

[NEWS :

Focus on coal technologies

THE LABORELEC COMBUSTION COMPETENCE CENTRE

Assisting power plants throughout Europe

Conventional power plants throughout Europe rely on the Laborelec Combustion Competence Centre to help them improve their combustion processes. The centre offers technical support, spreads best practices for generic problems, provides return on experience (REX), and develops the competencies necessary to achieve this.

The Laborelec combustion department has been assisting power plants with a wide variety of combustion related challenges, including emission regulations, combustion instabilities, and flue gas treatments. Michaël Deneve, Technology Manager Combustion Optimization and Thermodynamics: 'We have set up the Combustion Competence Centre to centralize best practices and to better exploit synergies. It makes our acquired expertise on combustion and emissions more easily available to all plants within the GDF SUEZ Group.'

[Tackling generic issues

The Combustion Competence Centre handles all combustion related issues of strong general interest. This can involve training, facilitation of REX, technical support with pilot testing, as well as other issues. Problems that are very plant-specific and new innovations that are too untested to be widely implemented do not fall within the scope of the Combustion Competence Centre and are still handled by the combustion department.

[Assistance with all aspects of the combustion value chain

Power plants can ask the competence centre for help with all activities within the entire combustion value chain, from purchase to flue gas treatment. Michaël Deneve: 'We assisted the Les Awirs power plant with the purchase of low NO_x burners, we advised the Langerlo power plant on Selective Catalytic Reduction (SCR) management, and we are currently studying how to lower the technical minimum of an Italian combined cycle gas turbine power plant.' The experience gained from these projects enables the Combustion Competence Centre to further spread best practices throughout the GDF SUEZ Group fleet.

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TOWARDS MORE EFFICIENT AND ENVIRONMENT-FRIENDLY COAL-FIRED POWER PLANTS

Coal is an important resource for electricity generation. It will continue to be one of the primary fossil fuels as we are continuously learning how to reduce its environmental impact. We are extending our research in technologies that improve the efficiency of coal-fired power plants (CFPP) and that reduce their ecological footprint. In this edition of Laborelec News we address our efforts in materials research for the new generation of CFPPs as well as ageing research for existing plants. We also present our Combustion Competence Centre and our innovative achievements in emission measurements.

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"THE COMBUSTION COMPETENCE CENTRE AIMS AT PROVIDING TECHNICAL SUPPORT WITH ALL ISSUES THAT ARE OF GENERIC INTEREST"

[In short

- Laborelec has set up a Combustion Competence Centre
- It provides technical support for issues of general interest, implements best practices, and maximizes return on experience
- Its scope includes all activities within the entire combustion value chain



The Laborelec Combustion Competence Centre combines experience in both combustion and emissions to cover the entire combustion value chain.

ANALYZING WEAR IN COAL-FIRED AND CO-COMBUSTION POWER PLANTS

Building up knowledge of material behaviour

Co-firing biomass in coal-fired power plants (CFPPs) has given a new impetus to these plants. Biomass, however, brings about different ageing behaviour in power plant materials. The impact on plant ageing also varies depending on the types of coal. Laborelec has consequently initiated several projects to analyze erosion and corrosion issues in coal-fired and co-combustion power plants and milling units.

The co-combustion of coal with biomass introduces new wear and corrosion issues. Ash accumulation on tubing, for instance, can affect thermal conductivity and the corrosion mechanism. The varying quality of wood pellets and coal can also affect equipment. Differences in coal hardness can accelerate crusher wear as well.

[Ageing assessment

Laborelec is assisting CFPPs with the monitoring of these ageing issues by implementing boiler life management (BLM) programmes. With a BLM, the remaining lifetime of each boiler component is regularly estimated based on the operational temperature and pressure. In addition to these estimates, the actual ageing conditions are also measured. Laborelec utilizes ultrasonic measurements to analyze tube thickness and detect oxidation.

