

# THE TRUE TEST

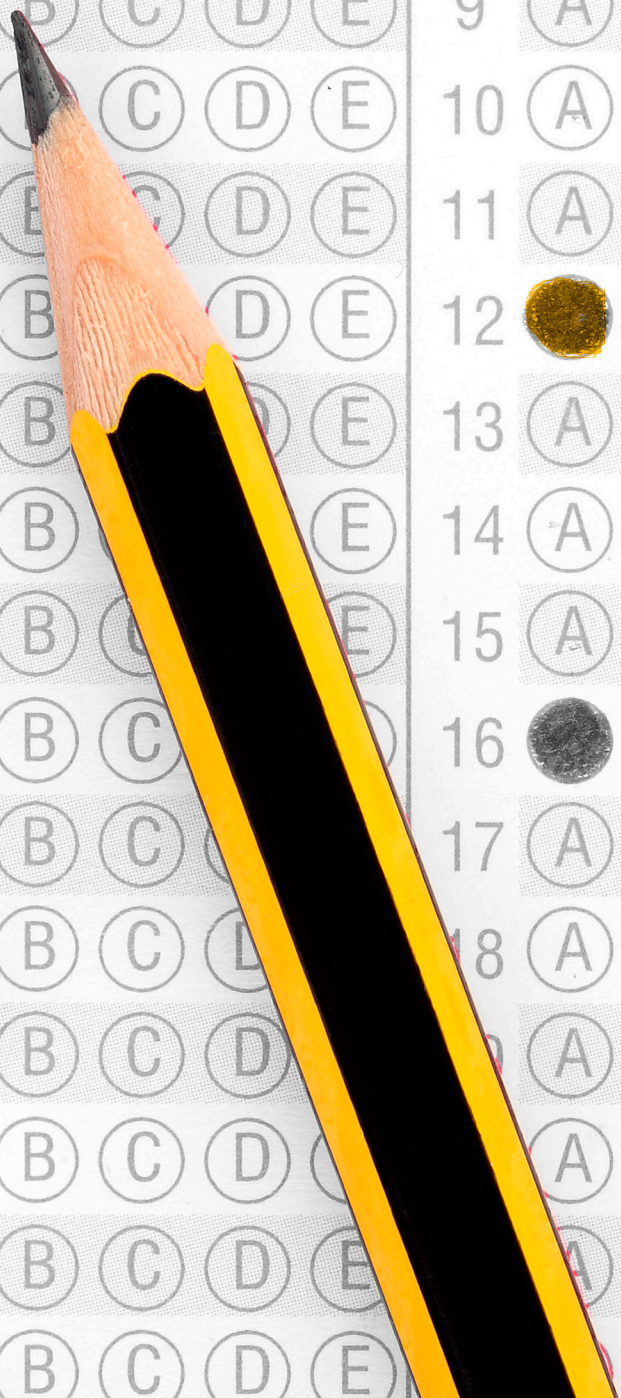
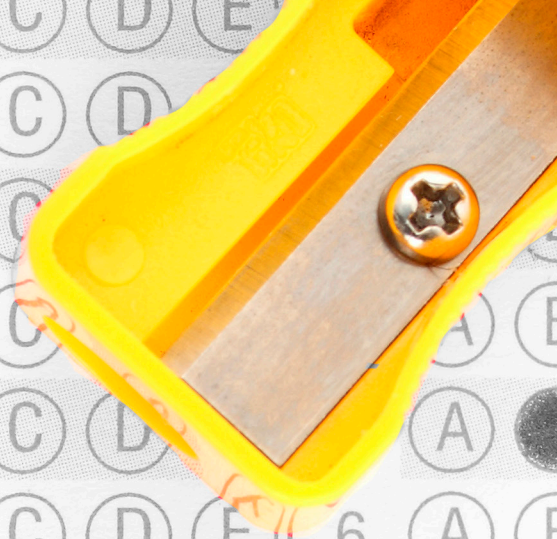
Johan Heiszwolf, Lhoist, Belgium, and Nenne Nordström, Gasmot Technologies, Finland, explain how Lhoist's continual investment in innovation has led to growth in a variety of market sectors, including flue gas treatment.

## Introduction

The aim of flue gas treatment (FGT) is to reduce the concentration of pollutants in stack emissions to acceptable levels, in compliance with all relevant regulatory requirements. It is vitally important, therefore, that the treatment of one pollutant does not increase the concentration of another, and that all prescribed pollutants are treated effectively. Consequently, Lhoist, a global leader in the development and manufacture of FGT products, employs FTIR (Fourier Transform Infrared) multiparameter gas analysis in both the development of new products and in the performance assessment of the company's FGT products. The FTIR technology is supplied by Gasmot Technologies and, together, the two companies have worked closely to develop effective FGT development and evaluation tools.

Working closely with Gasmot's Belgian distributor, Kelma NV, Lhoist has developed laboratory, pilot-scale, and mobile-process monitoring capabilities to evaluate FGT products that are still in the development phase and to demonstrate the effectiveness of existing FGT products at customers' sites.

