

**NETWORKS**  
**OF**  
**MINIATURE SENSORS**  
**FOR**  
**LOW CONCENTRATIONS OF H<sub>2</sub>S (ppb)**

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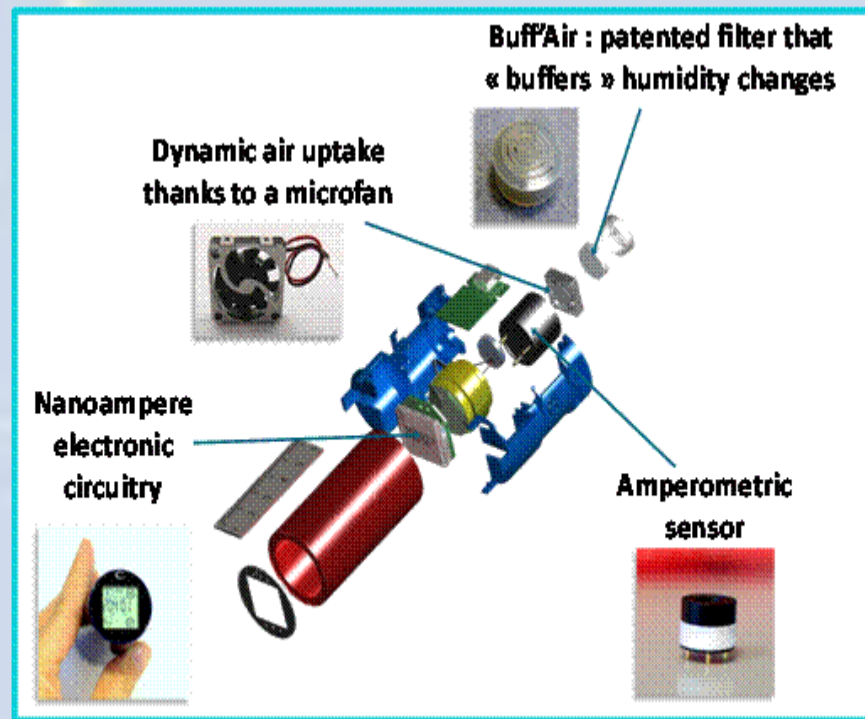
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- ❖ Due to increasingly coercive legislation, the need for continuous monitoring of air pollutants has increased considerably over recent years, driven by health and safety concerns and odor related annoyance or discomfort.
- ❖ Although gas exposure limit values are generally measured in ppm, odor nuisance is measured by ppb presence of indicators gases, a concentration that is one thousand times lower.
- ❖ Industrial players are therefore faced with the problem of measuring very low concentrations of gas (ppb) over a very wide area on a continuous basis, when the laboratory analyzers generally used for this purpose do not provide continuous data.

# Gas Sensors ?

- ❖ Industrial **gas sensors** available on the market (based on electrochemical or semiconductor oxides) could measure ppb range (but only in bench test).
- ❖ However, issues with **sensitivity, selectivity and stability** have limited their use on the field, often in favor of more expensive approaches (spectrometers...).
- ❖ Another limitation of these commonly used gas sensors is their **lack of reliability** while measurements are made on the field, especially during rapid changes of environmental conditions (like sudden **variations of relative humidity**).

