September 2007

TCR TECORA Today

MSSI: Multi Stage Stack Impactor

TCR Tecora introduces in its Emissions product line a major innovative product: the Multi Stage Stack Impactor.
This new product widen our offering in the applications for dust sampling.
MSSI is designed to facilitate the sampling in industrial stack emission where dust is present in low concentration, there is a large mass emissions and size classification is required. All these conditions are the perfect case for the isokinetic sampling with MSSI impactor.

MSSI is designed to meet the requirements of EN13284-1 and VDI2066 § 10. The European Standard EN13284 specifies a reference method for the measurement of low dust concentration in stack emission with concentrations below 50 mg/m3 standard conditions. This method has been validated with special emphasis around 5 mg/m3 on an average half hour sampling time.

The European Standard is primarily developed and validated for gaseous streams emitted by waste incinerators. More in general, it may be applied to gases emitted from stationary sources, and to higher concentrations.
Evaluation test of MSSI functionality has been performed by "CESI Ricerche", Power generation research centre, on different industrial plants as urban waste incinerator, coal fired power station and gas turbine generator combined cycle with positive results.

IN THIS EDITION

- *MSSI, Multi stage stack impactor*
- *Mercury in emission: Europe and US, two faces of one issue*
- *TEKRAN Series 3300*
- *Armstrong project: mercury reference test comparison*

TCR TECORA NEXT EVENTS

- *CEM 2007*
- *RICHMAC 2007*
- *EMISSION MEETING:*
  Sept. 25th Milan;
  Oct 24th Rimini;
  Nov 14th Florence
- *DECS TOUR Netherlands, Nov 7th and 8th*

MSSI components

A typical example of MSSI application is emission with a concentration below the 50mg/m3. For instance, gas turbine power stations, operating with natural gas where dust concentration is low and mass emissions beyond the million cubic meter per hour for power station of 100MW.
Since considered green for their low environmental impact (low NOx and SOx), this class of power generators are growing but, due for the large mass emissions, there is still the requirement to control their emissions.

The emissions limits nowadays in force is about 10 to 50 mg/m3, therefore the accuracy of the current applied method which is almost 0,5mg/m3 is not sufficient. In order to increase of 10 times the measurement accuracy, from 500 µg/m3 to 50 µg/m3, it is necessary to analyse how this value is affected by the adopted method.
The dust measurement is realised with gravimetric systems, summarizing: a given volume of flue gas is sucked through a filter, the dust is captured on the filter and than the filter is weighted in laboratory before and after the sampling test, to evaluate the weight difference.
The accuracy is determined by the error of two parameters:
• Collected dust weight;
• Gas volume;
In order to reduce the weight error, it is recommended to use quartz filters. Quartz filters are lighter and are binding free, because they are manufactured by compression process. This characteristic makes quartz filter, for this application, ideal since the weight of the filter remains stable even when they are exposed at high temperature.

page 6....

Mercury in emission: Europe and US, two faces of one issue

In US the awareness over the danger of Mercury deposition from emission is higher than Europe.
In Europe the standards establish that the allowed limit for total Mercury for stack emission is 50µg/m3 for Urban waste incinerators and 200µg/m3 for all other emission types. In US the approach is completely different, in fact the emission limit for each Mercury stationary emission is stated year by year in lbs or tons per year.

The Federal Government has adopted a special plan for a drastic reduction of Mercury emissions generated in the territory of the United States, called "Clean Air Mercury Rule" (CAMR). CAMR through a substantial investment plan in new technologies for process removal in emission and the measurement of Mercury emission, has the aim to reduce the Mercury emission from 11 tons per year (2006) down to 3 tons per year within the 2020.
In reality the Mercury deposition coming from emission all over the world into US territory is much bigger, about 140 tons per year where the major contribution comes from Asia and Eastern Europe. With this plan the US government wishes to demonstrate to the rest of the world that the reduction of Mercury pollution is possible and achievable. Through this approach US expects try to convince the world biggest polluter countries to take action over their emissions.
In the United States the major sources of the emission are coal fired power stations, due to the natural content of Mercury in the coal extracted from local mines and from imported supply. The plants are registered according to age of operation and mass emission.
This stringent requirement has originated the need to have Mercury CEM able to measure in stack down to 4 µg/m3 . This limit is 12 to 50 times lower than the European one!
The Mercury Rule requires as well a Mercury CEM with higher sensibility and reliability than ever before. The US Environmental Protection Agency (EPA) has promoted a development program together with major world wide manufacturer of a Mercury CEM suitable for the CAMR.
The program ends up in several RATA accuracy tests which consists in comparing in real time process measurement of the instruments under test vs reference system based on traditional chemical absorption sampling systems. TCR Tecora is a manufacturer of reference Mercury sampling systems.
During those RATA's Tekran Series 3300 has proved to be an excellent Mercury CEM matching all qualification tests in laboratories and in field as well, obtaining the best recognition supplying the EPA test laboratories with two Mercury CEM Series 3300.

