

*On-line Monitoring



Press Kit

...La mesure en ligne*

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FROM TECHNOLOGICAL INNOVATION TO PROVIDING INTEGRATED SOLUTIONS FOR ONLINE GAS ANALYSIS...

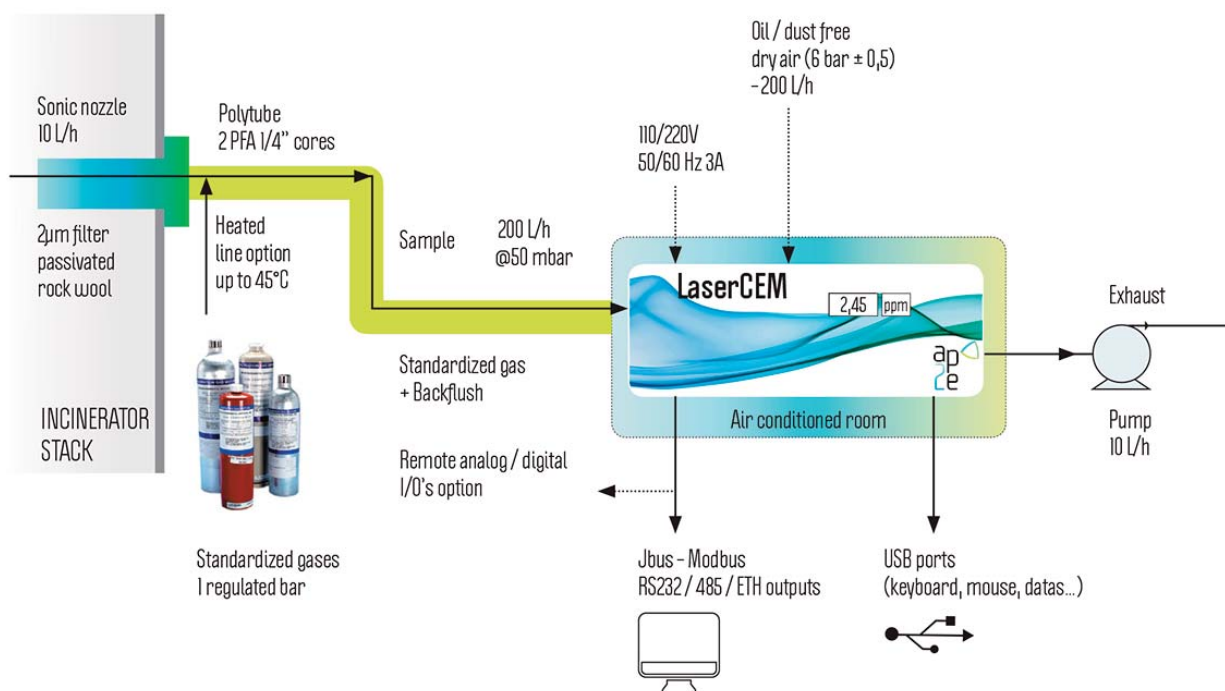
By the end of 2010, after two years of R & D studies, the AP2E ProCeas® was the award recipient of the USA "R & D 100" which rewards the 100 most innovative global technologies of the year. Starting in 2012, AP2E launched the industrialization of its ProCeas® product range, the continuous and multi gas analyzers using OFCEAS-patented laser spectrometry. This product range is based on several innovations, providing very high performance in terms of speed (less than a few seconds of response time) and great accuracy of the analyses (ppm, ppb). Only the wavelength of the lasers used differs from one application to another based on the type and number of the analyzed gases.

Three points mainly set apart the AP2E product offering:

- A low-pressure sampling which avoids, among other things, condensation problems which are a source of additional costs and analysis errors;
- Its Feedback technology which provides the equivalent of a digital spectral response of the absorption of the analyzed gases;
- An optimized resonant optical cavities technology which generates a very long optical path (10 km instead of the 10 meters in conventional FTIR and NDIR technologies).

