LABORELEC

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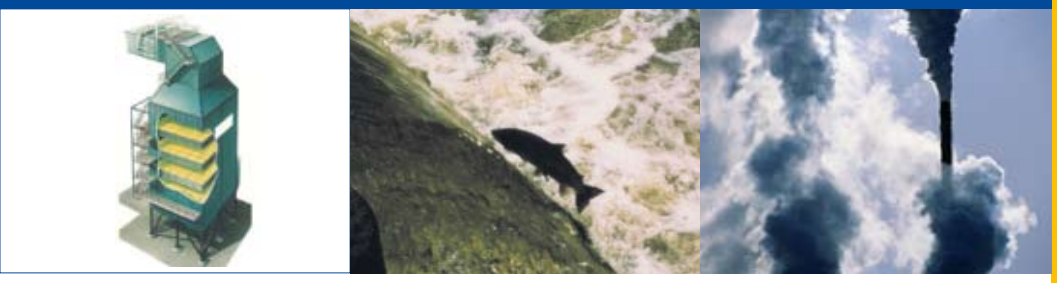

European Competence Centre for chemistry

Fostering best practices across SEE power plants

Laborelec recently set up a European Competence Centre for chemistry. Its role is to provide recommendations to SUEZ Energy Europe (SEE) power plants and to spread best practices in this field. Chemical monitoring primarily concerns the water/steam and cooling cycles at both newly commissioned and other operating power plants.

Various chemical aspects are involved in the operation of a power plant: water must be demineralized for use in the water/steam circuits and cooling systems, effluents must be treated, and boilers must remain clean. While the use of chemicals demands expert knowledge, modern combined cycle power plants do not require the full time presence of experts. Hence the need for external expertise. This need continues to grow with ever tighter environmental legislation.

Support and advice throughout a plant's lifecycle

Laborelec aims to make its chemical expertise available to all SEE plants by providing both technical support and engineering advice through the European Competence Centre.

- In the course of new plant development, Laborelec can provide advice during negotiations with equipment suppliers and system designers. It can also evaluate cleaning procedures suggested by contractors and suppliers. In addition, it can send experts onsite for operational assistance during plant pre-commissioning.
- In existing power plants, Laborelec carries out audits to review and improve chemical specifications, as well as such procedures as effluent treatment and recycling of wastewater. Ideally, plants should have their chemistry checked every month.

Defining best practices and working procedures

The creation of a Competence Centre enables the harmonization of best practices throughout Europe and the integration of these practices into new power plants right from the design stage. It also enables all operating feedback to be gathered in one place. Using this feedback, checklists can be established. The Competence Centre also provides valuable assistance during negotiations with equipment suppliers. The Competence Centre demonstrates Laborelec's intent to become the privileged partner of power plants for all of their chemical related issues.

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The technical Competence Centre
in energy processes and energy use.
From innovation to operational assistance.

Extending our chemical expertise to plants across Europe

Following the success of Laborelec's Competence Centre for chemistry in Belgium and Luxembourg, the scope of its activities has been extended to Europe. Electrabel plants throughout the continent will be able to rely upon our increasing expertise in power plant chemistry. At the same time, by gathering operating feedback from a larger number of plants, the Competence Centre's know-how will develop more rapidly. A beneficial evolution for the entire Group, particularly in the face of ever tighter legislation.

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The Laborelec team of chemistry experts also includes Marc De Wispelaere and Roger Ertryckx.

Can vacuum pump effluents be recycled?

Vacuum pump circuits in the water/steam cycle of combined cycle power plants (CCPPs) generate effluents that contain ammonia. With legislation on wastewater currently tightening, power plants must limit their discharge of such effluents. Laborelec, in collaboration with several power plants, is evaluating innovative ways to recycle wastewater from vacuum pump circuits onsite.

Because of the high ammonia concentration in vacuum pump effluents, their direct discharge is difficult since norms would be exceeded. Similarly, the presence of carbonates makes direct re-use in the water/steam cycle impossible, since the cation conductivity would then exceed turbine supplier specifications. In spite of the presence of ammonia and carbonates, this effluent is still relatively pure. To avoid its waste, Laborelec is evaluating the feasibility of various methods to treat the effluents onsite in order to re-use them in the steam cycle. Several options are being assessed:

- Injection of the effluents at the flue gas side of the Heat Recovery Steam Generator of a CCPP unit.
- In the case of a CCPP unit running on fuel: injecting the effluent water into the combustion chamber of the fuel turbine to decrease flame temperature and reduce nitrogen oxide formation.
- In coal-fired power plants, an ammonia solution is usually injected upstream of the DeNOx catalyst. The effluents could be used for this, although this requires transporting them between power plants.
- Decreasing the ammonia concentration by stripping the ammonia.
- Removing the carbonate ions by passing the effluent onto resins.
- Ozonation of the effluent.