Tekran Series 3300

Inertial Filter Stack Probe
with: Dilution, Blowback, Calibration & Spiking

Simplified Flow Diagram

Mercury CEM by TEKRAN: the solution for mercury emission

TCR Tecora, European leader in stack sampling systems, after the release of its dioxins long term sampling system, DECS, introduces in Italy and Europe: The new on line continuous monitoring system for Mercury in emission, Tekran Series 3300.
The Mercury analysis in gas phase is not something new. Systems capable of measuring with good accuracy the Mercury concentration in ambient has been working on the market for almost 15 years.
Although the typical concentration of total Mercury in stack of an industrial plant is 10 thousands time higher than ambient, to measure the concentration of Mercury in flue gas is a challenge. Generally the process conditions in stack are harsh so that materials

and instrumentation are highly stressed.
In order to measure the Mercury in-stack, it is necessary to have a sampling system which captures the gas sample to deliver it to the Mercury analyser. Besides, it is required a calibration and a quality control system to check permanently the analyser calibration and the overall total system performance.
Since Mercury easily combines with other chemical species in the stack, such as chlorine, the sampling system has to be designed with specific materials and solutions to avoid any sample degradation along the sampling line process. The quality of the sampling system is a key factor to ensure the system accuracy in the concentration measurement, and has to be in compliance with the Environmental Authorities.

The Tekran Series 3300 consists of a sampling system, flanged to the stack, featuring dilution system with isokinetic, heated, inertial probe to capture the flue gas without dust. The sample is then taken and treated in a conditioning unit. The conditioning module separates the Mercury into elemental (insoluble) and ionic (water soluble) species. Recombination and interference is avoided by the removal of SO2 and other gases by Tekran's patented thermal conditioner/scrubber system, which requires no chemical reagents. This cutting edge system allows measurements of both total Mercury (HgT) and elemental Mercury (Hg0) directly, while determining ionic Mercury (Hg2+) by difference.
The conditioned streams are analyzed by the Tekran Model 2537A Mercury vapour analyzer, which uses a pure gold pre-concentration and cold vapour atomic fluorescence detection.
The system is widely used around the world and has proven accurate, stable and reliable under the most harsh and rugged conditions.
Designed for years of continuous use, Tekran's patented pure gold cartridge is immune to memory effects and will not degrade over time like other cartridges built using gold sand, silica or wool.
The Series 3300 is equipped as well with an elemental Mercury calibration device. This is the most innovative component, of this series because, beyond the standard analyser calibration without standard gases, it performs automatically a total system validation injecting standard spikes of precisely known mass of Mercury in the sampling line to check the overall performance. The spike injection gives the opportunity to measure in real time the system response to be compared to the real time process measurements.
Based on fundamental physical properties, Tekran's unique approach provides long-term stability and delivery rates allowing continuous validation of the system.

ARMSTRONG PROJECT: mercury reference test comparison

Have you ever wondered why for mercury stack testing the Americans do it in a different way from Europeans? Indeed in US for reference testing is widely accepted the method called Ontario Hydro Method (OHM) and in Europe the EN 13211.
Which one can insure the best and more reliable results in reference measurement?
To this question tried to answer scientists from the Energy Research Center of Lehigh University of Pennsylvania US in cooperation of the scientists of Cesi Ricerche of Milan Italy.

Background. The US Federal Government has adopted a special plan for a drastic reduction of mercury emissions generated in the territory of the United States, mainly by coal fired power stations, called "Clean Air Mercury Rule" (CAMR). CAMR through a substantial investment plan in new technologies for the process removal of mercury in emission and the measurement of the emission, has the objective to reduce the emission of mercury from 11t/y (2006) to 3t/y within the 2020.
By January 1 2009, certified mercury CEMs need to be installed to a large number of coal fired power stations. Following certification, certified mercury CEM should collect 12 months of mercury emissions data. Reporting of data for compliance monitoring would start on January 1, 2010.