All these points enable us to both increase the detection sensitivity and simultaneously reduce the noise, which permits the detection of gases at very low levels of sensitivity (**traces of H₂S - LoD under 50 ppb, or traces of H₂O - under 1 ppm**). The ProCeas® provides the key benefit that its measurement does not drift in any way and it requires no new calibration over time. The simplicity of the low pressure sampling also offers the possibility of multiplexing several sampling points and, as a consequence, to significantly reduce analysis costs. Lastly, the ProCeas® can be equipped with several lasers which enables the simultaneous measurement of several gases. As a result, the ProCeas® measures all gases simultaneously, continuously, in one place, with the same technology, and without any conversion.

LAYOUT FROM SONIC NOZZLE TO LASERCEM ANALYZER



1// THE OFCEAS-PATENTED, CONTINUOUS INFRARED LASER SPECTROSCOPY TECHNOLOGY

The ProCeas® range and the LaserCem® are based on the OFCEAS (Optical Feedback Cavity Enhanced Absorption Spectroscopy) technology developed and patented by the University Joseph Fourier of Grenoble, coupled to a very low pressure **LPS sampling** (100 mbar absolute) developed and patented worldwide by AP2E, for the on-line analysis of different gases. It provides measurements with a very high spectral resolution in addition to an analysis system with a simplified sampling (no heated line nor treatment of samples) and an interference-free, fast and sensitive analysis, regardless of the matrix of the gas to be analyzed.

The OFCEAS technology essentially differs from the CRDS (Cavity Ring Down Spectroscopy or Spectroscopy by resonance damping time) technology by its Feedback principle : a part of the emitted radiation is returned from the chamber to the laser, enabling the tuning of the laser and the cavity, creating a resonance phenomenon as a result. With a volume of only 15 cm³, the measuring cavity in which the sample is analyzed is equipped with mirrors whose reflectivity exceeds 99,99%, providing an optical path between 1 and 10 km. The immediate consequence of this phenomenon is the identification of very intense absorption peaks with a very narrow spectral width. Given that the source used is a continuous laser, the system presents very high measurement stability: there is no zero drift and no need for new calibrations.

2// A PATENTED, LOW-PRESSURE SAMPLING AT THE SERVICE OF GAS MEASUREMENT¹

Most gas measurement techniques require a processing of samples to avoid the phenomenon of condensation of corrosive gases (the use of membrane filters at the top of the stack to remove water or the installation of a heated line between the sampling point and the analyzer). These technologies present some disadvantages: at the maintenance level (changing the membranes), at the investment level (the use of a heated line or equipment complying with ATEX standards according to the contexts in question), and sometimes the denaturation of the sample. The other innovation patented by AP2E concerns the sampling of gases which enables us to measure them directly without any sample processing system. It is carried out by a low pressure probe which conveys the sample from the sampling point to the analyzer without any risk of absorption / desorption of the compounds or any risk of condensation, and without any need for conveying it via a heated line. The integrity of the sample is therefore ensured. The very low airflow ensures a very low response time and a minimal contamination of the system.

3// OTHER ADVANTAGES OF THE PROCEAS®

An analyzer without zero drift or measurement distortion thanks to the technology used that enables us to perform a true absolute measure, a low detection limit (ppb, ppm), the simplicity of the system's design, reduced maintenance (10 years of operating lifetime for the infrared laser sources), a robust system (no moving parts) designed from its inception for industrial applications, very user-friendly and simple to use (integrated PC and touch screen providing a simple measurement of the various gases analyzed). In its simplified version, mono or bi-laser, the analyzer performs measurements within industrial processes (H₂S in biogas, NH₃ for engine test benches), and so forth.