The initial theoretical evaluation of these proposals is still under way.

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Tihange installs new technology to protect aquatic life

Fish mortality expected to be reduced by 85%

Following initial tests, Electrabel has begun installing a complete infrasound system to minimize fish intakes at its Tihange nuclear power plant. This advanced system significantly reduces fish mortality. It was jointly commissioned by Laborelec and developed by ProFish Technology. Laborelec is actively promoting the use of the technology across the SUEZ Group.

Water intake by power plants can seriously affect fish populations in rivers. Although many power plants currently use technologies such as luminous flashes, acoustic barriers, and electric discharge systems, none of these is efficient enough to repulse all species of fish.

Ultrasound interpreted as predator presence

The system developed by ProFish Technology — and commissioned in part by Laborelec — is an entirely different approach. It is based on the emission of very low frequency ultrasound signals of 20 Hz. Most varieties of fish interpret these signals as emanating from a predator. The normal reaction of fish is an immediate flight response, causing them to leave the area and avoid the plant's water intake system. The initial tests with this new technology were carried out in 2004 at the Tihange nuclear power plant, in Belgium. The tests demonstrated a mortality reduction of 85% for eels and Atlantic salmons, two types of fish threatened with extinction and protected by a European directive.

Large scale implementation

Given the success of the initial tests, Electrabel decided to install a permanent system comprised of six units at its Tihange site. The ProFish technology is universally applicable and relatively easy to install. The primary installation of the units is placed above the water level, inside the concrete embankment along the water intake corridor. The ultrasound source itself is attached by means of a steel tube and placed at a depth of 2.5 metres. A secondary placement in the concrete can be carried out underwater if necessary. The installation at Tihange is scheduled to be completed in June of this year. It will be a world first. Laborelec is actively promoting the ProFish technology within the SUEZ Group, with both Electrabel Netherlands and Electrabel Germany having already shown interest.

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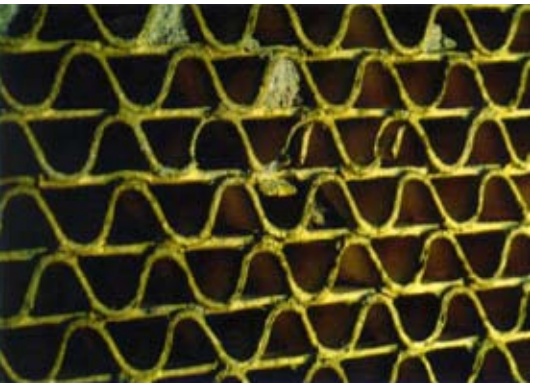
Assessment of catalyst quality

Improving purchase specifications and lifetime management

Laborelec has advised Electrabel power plants to improve their maintenance and replacement management of catalysts by sharing knowledge and spare parts with other plants. We are now also conducting research to gain a better insight into catalyst quality. This will help improve purchase specifications and support purchase decisions.

Recently a new guideline for testing catalysts was made by VGB PowerTech. Laborelec subsequently made a comprehensive inquiry into the management of catalysts in Electrabel power stations all over Europe. We made an inventory of possible failures or malfunctions and how they should be solved, enabling power plants to better assess their installed catalysts. In addition, we analyzed the possibility for power stations to share a stock of spare parts and backup catalysts, taking into account various compatibility considerations. We advised them to share at least a small pooling stock.



Catalysts usually serve for about five years, but we currently do not know the main factors that determine this lifetime.

Precise assessment of catalyst parameters

We are now striving for a better understanding of catalyst quality and durability to support purchase decisions. Little is known about the expected lifetime of a catalyst. They usually serve for about five years, but we currently do not know the main factors that determine this lifetime. Nevertheless we can measure and assess a number of quality parameters. We can measure the pressure drop over a catalyst. We can also assess the NO_x conversion activity and the efficiency in converting SO_2 in SO_3. Furthermore we can assess the ability to convert Hg(0) into Hg(2).

Research to fill the gaps

A number of other parameters are still difficult to assess. We are currently not able to determine the resistance to potassium poisoning, or to know whether or not a catalyst can be regenerated after normal lifetime. We are executing tests with sandblast systems to study a catalyst's resistance to erosion. Our research aims at filling these remaining gaps to enable a complete lifetime assessment of catalysts.