Isostack plus under test

With the support from the U.S. EPA, EPRI, U.S. electrical utility companies, and
the Italian Ministry of Economic Development, The Institute for Environment and Sustainability of the Joint Research Centre, through CESI Ricerche, and with great help from Allegheny Energy, the ERC organized a field test , what we call here in this report "The Armstrong Project", where the commercially available Hg CEMs and sorbent trap methods were field-tested at Allegheny Energy's Armstrong Power Station and compared to the reference method.

page 6....

Special

Dioxin Emission Continuous Sampling DECS

DECS Certification

Since its introduction to the European market DECS has already achieved important milestones in its young history.DECS is mCERTs certified, the evaluation test was completed in November 2006 and certification was issued the 12th of December 2006 by Cesi in Milan (Italy).

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

The certification follows the protocol defined by the UK Environment Agency according to standards and procedures of the specification "Performance Standards and Test Procedures for Automatic Isokinetic Samplers" Version 2 September 2005.
What is the mCERTs? The "Environment Agency", British institution for environmental protection, has designed the "Monitoring Certification Scheme" (mCERTs) to qualify environmental measurement systems which responds to quality and conformity criteria required by the Agency.
mCERTs is applicable for the monitoring systems certification, for people competences certification, for laboratories and audit consultants accreditation. This certification has the aim to guarantee the regulators that a certified equipment, is capable to deliver reliable results, according to regulation requirements and the manufacturer specifications. At same time, the end user is ensured that the mCERTs equipment is robust and compliant to standards and specification of the Environment Agency. The certification guarantees that the data measured are reliable and accurate and can be used for official communication in public.
It proposes to instrumentation manufacturers the independent evaluation of a recognised and reputable Organisation, facilitating the products introduction to British and international markets.

Field Tests

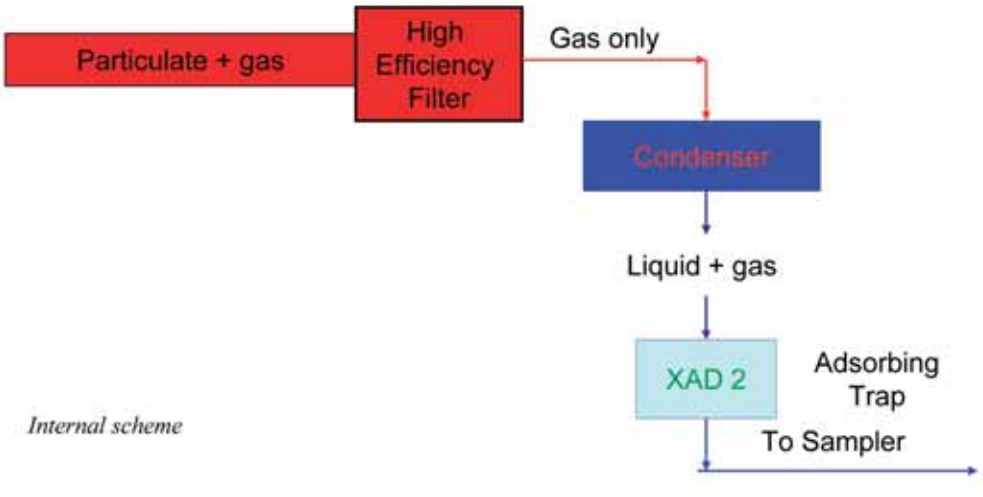
Tecora has independently run tests with a qualified national laboratory Sinal accredited, to check the effectiveness of DECS to capture Furans and Dioxins according to EN1948-1 standard.
We tested DECS three times over a period of six months. The tests were executed on two urban waste incinerators in Lombardia during their normal operation time.

Incinerator

Emission test for PCDD/PCDF

The measurement aim was to check the effectiveness of DECS to sample the total content of dioxins in the stack emissions: either in the dust phase or in the gas phase through the devices designed to capture the micropollutants; Second objective of our tests was to check the potential residual losses of dioxin sample in the gas condensate collected after the adsorbing trap.
DECS, continuous isokinetic *sampler adopts the "filter/condenser"* sampling method, as per standards EN1948-1, and the method EPA 23.
The dioxins collection is obtained by mean of heated quartz high efficiency filter for the dust and adsorbing trap on wet gas filled with XAD2 resin.

The two methods, EN1948-1 and EPA 23, are equal except for the condensate analysis required by European Norm and not required by US EPA.
The Laboratory provided to:
• preparation of sampling devices;
• collection of samples;
• extraction and analysis of the samples;
During one of these samplings it was collected and analysed as well the gas condensate. Tecora wanted to test the condensate after the adsorbing trap, to find out if the dioxin concentration was really negligible as expected.