CFPPs require an extensive follow-up of peripheral equipment such as coal mills, flue gas ducts, and coal and ash conveyors. Infrared inspections are also carried out on the coal powder pipes during operation to detect any erosion due to recent installations of wood dust injections.

[Predictive maintenance of hammer mills

In co-firing units, biomass and coal are sometimes mixed together before combustion. However, the milling technology used to grind coal is not necessarily suitable for grinding biomass. Laborelec has therefore initiated a project to assess hammer wear in wood pellet milling units. Although the hammers themselves are not excessively expensive, any stoppage time incurred to replace them is very costly. It is therefore essential to define the appropriate hammer material to postpone replacement. The aim of the project is to provide co-firing plants with recommendations in this area. It also stimulates the exchange of best practices between plants regarding wood pellet quality and alloy selection for hammers.

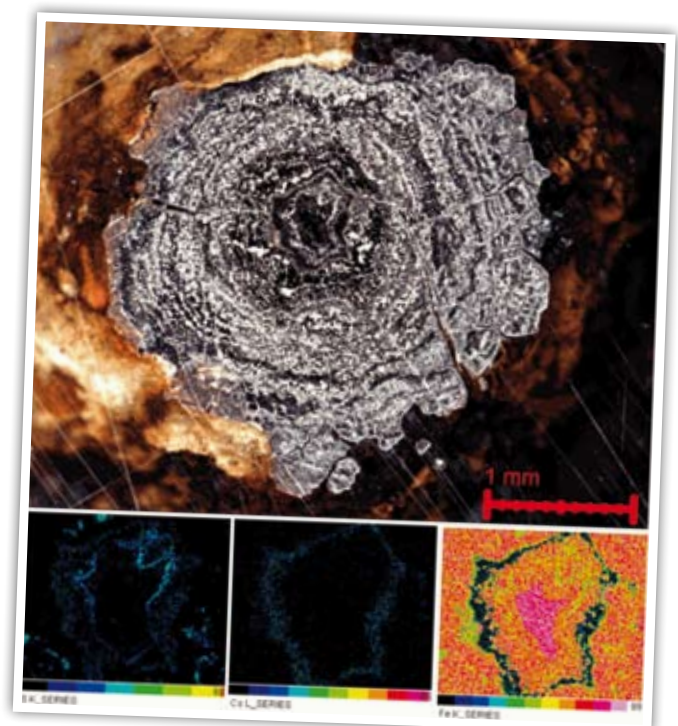
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[Following up corrosion due to biomass

Laborelec has developed a technique to follow up material corrosion occurring with the co-firing of biomass and coal. The technique uses probes to monitor corrosion in overheaters and evaporators off-line. Metal probes are placed at different heights and positions in the evaporator and put in contact with the steam tubes. They consequently acquire the same temperature and corrosion patterns as the steam tubes. After different exposure times, the probes are taken out of the evaporator for analysis by Laborelec. Insight can thus be gained into the corrosion mechanisms at work.

[In short

- Co-firing biomass generates different corrosion and erosion phenomena when compared with burning only coal
- Laborelec is using various inspection techniques to analyze coal-fired and co-fired boiler erosion and corrosion
- A project is also ongoing to assess hammer wear in coal mills crushing biomass



Top: stereo-microscope image of a corrosion probe.
 Bottom: SEM/EDS Elemental Mapping (QuantMap).

MATERIALS RESEARCH FOR USC POWER PLANTS

Anticipating future challenges

The high steam temperatures in Ultra Super Critical (USC) power plants impose heavy requirements on the materials used. Laborelec proactively investigates the behaviour of materials through participation in various European projects and a wide variety of detailed studies.

Increasing the steam temperature plays an important role in reducing CO₂ emissions in new coal-fired power plants (CFPP). State-of-the-art plants already achieve 600/620 °C. Future generations are expected to reach temperatures of up to 750 °C. 'It will be a real challenge to find the materials that are able to withstand the degradation mechanisms that are triggered at such high temperatures,' states Staf Huysmans. 'The martensitic steels currently used can only cope with 620 °C. New alloys such as austenitic and nickel-based materials may offer a solution.' However, little is known about the behaviour of these materials during operation in a power plant.