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Setting up a database of chemical monitoring devices

Effective water/steam chemistry programmes require a number of parameters to be continuously monitored. Laborelec is collecting operating feedback from power plants regarding chemical monitoring devices. This information will be complemented with new equipment testing in order to create a central knowledge database.

Laborelec experts have visited Electrabel power plants across Europe to collect the information. During their onsite audits, they assessed the efficiency of measuring devices being used as well as plant satisfaction regarding this equipment. Both the core parameters (specific and cation conductivity, acidity, and oxygen) and the diagnostic parameters (sodium and silica) were assessed. The experts also considered other online monitors: phosphate, turbidity, and total organic carbon. In addition to these onsite audits, Laborelec has begun testing new monitoring equipment. A degassed cation conductivity measuring device, for instance, has been tested onsite. Ultra supercritical coal-fired plants require extremely pure water. As a result, measuring devices must be able to detect the presence of ever smaller amounts of chemical compounds. Gaining knowledge about new devices is an important aspect of this project. All feedback is being gathered in a central database. The database classifies information by type of measurement, equipment brand, cell constant for conductivity measurements, temperature probe and type of electrodes for pH measurements. Using this database, Laborelec will be able to make better recommendations to power plants regarding the type of chemical measurement equipment to be used, as well as its positioning within the installations.

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Quest for negative CO_2 emissions leads to futuristic ideas

The struggle against global warming is leading to a worldwide surge in research to pull carbon dioxide (CO_2) out of the air. This quest for so-called negative CO_2 emission has given birth to a number of rather futuristic ideas. Laborelec keeps track of all of these evolutions in its Technology Watch programme.

Solutions aiming to pull CO_2 out of the air have gained an increasing interest from researchers all over the world, although they are often expensive, difficult to execute in practice, or involving high risks.
One technique being explored uses Mg and Ca silicates. These rocks are ground down and spread out over the landscape or shallow seas where they react with the CO_2 in the air to form $MgCO_3$ and $CaCO_3$ minerals. It is a proven technique but it has some major disadvantages. To capture the CO_2 emitted by burning one ton of coal, it requires ten tons of silicate rock. Grinding this rock consumes much energy, thereby cancelling out a large part of the positive results.
An even more far-out idea is the creation of artificial trees, mimicking the function of natural trees whereby leaves pull CO_2 out of the air as it flows over them.
Similar ideas are likely to be submitted for The Virgin Earth Challenge, a science and technology prize of $25 million for whoever can demonstrate a commercially viable design for removing greenhouse gases. Laborelec/Frans Van Dijen has already submitted an idea, but it must remain under closed cover as long as the challenge runs.

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One futuristic idea is the creation of artificial trees that mimic the CO_2 drawdown by natural trees.

Upgrading flue gas monitoring systems

Better definitions required for measuring fine particles

Existing systems for the monitoring of flue gas are rapidly becoming obsolete as power stations become cleaner. As a result, it is increasingly difficult for new power stations to prove that their emissions are below legal standards. The standards themselves are often ambiguous or incorrect. Laborelec is conducting research to assist in upgrading monitoring systems.

Newly built power stations are now much cleaner than those of a few years ago. As a side effect it becomes increasingly difficult to precisely measure the emissions of fine particles and other pollutants. The emission values that can be detected by current measuring tools are too high. Furthermore, environmental regulations require detecting various types of pollution independently. As a result, existing tools and the reference methods to interpret measurements are becoming unusable. Power stations now are in the position of being unable to prove their good emission quality.

Clear and practicable definitions

Laborelec does research in this field in order to assist in improving European standards. We have observed that current national and regional legal standards are often confusing because definitions are imprecise and often vary widely from country to country. The existing European standard EN 14181 on the Quality of Autonomous Measuring Systems is disputed for similar reasons: implementation is very difficult because it contains too many errors and lacks clarity. Laborelec now aims to determine and communicate clear and practicable definitions by quantifying fine particles and SO_2.

We are clearly defining how samples should be taken from the stack.

Reliable results with a known margin of error

Our research programme includes measurements taken inside and outside of the stack, as well as sampling flue gas. We are clearly defining how samples should be taken from the stack and how they should be subsequently transported into the monitor in order to control possible contamination of the sample. We are developing appropriate measuring tools for various types of flue gas pollutants that produce reliable results with a known margin of error.

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