Internal scheme

Test evaluation

In absence of an evaluation procedure, we set our objective to consider positive the test as follows:

- to match the historical data of dioxin concentration tested in the plant, within the accuracy set by 1948 method;
- to exceed limits of the spike recovery as per 1948 method.

As follows we just clarify some background about labelled standards or spikes.

Labelled sampling standards or spikes

The labelled sampling standards or spikes are chemical compounds with chemical characteristics identical to the one to be sampled, but physically different (isotope); There are two groups of spikes;

- The first group consists of 3 congeners and are applied to check the filtration efficiency;
- The second group consists of 13 congeners and they are applied to check the extraction efficiency.

A known quantity of spikes used for the filtration efficiency are added on the sampling device, and than extacted in the laboratory. This procedure is called "sampling standards recovery" or "spike recovery"; the sampling "spikes" and their quantity to be used are defined by standard 1948.

- In particular are the following:
- 13C12-1,2,3,7,8,-PeCDF 400 pg
- 13C12-1,2,3,7,8,9-HxCDF 400 pg
- 13C12-1,2,3,4,7,8,9-HpCDF 800 pg

Test summary

In the table below we are summarising the findings of the tests sponsored by Tecora.

Sampling 1 Analysis filter + XAD2	
Dioxins TEQ concentration	9,2 pg/Nm3
Sampling spike recovery	meet the standards
Sampling 2 Analysis filter + XAD2	
Dioxins TEQ concentration	3,9 pg/Nm3
Sampling spike recovery	meet the standards
Sampling 3 Analysis filter + XAD2	
Dioxins TEQ concentration	3,8 pg/Nm3
Sampling spike recovery	meet the standards
Sampling 3 Condensate	
Dioxins TEQ concentration	below LOD
Sampling spike recovery	meet the standards

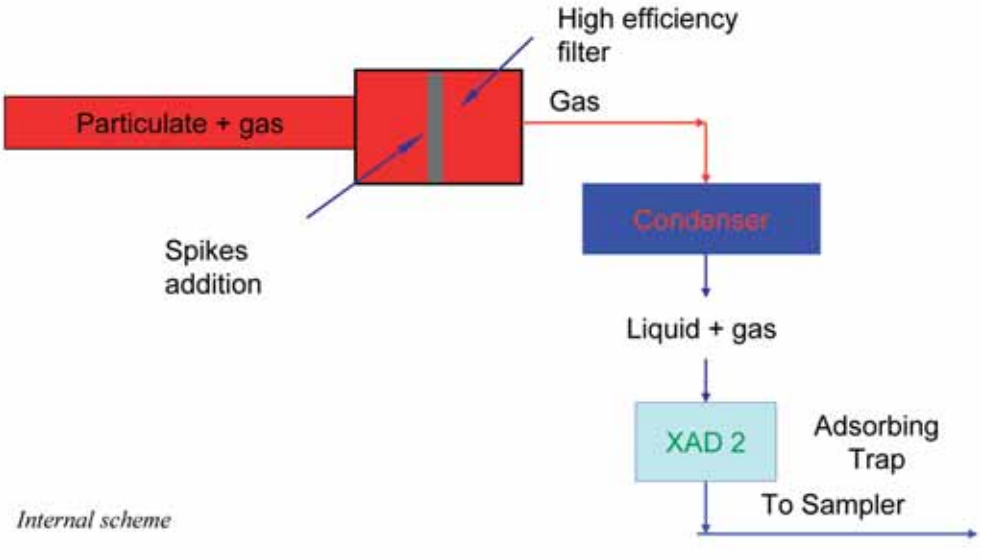
DECS

Conclusions about tests

The design of DECS perfectly suits the requirement for the collection of dioxins for stack emission control. The collection of the sample with filter/condenser with adsorbing trap on the wet gas proved to be effective. The system proved to be reliable and trustable. The test results proved that dioxin content in the condensate are negligible when sampled with the filter condenser and adsorbing trap. The condensate collection and treatment for analysis is rather difficult and complex.
Tecora offer options for the condensate collection, but after the tests, Tecora came to conclusion that EPA 23 method is more practical, since the condensate analysis is not necessary.

Tests never end

Since Tecora performed its own test, more test were performed by customers and in more stringent condition, many equivalence test were conducted comparing DECS sampling with 1948 portable isokinetic sampling systems. So far all of them proved to be satisfactory.



