MORE THAN TWO YEARS OF EXPERIENCE OF SEVERAL LASER INSTALLATIONS TO MEASURE O2, CO AND TEMPERATURE OF THE OFF-GAS[1]

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Summary

The Laser System is an exact and reliable tool to measure CO, Oxygen and temperature of the off gas. It requires much less maintenance than existing systems on the market. The system has good potential for existing or new post combustion systems. The laser will help to optimize the whole melting process. The system prevents high CO loads of the off gas, which increases the explosion safety tremendous. High water and dust content of the sample is no problem. The measurement works without drop outs, even under worst conditions.
Key-words: Laser, CO, Oxygen, Off Gas, Exhaust Gases

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INTRODUCTION

The idea to use the off gas as a control parameter for furnaces is well established. There are several process optimization techniques on the market which use the off gas as a controlling parameter. Several different systems have been tried at EAF off gas systems but did not fulfil the expectations. The main reason was that of unsatisfactory reliability. The standard technique has been to use a water- cooled open lance in the off gas pipe. The off gas is sucked in, filtered, dried, measured and somehow wasted (danger of explosion and poisoning because of the CO contents). This technique involves the use of a lot of equipment which requires a considerable amount of maintenance time and money to ensure optimum performance.

LASER BASICS

The light released is monochromatic. It contains one specific wavelength of light (one specific color). The wavelength of light is determined by the amount of energy released when the electron drops to a lower orbit.

With temperature and current modulation it can be adjusted very accurately. The energy of the used laser is similar to a laser pointer for presentations. The principle we use is called absorption spectroscopy (Figure 1).

Every molecule has a special resonance frequency. If the laser is emitting the same frequency, the molecules will start moving by absorbing the laser energy. The receiver detects a lower signal depending on the number of molecules between the transmitter and the receiver.

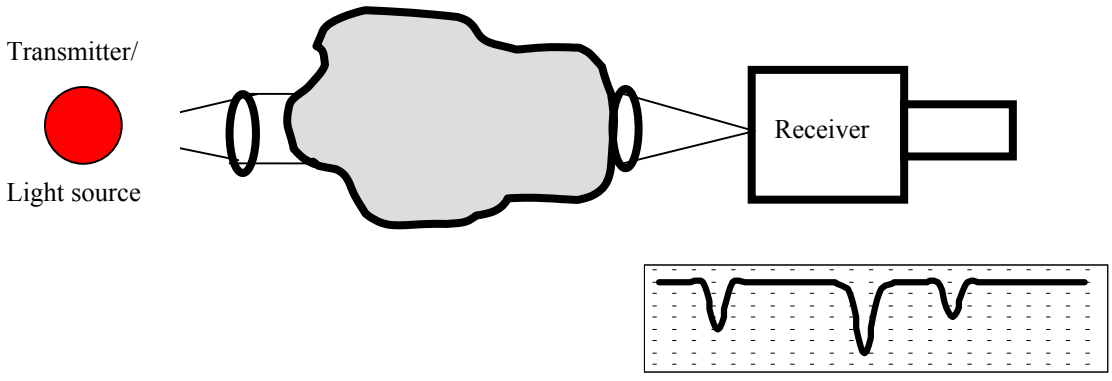

Figure 1. Absorption spectroscopy

Every molecule has a special resonance frequency. If the laser is emitting the same frequency, the molecules will start moving by absorbing the emitted energy. The receiver detects a lower signal depending on the number of molecules between the transmitter and the receiver.

And this is what you see here as “negative” peaks or as absorption.

The laser system is installed just behind the gap. The laser and the receiver are mounted outside of the off gas system (Figure 2). The path length of the lasers is reduced by two water cooled pipes. The whole system is purged by nitrogen to avoid dust in the pipes and on the optical systems.

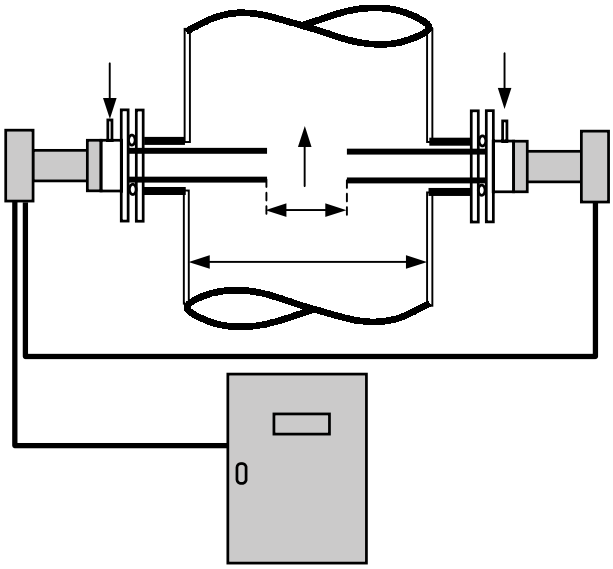

Figure 2. Principle of the installation

As output the system delivers CO, O_2, temperature and dust contents. Every gas needs an own laser. Additionally can CO_2 be measured with a 3. Laser too.