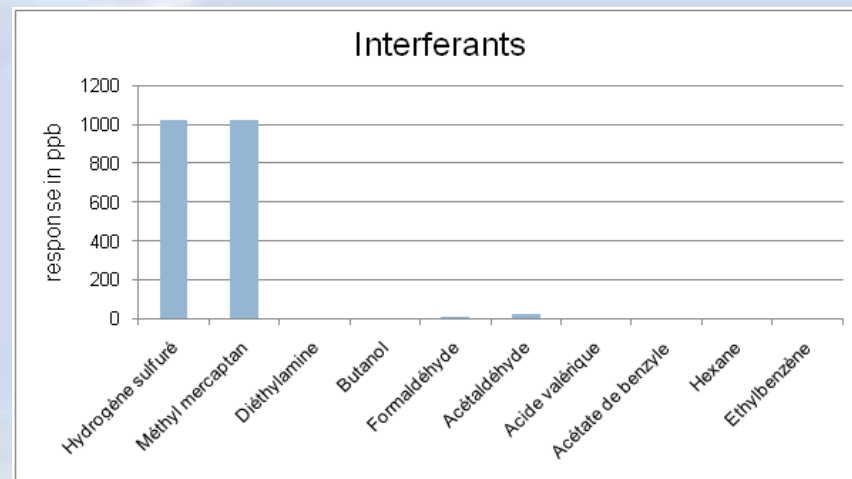
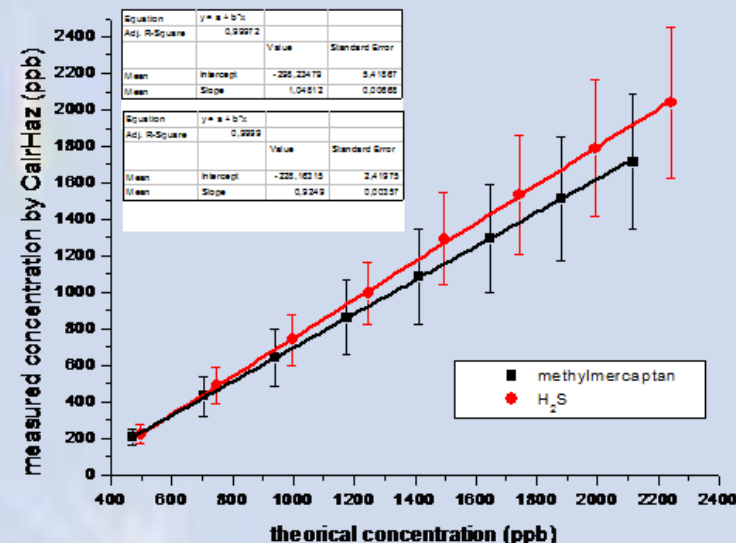
- ❖ The **reliability** of measurement was drastically improved during field measurements by using a filter based on a buffer effect against any environmental interference during gas monitoring (like rapid change of relative humidity)
- ❖ The **selectivity** of measurement was obtained with specific amperometric gas sensors, which have also the advantage to be low consumers of energy
- ❖ The **sensitivity** of detection was enhanced (ppb range) thanks to a dynamic uptake of the target gas to the amperometric sensor.



# Performances of CairHaz

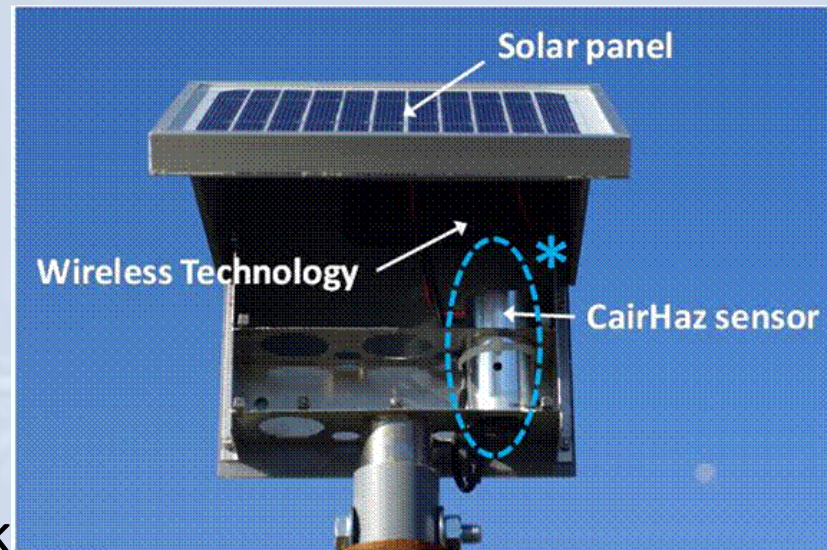
❖ The results show a high linearity ( $r^2 > 0.99$ ) and sensitivity of response in the low-concentration range of  $H_2S$  with a resolution of 4 ppb (vs gas chromatography).

❖ We found a cross-sensitivity to methylmercaptan ( $CH_3SH$ ) with the same performances (but it is as important as  $H_2S$  due to their nuisance odor effect). To date, no another interferant.