¹ monoxyde d'azote (NO), ammoniac (NH₃), protoxyde d'azote (N₂O), dioxyde d'azote (NO₂), monoxyde de carbone (CO), dioxyde de carbone (CO₂), chlorure d'hydrogène (HCl), fluorure d'hydrogène (HF), sulfure d'hydrogène (H₂S), l'eau (H₂O), dioxygène (O₂) Méthane (CH₄) dioxyde de soufre (SO₂), Trioxyde de soufre (SO₃)



KEY DATES AND CLIENT REFERENCES'AP2E

2006

- Creation of AP2E and development of partnerships with research centers for the transfer of innovative technologies at the service of industrial enterprises

2008

- Global filing of LPS (Low Pressure Sampling) patents and obtaining of the exclusive worldwide license for the sale of the OFCEAS technology (Optical Feedback Cavity Enhanced Absorption Spectroscopy)
- Acquisition of an equity interest in AP2E by the investment fund Viveris Management, the Caisse d'Epargne and the Caisse des Dépôts et Consignation to the tune of € 1,5 million, enabling AP2E to industrialize its technology

2010

- USA: "R&D 100" Award, which recognizes the 100 innovative global technologies of the year
- France: AP2E received the industrial analysis award in "Mesures" magazine technology ranking
- Awarded supply bid of the equipment for monitoring the air quality in submarines for the DCNS company.

2011

- Marketed the first multi-gas and multi-laser measuring equipment for the biogas market
- Marketed the first continuous measuring device of H₂S traces with unmatched precision to this day of 50 ppb, in the natural gas, syngas, and biogas markets in the US
- First installation of extractive multi-laser, multi-gas CEM (Continuous Emission Monitoring) devices for the regulatory measuring of emission discharges
- A comparative study of the United States Environmental Protection Agency (EPA) presented the ProCeas[®] as the best existing industrial technology to measure greenhouse gases generated by combustion engines

2012

- Contract for the supply of ProCeas[®] analyzers in the US for the real-time control of gas emissions of engine test benches in the automotive industry
- Contract with Exxon for the supply of O₂ and CO real-time analyzers for the control and safety of the combustion cycle of refinery boilers
- ACG Management (ex-Viveris) and the PACA Investissements Fund made a € 2 million capital contribution to promote the growth of AP2E

2013

- Worldwide OEM contract with the Hobr  Instruments B.V (Netherlands) company for the supply of analyzers (CO & H₂O) to ensure the safety of the installation and the optimization of the dehydration process in the agribusiness industry
- The report by the RECORD Association validating ProCeas[®] H₂S as the most efficient for analyzing the processes of biogas filtration
- World Premiere and AP2E marketed a ProCeas[®] for H₂ trace analysis for the chemical industry

2014

- Marketed the ProCeas[®] SO₃ Control at the exit point of combustion units and for monitoring catalysts
- Continuous measuring of formaldehyde (ppb) for monitoring indoor air and human safety (test report by LNE, the French National Weights and Measures Laboratory)
- To accompany its growth and double its capacity of production, AP2E moved into its new premises of approximately 1,000 m².

SOME CUSTOMER REFERENCES

■ **In France** : Air Liquide Areva, Arkema, Artélia, CEA, CLEMESSY, CNRS, Eau & Industries, Esso, DGA, DCNS, Fives Pillard, GDF SUEZ, Véolia, Total, SAVE, Novacarb.



Monitoring the air quality in submarines



Measuring biogas quality

■ **Abroad** : Creative Oxygen, ELEKTRONIC KONTOR, Exxon, Hobr  Instruments BV, Michell Instruments, MIDREX, Nestl , PRAXAIR, Siemens, Sensors-Inc., SIMTRONICS Fire& Gas, Terrabon.



Multi-laser, multi-gas CEM devices for the regulatory measuring of emission discharges

IV SOME APPLICATION FIELDS OF THE Proceas®

The ProCeas® application range is broad. R&D activities enabled the definition of designs adapted to about 30 industrial gases, sharing a number of common elements, which enabled a streamlined industrialization of them.

