Continuous monitoring of diffuse pollution
Detection of odorant compounds

Cairnet advantages:

- Identify pollution sources (inside or outside the plant)
- Anticipate critical hazard levels, situations at risk...
- Limit impact (environment, public...)
- Reduce ongoing operating and treatment costs
- Communicate with neighbours and authorities

According to French Environment law L220-2: "Atmospheric pollution is comprised of [...], introduction by Man, directly or indirectly, or the presence of, in the atmosphere and enclosed spaces, chemical, biological or physical agents which may have a harmful impact and cause olfactory nuisance".

Due to their high olfactory impact at very low concentrations (just a few ppbv), compounds such as hydrogen sulphide (H_2S), methanethiol (CH_3SH), ammonia (NH_3) and certain volatile organic compounds (VOC) correspond to this definition and may consequently represent a source of atmospheric pollution which must be monitored.

The presence of such compounds in the air results primarily from industrial and agricultural activities such as waste processing, storage and fermentation of organic materials (compost, waste water treatment sludge), or livestock breeding.

It is possible to obtain very precise measurements at a given time and place but these readings do not provide a full picture of the global level of pollution. The spatial and temporal dimensions, which define diffused pollution, are lost. A more representative assessment of the real situation is obtained by a network of readings over a given territory provided by a number of devices. To achieve this, one requires miniature, reliable and cost efficient sensors which are capable of continuously monitoring the presence of diffuse pollution at very low concentration levels, even down to just a few ppbv.

A new generation of miniature sensors, Cairclip, has been developed to continuously monitor hydrogen sulphide (reduced sulphur compounds in general), ammonia and certain volatile organic compounds, at concentration levels of just a few ppbv. Cairclip uses amperometric sensor technology and needs no further calibration for one year (drifts are corrected automatically). It is equipped with a dynamic air sampling system, a patented filter and a highly sensitive electronic circuit connected to a data logger.

When combined with wireless communication, a solar panel and a backup battery, one can set up an autonomous network of sensors (CairNet). Furthermore, their low unit cost means that a network of 20 to 30 sensors can be set up for the price of a single conventional device. The user-friendly interface (CairMap) provides easy and continuous monitoring of the emission of diffuse pollution compounds at low concentrations which have a high olfactory impact, such as H_2S.

Average human olfactory thresholds (for H_2S, CH_3SH and NH_3) compared to Clairclip detection capacities

Compounds	Olfactory threshold	Smell	Detection limit	Range
H_2S	1 to 30 µg/m³ so 0.7 ppbv to 20 ppbv	Rotten egg	10 ppbv 20 ppbv	0-1000 ppbv 0-20 ppmv
CH_3SH	0.5 to 80 µg/m³ so 0.7 ppbv to 110 ppbv	Cabbage, garlic	10 ppbv 20 ppbv	0-1000 ppbv 0-20 ppmv
NH_3	0.5 to 37 mg/m³ so 0.7 ppmv to 50 ppmv	Pungent, irritant	0.4 mg/m³ 0.5 ppmv	0-18 mg/m³ 0-25 ppmv

Thanks to their high performance detection thresholds, Cairclips provide advance warning of a nuisance which may arise due to the presence of foul smelling compounds… long before the general population will have noticed anything.

Comparison of Cairclips H_2S with a reference analyser in a laboratory

Before being used for field measurements, Cairclips are calibrated in a laboratory using a permeation calibrator (VE3M, Environnement SA, precision ±5%).

The Cairclips are exposed to increasing levels of H_2S and the data are compared to those obtained with a reference analyser (gas chromatograph combined with a flame photometric detector GC-FPD, Chroma S).

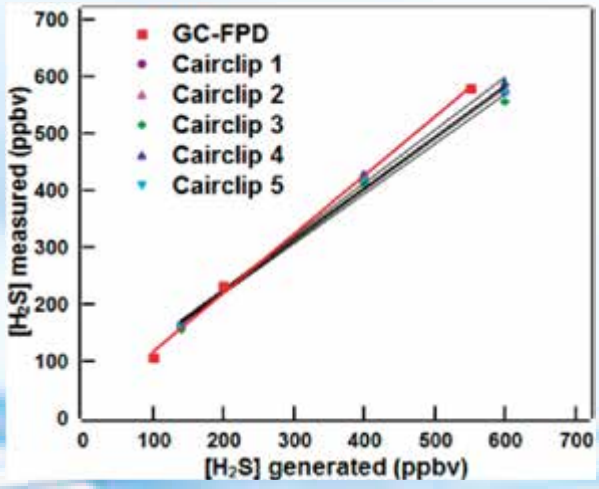

Fig.1 Comparison between the readings obtained using 5 sensors and those of the GC-FPD

The average sensitivity of Cairclips only varies by 13% compared to the reference analyser, representing an excellent correlation. It should also be noted that when using the sensitivity of the sensors themselves as an indicator, there is a mere 2% variation between the different Cairclips, proof of a high level of reproducibility.

In compliance with Directive 2008/50/CE (European Union Official Journal, L, 152, June 2008: 1-44) which notably sets "monitoring objectives for assessing ambient air quality", over 90% of the readings differ by less than 30% to the readings obtained with the reference device.

Monitoring of reduced sulphur compounds at a Waste Water Treatment Plant (WWTP)

Given that the GC-FPD cannot be deployed easily in a severe environment, a total reduced sulphur compound analyser (TRSC analyser, AF22M-TRS, Environnement SA) was used as an intermediate comparison facility on-site. The TRSC analyser readings were previously validated using the GC-FPD.