[COMTES 700: studying material behaviour on site

Laborelec actively participates in various European projects to gain insight into future challenges. The COMTES 700 project, for instance, facilitates the study of the long-term behaviour of materials. To this end, a Component Test Facility containing tubes in various materials has been incorporated in a German power plant. The first milestone of 16,000 operating hours has already been reached. Staf Huysmans: 'Laborelec investigated the tubes made from austenitic and nickel-based materials. First results showed that the high temperatures have not degraded the high-alloy materials as much as originally expected. A follow-up study is planned for the second half of 2009.' Another project, PP700, focuses on the actual realization of such a USC power plant. Laborelec is part of the Material Expert Group that investigates, among other things, properties and methods for fabricating parts with the new alloys.

[A wide variety of projects on the effects of high temperature

Participation in international projects enables the determination of which issues need further investigation. 'We have started up a wide variety of dedicated research projects to deepen our insight into material behaviour,' says Huysmans. These include:

- Investigation of **oxidation** mechanisms in cooperation with the FSZ Jülich Research Institute in Germany
- **Coating and cladding** of tubes and pipes to prevent high temperature corrosion
- Building up an **experience database** on martensitic materials
- Investigation of an innovative **Cold Repair Method** as a time-saving alternative for the current welding method used to repair creep resistant martensitic materials

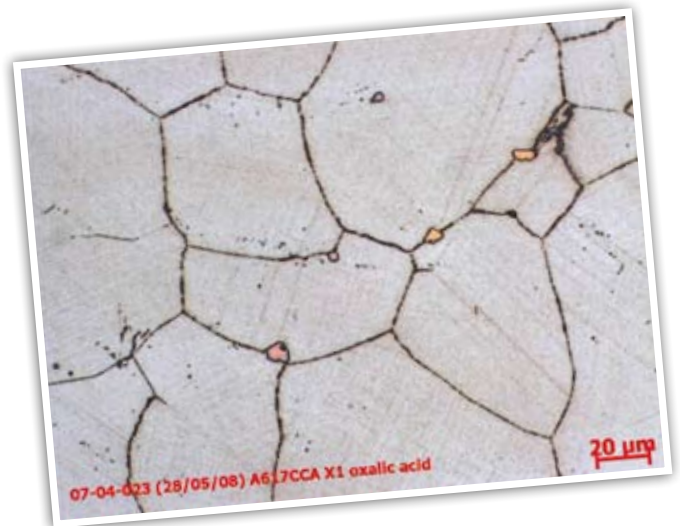
The latter project is in cooperation with the Belgian Welding Institute. Initial results have indicated that the method is feasible, although it requires substantial skills and training of the welders.

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[In short

- New materials are being investigated for use in USC power plants
- Laborelec takes part in various European research projects that anticipate future challenges
- Such projects enable the distillation of focused research projects to gain more insight into material behaviour

"WE ARE INTENSIVELY STUDYING THE IMPACT OF HIGH TEMPERATURES ON MATERIALS IN ANTICIPATION OF THE NEXT GENERATION OF USC POWER PLANTS"



For the COMTES 700 project, Laborelec investigated tube samples to assess the impact of high temperatures on material behaviour.

MONITORING AMMONIA IN COAL-FIRED POWER PLANTS FOR ENVIRONMENTAL AND PROCESS PURPOSES

Diode laser technology enables continuous monitoring

Monitoring ammonia in coal-fired power plants is important for environmental as well as operational reasons. Until now, measurements were mainly carried out manually and were thus time-consuming and expensive. New Automated Measuring Systems (AMS) featuring diode lasers are showing great potential. Laborelec has therefore started reviewing the suitability of these tools through a literature, market, and experience feedback study.