1// OPTIMIZING THE COMBUSTION CYCLE (CO, O₂) IN OIL REFINERIES

References : EXXON (optimizing combustion in boilers), Fives PILLARD (optimization tool for the production and the adjustment of burners for boilers).

With the environmental constraints (taxes on pollutants) including the end of free carbon (CO) emission allowances at the end of 2013, solely monitoring oxygen is not enough. Oil companies are looking for optimum energy and environmental efficiency of their burners through a double and simultaneous online monitoring of the couple O₂ and CO to ensure that the discharge of CO complies with standards and that the burning of O₂ does not produce a nitric oxide (NO) type by-product. To have good combustion, a residual rate of O₂ of less than 3% is needed with a reduced response time (<5 seconds). In addition, according to the thermal performance of the burner, even a reduction of 0,1% of oxygen in excess represents millions of dollars of savings in the annual consumption of fuel.

2// SO₂/SO₃

AP2E also intends to enhance the approach aimed at combining environmental management of discharges and economic optimization, even if this seems less obvious to understand at first sight. If today SO₂ is correctly measured, this does not fully reflect the sulfur emissions from combustion units subject to this requirement. In the presence of oxygen, SO₂ does in effect form sulfur trioxide (SO₃), a gas that is much more corrosive than SO₂. And other chemical phenomena occur, particularly in denitrification (denox), which in the presence of ammonia may lead both to an over-consumption of ammonia and to filter blockages. Therefore, not measuring SO₃ entails the under estimation of sulfur emissions, and also additional maintenance costs and over-consumption of reagents.

To have continuous and precise knowledge of the SO₂ / SO₃ couple enables the operator to choose the controlling conditions for limiting the formation of SO₃ and its indirect costs.



Online monitoring of the couple O₂ and CO

3// BIOGAS

The processing of gases from biomass (biogas, bio-methane) remains a key step in industrial processes for producing various types of bioenergy, a manufacturing process that requires optimizing. It is therefore imperative to have the ability to calculate the calorific value of these new gases and to be able to quantify the impurities present there, in order to reduce the risk of damage to facilities, to react quickly in case of malfunction, and to certify the quality of finished products. AP2E has installed several equipment units within the facilities of various players of the world of biogas in Europe. They analyze the CH₄ and CO₂ content, as well as the residual concentration of H₂S (hydrogen sulfide). This is a major impurity which transforms into sulfuric acid in the presence of some moisture.

It is a very corrosive acid; consequently it is destructive for the facilities and the engines that burn biogas or bio methane.

The ability to analyze in the same multiplexing equipment the H₂S content (which varies according to the time of day) of the "crude biogas" at the exit of the casing serves to determine the use of this biogas: is it best to purify and enhance it in the engine, where the H₂S rate at such time is excessively high, momentarily justifying its direct burning ? Other compounds may also be monitored by adding specific laser sources, such as the water content, in order to control the efficiency of the condenser. AP2E is also currently studying the analysis of siloxane, another sore point for energy recovery.

It is worth noting that the analysis of the purity of natural gas or of the composition of bio methane before injection in the network rigorously searches for the same "poisons" (H₂S, H₂O).

Other references: SP Technical Research Institute of Sweden, Rhodia (France). VEOLIA for its Centre de Recherche Energie Environnement Déchet (CREED, Center for research on energy, environment, and waste).



4// AMBIENT AIR QUALITY (CO, CO₂, FORMALDEHYDE, FREON, ETHANOL)

AP2E is already working in the confined air field (submarines) and is interested in the building sector. In 2010, AP2E won an important contract with the DCNS for air quality control equipment for the confined interiors of submarines (on-board crew safety).

