	CHEM. FORMULA	DETECTION-LIMIT
PDCB	Perfluorodimethylcyclobutane	C_6F_{12}	50 ppt
PMCP	Perfluoromethylcyclopentane	C_6F_{12}	50 ppt
PMCH	Perfluoromethylcyclohexane	C_7F_{17}	100 ppt
mPDCH	Perfluoro - 1,2/1,3 - dimethylcyclohexane	C_8F_{16}	50 ppt

PDCB and PMCP are closely related PFT, which almost have the same retention times and should not be used in the same test

It is *not* possible to analyse SF_6 and PFT with the same AUTOTRAC, because different columns are required for analysis. Within the gas chromatography process the SF_6 peak is the first peak followed from the oxygen peak. This is opposite with PFT. Here the oxygen peak arrives first followed by the different PFT peaks. The advantage of this behaviour is that the PFT peaks are not limited by the oxygen peak thus allowing higher retention times and higher measurable concentrations.



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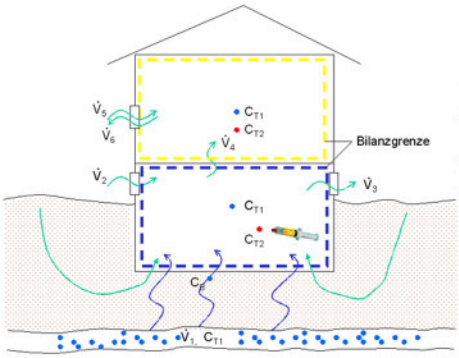
Autotrac 101 for Perfluorocarbontracer (Continued)

The analysis of 3 PFT needs approximately 3 minutes. This is done within one analysis step which can be initiated through the manual injection of a syringe or automatic sampling using the integrated pump. The concentrations are one by one displayed on the LCD Display and can be reviewed by pushing the VIEW button on the front side of Autotrac, they can be stored to diskette, MC card, printed or transferred via the WIN95 software to other spreadsheet programs.

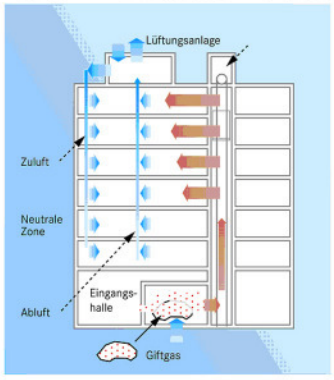
Typical Applications of Multi Tracer Gas Testing

Multi tracer gas tests are required where the quantification of a gas flow can't be done by a tracer gas mass balance on a single tracer and where the ambient conditions might have changed if the test is repeated with another set-up. Often multi gas tests are conducted just to save time. Some examples are depicted here, however they could be extended accordingly.



Radon Transport into a Building

The picture shows the transport of Radon from a Radon mine (or from the soil) into the cellar of a dwelling. To quantify the percentage of Radon-laden air through the soil into the cellar, one injects tracer T1 into the mine. Tracer T2 is injected into the cellar to measure the ACR. This allows to quantify the amount of Radon entry into the cellar.



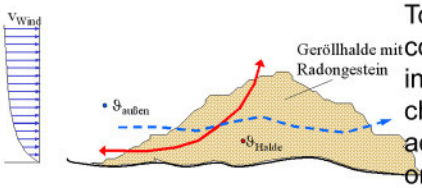
Contaminant Transport into a Room

Almost similar is the quantification of exhaust gas from an underground garage into the above building or the spreading of a chemical agent throughout a building or an underground railway station.

$$L_{eff} = \frac{c_{T1,Room}}{c_{T1,Garage}} \cdot n_{Room}$$

L_{eff} is the leakage rate of an underground garage into a room, C_{T1} is the equilibrium tracer concentration of tracer T1 in the room and in the underground garage; n_{room} is the ACR measured with tracer T2 in the room.

Air and Contaminant Transport in Soil Dumps



To study the air movement in soil dumps as a function of ambient weather conditions (convection flows driven by temperature differences between the interior of the dump and outside, but also the influence of wind or pressure changes) or to study the tightness of dump covers , multi tracer gas tests are advantages. Air flow pattern in dumps are complex. With a single tracer gas only very limited knowledge can be obtained in a specific time interval. With multiple tracers at the same time a much better understanding can be obtained within a shorter time frame.

Cold Air Downdrafts from Hill Slopes and Influence on Air Dispersal through a City

The study of nocturnal air movements from adjacent hills through cities is complex especially because weather conditions change every day. The repetition of a test under the same environmental conditions is almost impossible. Here multi tracer tests are of high value.

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