Ammonia is known to have environmental impacts such as eutrophication, acidification, and secondary particulate matter formation. Monitoring the quantity of ammonia emitted by a power plant is therefore increasingly regarded as good practice. Ammonia in flue gases originates from its use in the deNO_x process. In addition to being important for environmental reasons, reducing ammonia concentrations is essential to ensure the optimal operation of downstream processes. If too much ammonia is injected in the deNO_x unit to reduce NO_x levels, ammonium salts may form, which can potentially block equipment located downstream. Today, the amount of ammonia used in the deNO_x system is calculated based on NO_x measurements before and after the deNO_x unit: the higher the NO_x concentration, the more ammonia is injected. By being able to measure ammonia concentrations directly and with high accuracy, the optimal quantity of ammonia for DeNO_x purposes can be defined with greater precision. Additionally, ammonia monitoring allows a close follow-up of the deNO_x catalyst ageing.

[Diode laser detects ammonia

Laborelec has started assessing laser tools to measure ammonia concentrations. 'Based on an initial market analysis of six tools, we have selected two Tunable Diode Laser Absorption Spectroscopy (TDLAS) instruments for on-site tests in power plants,' says Jan Mertens. 'We believe that TDLAS tools are appropriate for ammonia measurements in coal-fired power plants.' The emitting wavelength spectrum of the diode laser can be tuned to detect a specific gas component. Gas molecules absorb energy at specific narrow wavelength spectra. Since the emitting wavelength spectrum of the diode laser is narrow as well, the concentration of a certain gas component can be precisely measured without interference with other components. Only the desired component is thus measured. The two selected systems will be tested in the field in 2009. These tests will primarily assess the TDLAS tools with respect to their accuracy, as well as the presence of optical alignment problems and transmittance issues as a result of high dust concentrations.

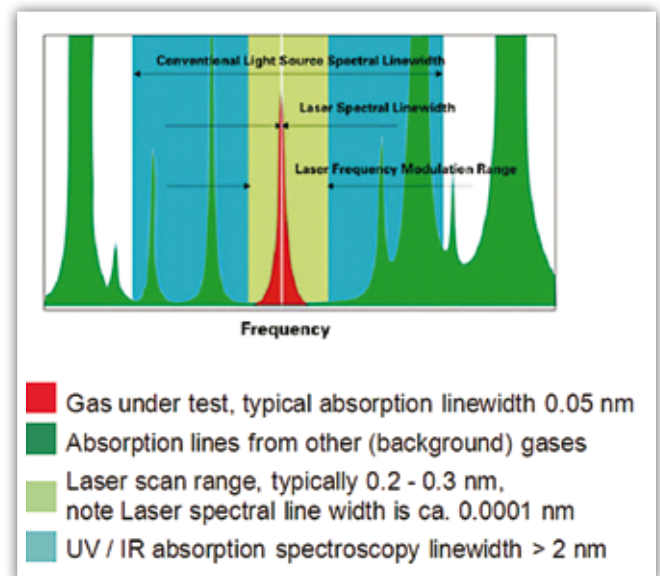
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[Reporting ammonia emissions to EPTR

Although there is no EU obligation to continuously monitor ammonia emissions, coal-fired power plants must regularly inform the European Pollutant Release Transfer Register (EPTR) of their emission volumes. Continuous monitoring of ammonia emissions is increasingly viewed as good practice. TDLAS tools have the potential to make measurements easier and faster, and thus less expensive if calculated over a larger period of time.

[In short

- Laborelec has started reviewing Tunable Diode Laser Absorption Spectroscopy (TDLAS) tools to continuously monitor ammonia emissions in coal-fired power plants
- TDLAS measurements are easier and faster than with current manual techniques; they also allow for a better monitoring of ammonia emissions and related environmental impacts
- TDLAS tools are useful in helping power plants identify the appropriate quantity of ammonia to be used in deNO_x equipment



Source: NEO Monitors

The laser scan wavelength range of TDLAS equipment is much narrower than that of "traditional" UV/IR absorption spectroscopy. This results in improved precision and less interference.