In April 2015, European regulations included formaldehyde as a proven carcinogenic product (CMR). This new classification impacts devices monitoring the exposure to workers or to the public of formaldehyde present in the indoor air of industrial sites or sites hosting the public. The ProCeas[®] Formaldehyde continuously measures these changes with a minimum 10 ppm threshold (maximum 1%). In 2014, it was approved by EXERA (Association des Exploitants d'Equipements de Mesure, de Régulation et d'Automatismes; Association of operators of measurement, control, and automation equipment) and the LNE (Laboratoire National de Métrologie et d'Essais, National laboratory of metrology and testing).

5// DRYING OF FOOD POWDERS (H₂O)

The drying field is another good example of energy efficiency to be kept in mind, especially that of food powders. The monitoring of water is useful for avoiding excessive energy consumption (drying only what is necessary in order to obtain an optimal residual H₂O content). The monitoring of carbon monoxide answers safety concerns. When food powders are dehydrated, the conditions may be such that CO is generated in the dehydrator. Once conditions for generating CO are present, CO tends to increase its concentration very quickly. In order to prevent any possibility for it to reach a potentially dangerous level, it is necessary to detect the first signs of CO which appear above the levels already present in the atmosphere. This is what was put into operation within ten drying towers in the production facilities of one of the main agribusiness players in the world.

6// OPTIMIZING ENGINE TEST BENCHES (AUTOMOBILE, TRANSPORT)

The automobile engines sector also remains a major target. With the arrival of the new EURO VI standards since September 2014, manufacturers have been forced to measure many pollutants (NO, NO₂, N₂O, NH₃, CO₂, CH₄, and ethanol). Successful testing with ProCeas[®] was conducted around the world:

- NH₃ at Renault and VOLVO (France)
- N₂O at Volkswagen (Germany)
- NH₃ at General Motors (USA)
- NH₃, N₂O, NO, NO₂

In the USA with Sensors Inc. – (www.sensors-inc.com): in May 2012, AP2E signed a contract for supplying ProCeas[®] analyzers for the real-time control of gas emissions of engine test benches in the automotive industry. Sensors Inc. is the leading American manufacturer of real-time testing equipment for gas emissions in the transportation industry. The new range of measuring instruments is marketed in the US under the name of SEMTECH LASAR and it consists of four modules (NH₃, N₂O, NO, and NO₂), each capable of analyzing three gases simultaneously.

7// NATURAL GASES (H2S AND H2O SIMULTANEOUS MEASUREMENTS)

To be used in the best conditions, so that it limits damage and maintenance of equipment, natural gas must be rid of impurities, especially hydrogen sulfide (H₂S), which is very corrosive, and all traces of moisture (H₂O). Current filtration systems run against, among other things, the problem of measuring residual traces of these impurities because no reliable continuous analysis system was available so far. Today the main players in the "Oil & Gas" market deem the ProCeas[®] as the most efficient natural gas analyzer for continuously and simultaneously measuring traces of H₂S (LoD under 50 ppb) and H₂O (under 50 ppm), without interference, without any dependence vis-à-vis the constitution of the gas, and with response times under a few seconds.

8// PURE GASES (NITROGEN, HYDROGEN)

The ProCeas[®] is used by producers of pure gases to measure the quality of their gases (N₂, H₂, and so forth).