Internal scheme

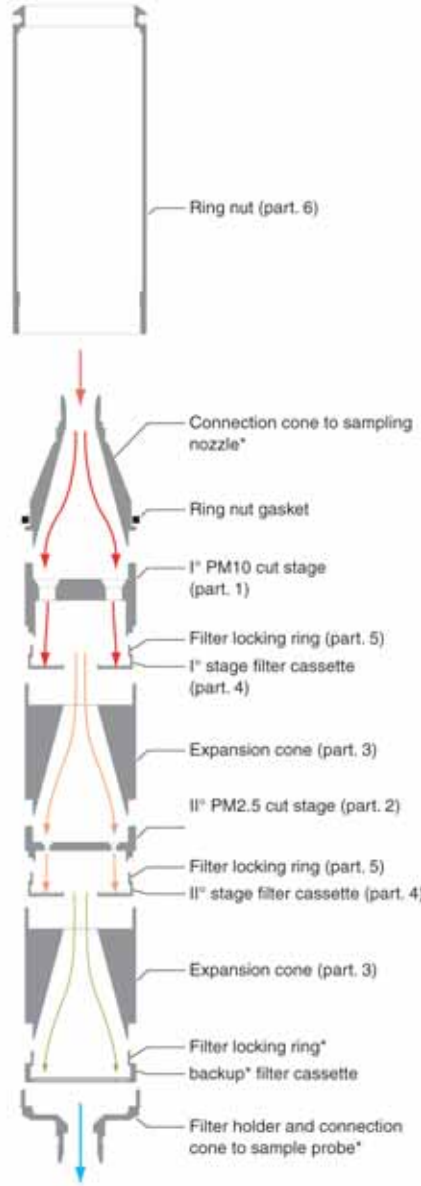
Armstrong project...

Therefore in July 2006 all involved parties met at Allegheny Power Station to participate the field test. In particular CESI Ricerche used TCR Tecora equipment Isostack Plus with EN13211 sampling train and newly developed MSSI for the dust testing PM2,5 and PM10.
From the final report of Lehigh University we read:
"*In summary, EN-13211 is, in many aspects, similar to the OHM. The main difference is that isokinetic rate is computer-controlled (no operator is needed), and only three impingers are used. These impingers are smaller compared to the Smith Greenburg impingers. Also, the sampling volume is smaller and sampling time is shorter compared to the OHM. These features make EN-13211 inexpensive to use.*"
Moreover the Isostak plus and his accessories proved a great flexibility, because with the same equipment and same arrangement of the sampling train was possible to perform:
1)the heavy metals
The measured metals included: Arsenic (As), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Nickel, (Ni), Thallium (Tl), Vanadium (V), Antimonium (Sb);
2) with addition of MSSI impactor to the standard probe and few modification to sampling train was possible to perform dust sampling with PM2,5 and PM10 impactors according to EN13284-1.
Therefore with Isostak products is required less sampling time, only 45min, less resources only 1 operator per train vs 2 of OHM, less chemical just 150ml and more stable sampling operation due to: less volume and good absorption because of the side stream, isokinetic automatic control and calculation, data logging integrated with computer download facility.

MSSI ...

In order to increase the accuracy of the volume and to collect more dust, it is recommended to have a longer duration of the sampling time. In addition, to achieve the objective, it is advised to use an isokinetic automatic sampler like Isostak Basic or Isostak Plus, which allows to sample for long time an accurate volume of gas measured through a dry gas meter and keep control of the isokinetic condition, with minimum operator involvement.
The isokinetic automatic sampler guarantees a volume measurement with an accuracy within 2% and save operation cost due to reduction of operators required to monitor and to manage the test sampling.
In order to understand the nature of the dust, to identify process issues or to optimise the emissions, it is required to make a particles sizing.
Possible particle nature may be the following:
• Earth erosion solids residual in fuel gas;
• Particle originated from plant metals erosion;
• Incombustible;
• Presence of carbon black in case of CH4 combustion.

According to the sampling method available we may consider three approaches:
1. Integrated isokinetic heated probe;
2. PM10 and PM2,5 Cyclones;
3. Sampling with multi stage impactor;
The main differences are the following:
1. The isokinetic probe is a well tested method, but does not allow particle sizing;
2. Cyclons are a well tested method, but part of the sample cannot be collected on the filter and gets lost, and for this reason this method is not ideal.
3. The probe with the multistage impactor MSSI, with low dust concentration, guarantees the maximum collection of dust in different sizing as PM10 and PM2,5.
The dust enters the impactor and is accelerated at high speed and hits against the filter membrane due to their inertia. In this way the dust remains bind to the filter to avoid any sample loss in the next analysis process.



MSSI Internal scheme