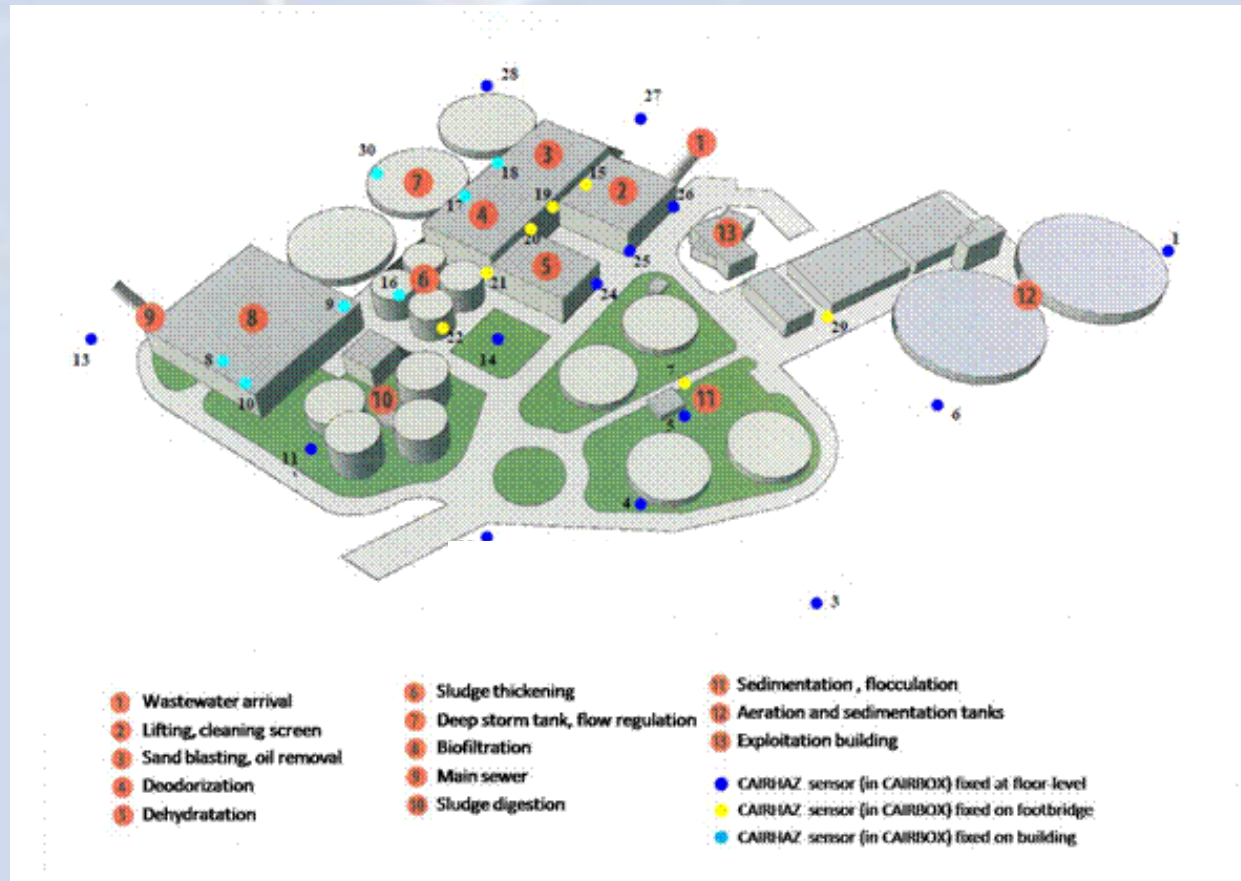




- ❖ WWTP was equipped with 30 sensors that measure the concentration of reduced sulphuric gases ( $H_2S$  and  $CH_3SH$ ) every minute.
- ❖ The sensors have a solar panel and a wireless connection to a viewing station with a special HMI that gives real-time alerts if any threshold is passed at any point within the plant. We can also check whether the problem identified occurs at the same time every day and therefore requires preventive action to be taken.



# Sensors positioning in WWTP



**Schematic view of the WWTP in south of France with the position of all Cairboxes**



**Map of 24h scale:** Allows to select a moment by slice of 10min



**Sensors flags:** the color represents the levels

**By passing over the flag,** historical data of the day appears

**30 days scale:** Allows to select a day



- ❖ The overall results from this study demonstrate the **high performances** of the **Cair'Haz** for the selective, accurate and sensitive monitoring of low-level  $\text{H}_2\text{S}$  &  $\text{CH}_3\text{SH}$  concentrations without any recalibration (during one year).
- ❖ Installing arrays of **miniaturized and low-cost sensors** in way **mapping pollutant levels** in extended areas like WWTP and to **anticipate process adjustments** is now possible.
- ❖ Next step
  - ❖ Meteorological station correlation for plume prediction: in progress
  - ❖  $\text{NH}_3$  sensor development: in progress
- ❖ **Small demonstration of Cair'Map?**