INSTALLATION AT MARIENHUETTE

The Lindarc Laser System was developed with the help of Marienhütte, Graz. They are 100% scrap based with a tap to tap time of round about 43 min and 390 kWh/t

MARIENHÜTTE

Figure 3. Marienhütte, Graz

Marienhütte is Austrians largest producer of concrete-reinforcing steel with the following basic data:

tapping weight	35 t
tap to tap time	43 min
annual production	345.000 t
producing rebars and round bars	

Figure 5. The water cooled laser housing

Figure 4. The open furnace with the laser housing

Figure 6. The lances after three month of operation.

After 3 month of operation are the lances still looking good. We have often a lot of slag hanging at the side wall were the lances are coming into the off gas system. But this is only an extra protection of the lances. The lances are made of stainless steel and have a life time of round about a year (if nobody switches the water off...)

INSTALLATION AT ICDAS

The steel plant is located in Biga, Turkey and south west of Istanbul on the Asian side. The steel plant was started in January 2004 with the following data:

tapping weight 178 t

tap to tap time 50 min

producing rebar and wire rods

Figure 7 and 8 are showing the installation at this huge Concast furnace

Figure 7. The installed lances

Figure 8. The laser housing behind the white cloth

EXPERIENCE AND ACHIEVMENTS

The system is with 10 ms measuring cycle very fast and the curves are very much fluctuating. The reason is the not constant pressure of this high dynamic process. To get a good signal to measure we have to average it. It varies between 10 and 100, depending on the following evaluation systems or software.

The temperature generated by the oxygen laser is used to correct the temperature influence in the calculation for the CO laser.

Because of this high temperature changes from 0°C (32°F) to 1.600°C (2,912°F) we have to compensate the temperature influence at the CO. A single CO laser installation can only be optimized for a special temperature.

Marienhütte

The oxygen use was optimized. The O2 consumption was not changed, but the oxygen is now used when necessary. This reduced the electrical consumption.

The false air gap of the post combustion chamber was adjusted to avoid CO in the bag house.

The start and stop points of the post combustion system were redefined

Extra oxygen is used during scrap charging to avoid CO peaks in the bag house.

A new burner system from Techint was installed: KT burners -> the off gas system was reoptimized – the complete process was monitored to support Techint to optimize their new burner system.

Interesting are the temperature readings. The average is round about 1.000°C (1,832°F) during the complete process with peaks in refining period of 1.400-1.600°C (2,552-2,912°F).

The maintenance consists of a weekly check of laser output holes by eye. Over three month even this check was not done and the system was still running continuously.

Içdaş

The oxygen use was optimized. The post combustion lancing was reduced by 2 Nm³/t.

The temperature average is like Marienhuette round about 1.000°C (1,832°F) during the complete process with peaks in refining period of 1.400-1.600°C (2,552-2,912°F).

The CO readings are lower than we expected because we couldn't install the system close enough to the false air gap. The off-gas system has a movable collar which prevents a closer installation.

Achievements

The financial savings of the Lindarc Laser System are between 15.000€ and 45.000 € a month, depending of the production and if the Lindarc Laser System is used stand alone or closed loop.

The conservative calculations for the achievements are based on a 60 t furnace with 40 Nm³/t oxygen.

We estimate the same oxygen consumption as before, a power on time reduction by 1%, ttt time reduction by 1%, electricity consumption by 2% and electrode consumption by 2% too. This would create a 400t higher production per month.

This is an estimation which has to be checked case by case.

REFERENCES

1 WINDHOLZ, L. **Optische Fernmessung atmosphärischer Schadstoffe – DOAS, LIDAR, DIAL**. Austria: Institut für Experimantalphysik Technische Universitaet Graz, 19-?.

MAIS DE DOIS ANOS DE EXPERIÊNCIA EM DIVERSAS INSTALAÇÕES UTILIZANDO O SISTEMA LASER PARA A MEDIÇÃO DE O2, CO E TEMPERATURA DOS GASES DE EXAUSTÃO

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Resumo
O sistema laser é uma ferramenta precisa e confiável para a medição de CO, Oxigênio e temperatura dos gases de exaustão. Requer bem menos manutenção comparada aos outros sistemas disponíveis no mercado. O sistema pode ser aplicado tanto em instalações de pós-combustão novas como em existentes. O sistema laser ajuda a otimizar todo o processo de fusão. Também previne o acúmulo de elevadas concentrações de CO nos gases de exaustão, que podem aumentar muito o risco de explosão. Elevadas concentrações de água e poeira no gás de análise não é um problema. O sistema trabalha sem interrupções, mesmo nas mais severas condições de utilização.

Palavras-chave: Laser, CO, Oxigênio, Gases de exaustão, Saída de gases