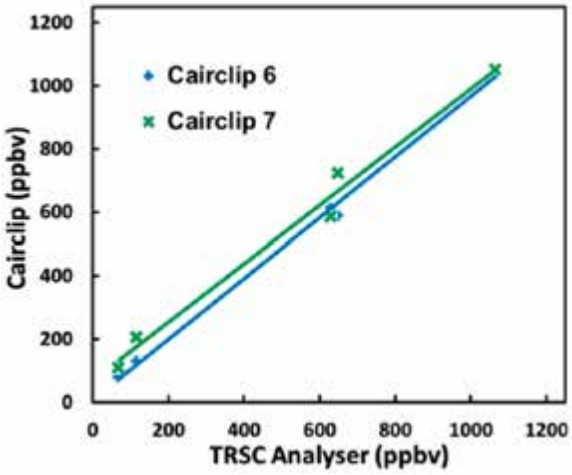

Fig 2. WWTP readings from the TRSC analyser compared with those obtained by 2 Cairclips.

The TRSC analyser was then positioned on a Waste Water Treatment Plant, in different locations, alongside Cairclips.

The analyses made with the Cairclips enabled real time monitoring of reduced sulphur compound levels at different locations of a WWTP with excellent precision and reproducibility.

Monitoring of reduced sulphur compounds at a landfill site

The sensors also proved their efficacy at a waste landfill site. The quality of the readings obtained enabled the establishment of reliable continuous monitoring of low concentrations of gaseous pollutants.

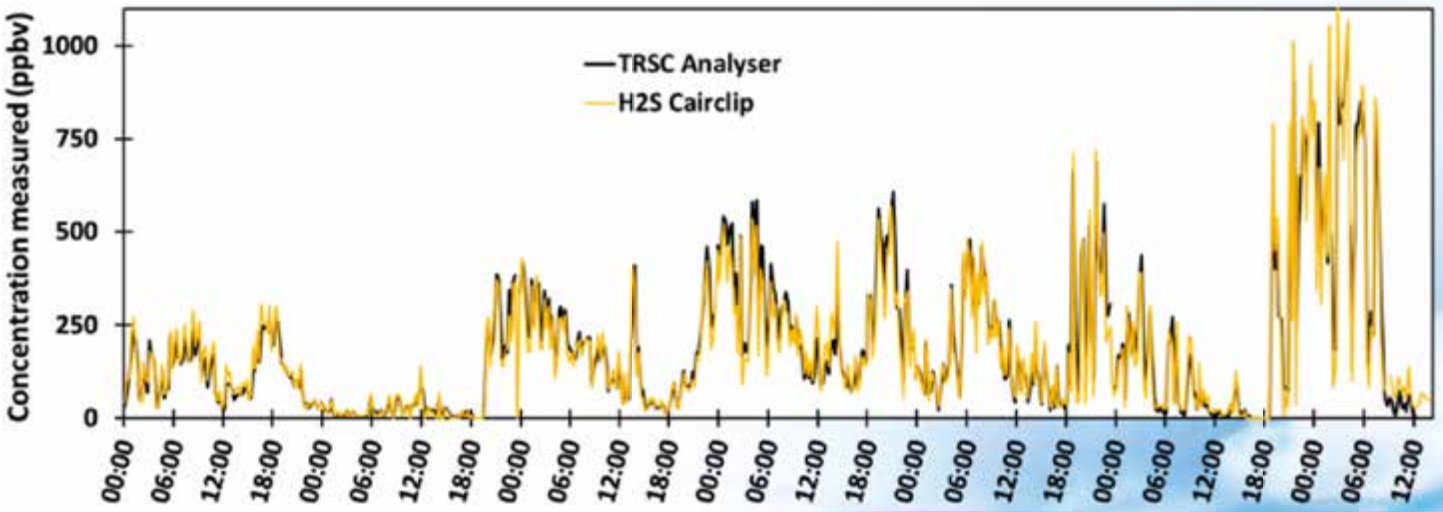

Fig 3. Comparison of readings obtained over several days with a Cairclip H_2S and a TRSC analyser

Cairmap: an intelligent graphic interface for data management

Thanks to an innovative graphic interface, CairMap, monitoring diffused emissions has been vastly simplified and expert assessments, such as the observation of the occurrence of phenomena, are possible in just a few seconds. Report production and internet access facilitate information exchange (group level management, authorities…) and the improvement of the related processes. The readings from each sensor are communicated on a screen on a continuous basis, using adapted colour codes.

A simple click instantly generates a time curve over the past day or a longer period, as required.

Selected bibliographic references :

La surveillance des émissions diffuses de basses concentrations de polluants gazeux (Monitoring diffuse emissions of low concentrations of gaseous pollutants) - Print Industrie N°48, October 2011, p61-64 by B. Aubert, J. -L. Fanlo and C. Renner.

Journées Interdisciplinaires de la Qualité de l'Air (Interdisciplinary Congress on Air Quality), February 2012 by O. Zaouak, D. Rivière, B. Aubert and J.-L. Fanlo

Network of low-cost devices for the precise and reliable monitoring of low concentrations of h2s near waste water treatment plants- EPTEE Shanghai-

ZAC du Capra
55 avenue Emile Antoine
30340 MEJANNES LES ALES
Tel.: +33 (0)4 66 83 37 56

contact: info@cairpol.com