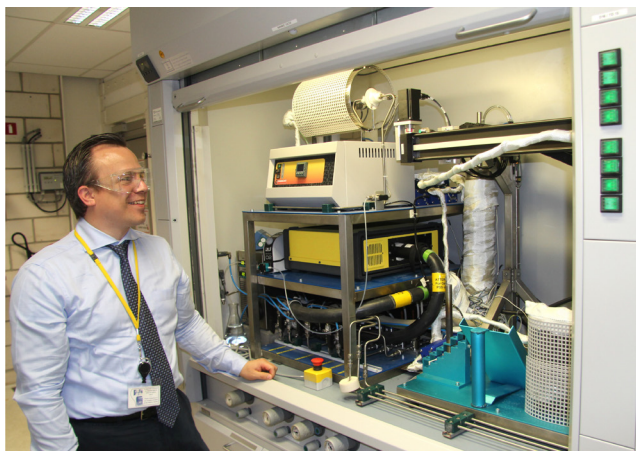
The FGT market has grown considerably in recent decades, as a result of higher environmental standards and the development of regulations that impose emissions limits on industrial processes. Process operators around the world have therefore sought to monitor multiple gases simultaneously with FTIR analysers







Field trial.



Lhoist laboratory.

in order to manage their processes and demonstrate compliance with emission limits.

One of the reasons for the diversity of Lhoist's markets is the company's focus on innovation. Tangible evidence of this exists just outside Brussels, where the company has established a Business Innovation Centre (BIC).

## FGT research

One of the first innovative product groups to be developed by the Lhoist BIC was Sorbocal® which removes major acid pollutants (SO<sub>x</sub>, HCl and HF) in gaseous emissions. A number of different products within the Sorbocal range were developed to meet the needs of different processes. For example, particles of Sorbocal SP/SPS have a much larger surface area and pore volume in comparison with standard

hydrated lime, so this product is employed in applications that require enhanced performance.

An enormous number of tests have to be undertaken to evaluate potential new products and, in the case of FGT, the effectiveness of candidate products to remove pollutant gases is key. The BIC laboratory has therefore developed a capability to generate artificial flue gas mixtures containing acid gases (SO<sub>2</sub> and HCl) in a mixture of N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O, and NO<sub>x</sub>. The gas composition of this artificial flue gas is tightly managed using mass flow controllers to ensure an accurate comparison of pre- and post-treated gas for each candidate product.

## Gas analysis

Different gas analysers were initially used to measure different gases. For example, an infrared (NDIR) analyser was used to measure SO<sub>2</sub>, but it was necessary to remove moisture from the sample gas before analysis by this instrument. Some SO<sub>2</sub> was lost from the sample as a result. "This complicated the work and incurred delays," commented Lhoist's Johan Heiszwolf. "It was also necessary to operate a separate bench for HCl, which further extended the time taken for the tests and introduced a higher possibility of experimental error. A key advantage of FTIR is that it measures both SO<sub>2</sub> and HCl, and does so without removing water from the sample."

The initial contact with Gasmet was made via Bart De Backer from Gasmet's local distributor, Kelma, who visited the BIC and explained the advantages of multigas monitoring with FTIR. Following an initial trial, this led to the utilisation of a Gasmet DX4000 analyser within the BIC laboratory. At the same time, the staff developed an automated system for running the test unattended and, as a result of the FTIR's ability to monitor multiple gases in almost realtime, in conjunction with test automation, the throughput of the laboratory was increased tenfold. "The use of Gasmet FTIR gave us a greater insight into the characteristics of the sorbent and facilitated a major step forward in our development programme," said Heiszwolf. "By dramatically increasing the throughput, we were able to evaluate a larger number of samples in a shorter period of time, which allowed us to discard those products that failed to meet the required levels of performance at an earlier stage."

The laboratory trials assess the intrinsic capacity of the sorbents and, if they perform well, the assessment process is continued in a pilot plant to evaluate performance under simulated operating conditions. The pilot plant was also developed by the Lhoist BIC, and is capable of generating a mixture of gases and steam at 180°C to mimic aggressive emissions. The pilot plant is also able to measure sorbent performance under dynamic conditions with varying gas concentrations and temperature.

The pilot plant consists of two separate units, each capable of generating dynamic emissions across a broad range of conditions. The emissions from the older of the two units are monitored by a Gasmet DX4000 heated multigas FTIR analyser. A new pilot unit is monitored by Gasmet's fixed FTIR continuous emissions monitoring

system (CEMS), which analyses gas both before and after treatment using a heated switch-over system.

In addition to the chemical characteristics of the sorbent, Lhoist also places a heavy emphasis on its physical characteristics. For example, the grains of a dry powder product have to be fine enough to be reactive, but not too small to negatively impact the flow behaviour of the powder.

In addition to research, the facilities at the Lhoist BIC also provide an important resource for the group's operating companies around the world. "In the UK, we have two laboratories providing internal quality control in addition to customer service, but where more comprehensive or in-depth analysis is required it is a great benefit to be able to utilise the capabilities of the BIC," explained John Whitehurst, UK Business Manager for Environmental Applications.