Gases cabinet for ultra-trace analyses

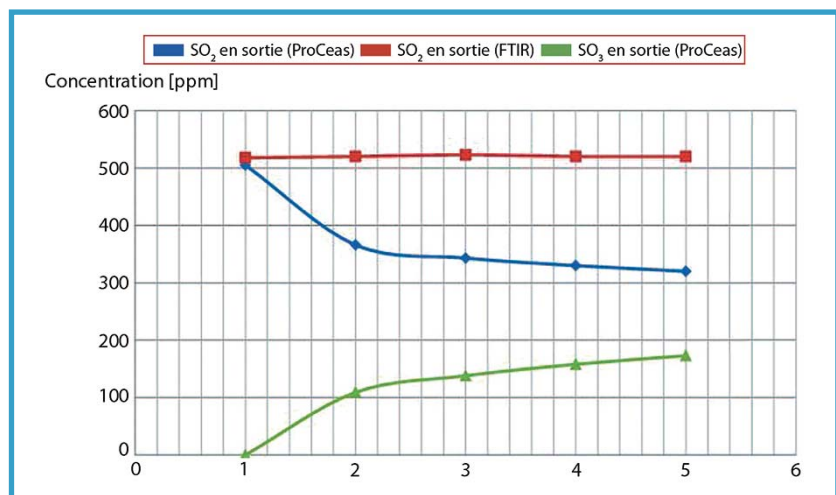
1// THE ANALYZER AS A DRIVER OF COMPETITIVENESS - SO₃ AND BIOGAS

■ With the announcement of the continuous measurement of SO₃ (sulfur trioxide) at the exit of combustion units, AP2E represents the link from an industrial point of view between regulatory measurements (EMC) and optimizing production processes. If SO₂ is now properly measured, it does not fully reflect the sulfur emissions from combustion units subject to this requirement. In the presence of oxygen, SO₂ does in effect form sulfur trioxide (SO₃), a gas that is much more corrosive than SO₂. And other chemical phenomena occur, particularly in denitrification (denox), which in the presence of ammonia may lead both to an over-consumption of ammonia and to filter blockages. Not measuring SO₃ entails the under estimation of sulfur emissions, and also additional maintenance costs and over-consumption of reagents. To have continuous and precise knowledge of the SO₂ / SO₃ couple enables the operator to choose the controlling conditions for limiting the formation of SO₃ and its indirect costs.

SO₂ & SO₃ value concentration

Simultaneous SO₂/SO₃ measurement in outlet catalyst according to the oxygen content variation have been done with the ProCeas® analyzer (on site test were performed in Ibiden).

When SO₃ value concentration increases, injecting more and more O₂, the SO₂ value concentration decreases ($2 \text{ SO}_2 + \text{O}_2 \rightarrow 2 \text{ SO}_3$), the sum of SO₂ and SO₃ being nearly stable.



■ using a continuous analyzer as a means of industrial control and economic optimization of production units is for the control of biogas quality. For the cogeneration of biogas, the absence of hydrogen sulfide (H₂S) is crucial. It is a major impurity and a source of engine breakage. However, conventional means of analysis have trouble distinguishing methane (CH₄) from H₂S.

Therefore, operators are forced to adopt an excessively prudent approach in the treatment stage with active carbon: it is changed even before it is totally saturated. With a continuous, accurate, and reliable analysis of the level of H₂S in the exit of the adsorption bed, we can instead use it until its saturation point and reduce overall costs.

Tests conducted on a site with a valuation of 1 MW showed that the amortization of the analyzer could be performed based on this single criterion of active coal consumption in less than a year.

Indeed the cost of a monthly activated carbon charge is € 30,000.

■ Other industrial examples include the joint measurement of CO and oxygen in combustion fumes, where there is a real potential for optimizing large burners, especially for petroleum refineries. For energy efficiency in the drying field, notably of food powders, controlling water is therefore useful in order to avoid energy over-consumption.

It is these industrial examples that illustrate a new approach to the market of online gas analyzers, even if the cost of the ProCeas® is sometimes higher than that of its competitors using more conventional techniques. However, its function is different. It is not a question of simply conducting self-monitoring analyses to safeguard oneself in respect to environmental regulations. The objective is to optimize industrial processes, consequently generating productivity gains and savings that are much more significant than the initial investment cost.

2// PRAXAIR AND MIDREX - TWO EXAMPLES OF THE PROCEAS® ANALYZERS FOR BIOGAS AND SYNGAS

Praxair uses the ProCeas® as an online analyzer of H₂O, CO, CO₂, and H₂ rates, in a process for producing syngas from the gasification of coal, oil residue, pet coke, and biomass. This syngas is then used either as a source of energy in a heat and electricity cogeneration process or in a Fischer Tropsch process for producing second-generation biofuel. This process requires that the residual H₂S generated by gasification have a value of less than 1 ppm to avoid the destruction of the polymerization catalysts.

Midrex is a steel manufacturer that uses a gasification process similar to Praxair's in order to cogenerate the electricity and heat needed in the manufacture of its steel. AP2E delivered to Midrex complete solutions that have enabled it on the one hand to measure the calorific value of these synthetic gases (by measuring CO, CO₂, H₂O, CH₄, and H₂) and also the presence of impurities such as H₂S and NH₃. In France, Total, CEA Grenoble, IFP (Institut français du Pétrole, the French Petroleum Institute), and GDF work with syngas). The ProCeas® is used by VEOLIA for its Centre de Recherche Énergie Environnement Déchet (CREED, Center for research on energy, environment, and waste).



Proceas H2O-CO-O2

3// EXAMPLE OF MEASURING HYDROGEN (H₂) AND WATER (H₂O) IN CHLORINE (Cl₂) AT ARKEMA

Today, the ProCeas® provides what no other infrared laser technique could : the direct measurement of hydrogen (H₂) and water (H₂O) in chlorine (Cl₂) without reagents or discharges, and interference-free. The ProCeas® performs measurements with a very high spectral resolution of very low concentrations (under a few ppm), with response times under a few seconds. This analyzer also provides a control of the drying (H₂O) in a chemical process at Arkema.

VI SCIENTIFIC OR INDUSTRIAL STUDIES PERFORMED WITH THE PROCEAS®

1// STUDIES BY THE RECORD NETWORK ON THE USE OF THE PROCEAS® FOR MEASURING BIOGAS QUALITY

The cooperative French research network Record, bringing together French industrialists around the waste treatment issue, has conducted multi-site testing on the metrological quality of AP2E's ProCeas® analyzers for online measurements of biogas.



2// ABOUT THE RECORD ASSOCIATION

Source: <http://www.record-net.org/record/activite.php>

The complexity of the problems relating to waste management and the volume of investments required for a more fundamental approach to solutions justify solely by themselves a recourse to a cooperative form of research.

This explains why RECORD is the result of a triple cooperation: industrialists eager to group together their needs and their research means, public authorities such as ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie, Environment and Energy Management Agency) and the Ministry in charge of the environment, and researchers that cover almost the entirety of the disciplines of the physical, chemical, mechanical, biological, economic, and sociological sciences, and other related ones.

All work is carried out within the laboratories involved.

The network currently consists of 13 members: 11 companies and 2 public bodies.

Today, after 18 years of existence, RECORD has funded more than 100 research study contracts. This work resulted, in particular, in 30 syntheses, 15 theses, and 5 published books. Over 30 laboratories in France and abroad have participated in this work.

Patrick Germain, who is both a teacher-researcher at INSA Lyon (LABORATOIRE DE GENIE CIVIL ET D'INGENIERIE DE L'ENVIRONNEMENT (Civil engineering and environmental engineering Laboratory)) and scientific director of the Record network proposed to evaluate the ProCeas® for measuring biogas quality. The project was accepted by the Association and AP2E's equipment was tested in 2013 on different sites.

3// SUEZ ENVIRONNEMENT SITE (ANAEROBIC DIGESTION)

On a site operated by SUEZ ENVIRONNEMENT, AP2E provided two probes, a multiplexer, and a ProCeas® for the testing. The ProCeas® was configured to measure CH₄, CO₂, H₂S, O₂, and H₂O. The INSA was then able to visualize anaerobic digestion events unknown to date and, in particular, the efficiency of the H₂S filter depending on the time the day and the temperature. This is a technology that can save from one to several active charcoal charges during the year (the cost of one monthly charge is € 30K).