### FGT field trials

In addition to the laboratory and pilot plant facilities, Lhoist has developed a mobile system that is able to operate at customer sites. Historically, this involved the deployment of a large truck but, thanks to the compact nature of the portable FTIR analysers, this is no longer necessary. KELMA has supplied two Gasmeter DX4000 portable FTIR analysers in customised rugged transport cases so that the monitoring equipment can be quickly and simply shipped around the world to customer sites. These analysers have a remote communication capability, allowing staff in Belgium to analyse the results without having to travel to site.

### Cement industry

In the past, the main market for FGT products was the waste-to-energy sector, but, according to Heiszwolf, "we have seen significant growth in demand from the cement sector, particularly from plants in southern Europe."

A French cement plant producing 1.5 million tpy was in compliance with the atmospheric emission limit values (ELVs) in European directive 2000/76/EC (10 mg of HCl/Nm<sup>3</sup>). Anticipating more stringent ELVs in the future, which would affect its production process in terms of combustible raw materials, the operators contacted Lhoist for help in improving the performance of its FGT system.

In order to test the injection of powdered sorbents upstream of the electrostatic precipitator, Lhoist provided an Injecto-Matic big bag test facility to assess Sorbocal H (standard hydrated lime), SP (hydrated lime with a high specific surface area and pore volume), and Minsorb® (non-flammable adsorbent mineral). Tests were conducted over several weeks without affecting production, and Sorbocal SP was found to be the best solution both technically and economically.

In the US, the cement industry is facing compliance challenges relating to changes in the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. These require many plants to install equipment to control the emissions of hydrochloric acid, mercury, hydrocarbons, and particulate matter.



Lhoist pilot plant.

A global cement producer with a capacity in the US of more than 10 million tpy, had a requirement to meet an HCl limit of 3 ppmv, averaged over a 30-day period, so the company decided to use dry sorbent injection of calcium-based products: a low capital cost approach. Working with the company's technical team, Lhoist's FGT experts conducted trials comparing standard hydrated lime with Sorbocal SP. The test included injections at three locations at various feed rates to determine optimum performance. Production at the plant was unaffected during the week-long test.

The effectiveness of the dry sorbent injection system was assessed with a FTIR system, providing real-time stack gas analysis. The trials confirmed that the use of hydrated lime would be an effective solution for controlling the plant's HCl emissions. Injecting Sorbocal SP into the ID fan before the baghouse provided the best removal levels. Moreover, Sorbocal SP was found to outperform standard hydrated lime in every case.

Emphasising the importance of emissions monitoring with Gasmeter FTIR during trials, Heiszwolf concluded: "Onsite monitoring is conducted by Lhoist technical support teams to demonstrate the enhanced performance of the Sorbocal product, show customers how to maximise treatment efficiency, provide an insight into process control, and help customers troubleshoot abatement issues."

### Advantages of FTIR gas analysis

FTIR is a sophisticated technology for analysing gases both qualitatively and quantitatively. The key feature

of these instruments is their ability to monitor multiple compounds simultaneously. The Gasmeter FTIR analysers are capable of measuring almost any gas and have been developed over many years specifically for emissions monitoring applications. This means that the instruments are extremely rugged and work reliably in both fixed and portable versions. However, a key benefit for environmental applications is their ability to analyse hot, wet, aggressive gas mixtures.

All of the company's FTIR instruments – fixed and portable – contain the same core analyser which means that they can be operated with the same software: no extra training is necessary and results are directly comparable.

Using Calcmet™ software, users of Gasmeter analysers are able to analyse sample spectra, producing almost real-time data for pre-selected compounds. However, the retention of recorded spectra offers an opportunity to identify 'unknowns' by comparison with reference spectra, and to analyse recorded spectra retrospectively for compounds that were not necessarily of interest at the time of the measurement. For example, Lhoist has recently investigated HCN and HF removal for some applications and now has the ability to study measurements of these compounds from readings that were taken in the past. This highlights an important advantage of FTIR: when it becomes necessary to measure new compounds, because of new legislation for example, no extra hardware is necessary, so the additional costs are negligible. The Gasmeter FTIR

instruments also do not require periodic recalibration, a daily background spectrum measurement with zero gas (nitrogen) is enough to preserve measurement accuracy. Instead of periodic span calibrations, reference spectra for analysed gases are measured at the factory when the instrument is made and these do not drift.

## Conclusion

From Lhoist's perspective, Heiszwolf said: "The ability to work with wet, corrosive gases is obviously a major advantage, and since we routinely analyse over ten gases, monitoring is much less complicated now that we can do so with just one analyser. Simultaneous multigas analysis is essential because it provides a complete picture of the emissions reduction capability of candidate products, rather than just the isolated effects of FGT on one pollutant.

"The size of the Gasmeter analysers is also a major advantage for us: they fit neatly into the automated testing system which is installed in a normal laboratory fume cupboard, and the portable equipment is easy to transport to remote customer sites, especially since large calibration gas bottles are not necessary.

"Following the rigorous assessments conducted by our laboratory and pilot plant facilities, a number of new products are currently progressing to the scale-up phase, and we anticipate being able to commercialise them in the near future." 🌐