4// GDF SUEZ SITE (BIOMASS BOILER)

GDF SUEZ also participated in the test-one of their sites was equipped with a 2-way ProCeas[®] for measuring H₂O. This was an innovative biomass boiler equipped with a condenser for the fumes so as to increase energy efficiency. The ProCeas[®] probes were installed upstream and downstream of the condenser to measure the H₂O concentration differential which is linked to the effectiveness.

5// GDF SUEZ RESEARCH CENTER (BIOMETHANE)

The GDF SUEZ research center equipped itself with a ProCeas[®] to evaluate the quality of purified biomethane prior to injection into the natural gas network. Effectively, this solution is one of the promising ways for decreasing France's dependence on natural gas imports. The center uses a ProCeas[®] configuration for measuring CH₄, CO₂, H₂S and NH₃.

6// TESTIMONY FROM THE "LABORATOIRE DE GÉNIE CIVIL ET D'INGÉNIERIE DE L'ENVIRONNEMENT" (LGCIE, CIVIL ENGINEERING AND ENVIRONMENTAL ENGINEERING LABORATORY)

The LGCIE is a research laboratory that belongs to the Ministry of Higher Education and Research, implanted in an engineering school, the INSA de LYON. It was created in 2007 following the merger of three laboratories. It includes 50 permanent teacher-researchers. One of the themes of the laboratory's research is the characterization and treatment of biogas.

It works with industrial partners which must comply with specific regulations. In the study carried out by Record, the quality of the biogas is not subject to regulations or standards, but to technical recommendations (CO₂, CH₄, H₂S, H₂O, COVSi...) for enhancing the biogas cogenerating engine (for producing electricity). The combustion gases themselves are subject to regulations (prefectural decrees defining discharge standards).

The LGCIE was selected for the Record study on the basis of its high-level expertise and experience in the field of biogas.

What kinds of measurement and analyses were performed as part of the study of the "Record" network ?

Continuous measurements of biogas of non-hazardous waste storage facilities before and after the purification treatment (H₂S elimination), spot measurements of combustion gases, and measurements of a multi-compound syngas CH₄-CO₂-H₂S in the laboratory. For the time being, the LGCIE has compared the ProCeas[®] to electrochemical and chromatographic (μ GC, GC-MS) techniques.

The feedback from users: the ProCeas[®] is a very good option for continuous gas analysis. It presents many advantages (robustness, fast response, autonomy, remote control, ease of use, multiplexer, etc.) for monitoring industrial processes, such as the treatment of biogas.

To which kinds of problems encountered by companies in your sector does the ProCeas[®] provide an innovative answer?

- At the research level, the continuous and upstream/downstream analysis of a biogas treatment process constitutes a very interesting tool: it provides real-time information on several compounds and a wide range of concentrations.

- At the industrial level, especially the treatment and enhancement of biogas from non-hazardous waste storage facilities: the ProCeas[®] enables the continuous analysis of complex gases which vary in quality. Having a device like this on site can enable operators to better monitor the process in order to optimize it and to reduce its cost. Currently, there is a lack of control of the biogas treatment linked to a lack of techniques and adequate analytical equipment (either they do not permit continuous analysis or they require expertise, frequent calibration, the presence of water in the gas is often inconvenient, etc.).

What are the benefits of ProCeas® compared to the other existing solutions ?

It provides continuous analysis, several analyzed molecules, robustness, remote control, high sensitivity and high resolution, water analysis, fast response...

7// EUROPEAN STUDIES(INSTITUTE FOR AGRICULTURAL AND FISHERIES RESEARCH, LIPMANN, CEMAGREF)

The ProCeas® is also used in a European study on the impact of animal food for greenhouse gas discharges (methane) conducted by the Institute for Agricultural and Fisheries Research (ILVO - Belgium) and by LIPMANN in Luxembourg. It is also used at the CEMAGREF (France) for measurements of N₂O, NH₃ and CH₄.

