MERCURY INSTRUMENTS
Analytical Technologies

Facts contra Fairy Tales:

SM-4- Mercury Stack Monitor Fact Sheet

Mercury is a relatively new component to be measured according to the regulations. Potential users of mercury CEMs are facing plenty of arguments and myths. Following explanations shall bring light into some of the obscurities about continuous mercury emissions monitoring.

1. Have carrier gases like Argon necessarily to be used in mercury analyzers?

Special carrier gases like argon or nitrogen are only required if Atomic Fluorescence Spectrometry (AFS) is used for detection of the mercury. This is because other gases cause a quenching effect which means a dramatic loss of sensitivity. **Mercury Instruments SM-4** is using **Atomic Absorption Spectrometry** (AAS), a method which is absolutely not prone to quenching. Therefore simply clean air is used as a carrier. As a very welcome side effect the oxygen fraction of the air boosts the purification of the system by oxidation of impurities which often are contained in the sample.

2. Are instruments based on Atomic Absorption less sensitive than those based on Atomic Fluorescence?

Atomic Absorption based systems are practically not less sensitive than Atomic Fluorescence based instruments. The Mercury Instruments SM-4 has an instrument detection limit (IDL) of less than 0.1 ng/m3 (nano-grams per cubic meter, parts-per-trillion level). The limit of detection which can be practically achieved with a standard SM-4 system is lower than 0.05 µg/m3. This considers the complete system including dilution unit with a 1:40 dilution ratio, sample line and all the other system components. There are no special conditions required to obtain this detection limit.

3. Is the Mercury Instruments SM-4 proven and tested?

Mercury Instruments people have over 15 years experience in development of mercury stack monitors. MI developed the SM-3 Mercury Stack Monitor. This was the first approved mercury CEM world wide which used a thermo catalytic converter thus avoiding the need of chemical reagents for operation. The first SM-3 has been installed in 1998 and is still in operation. There are over 60 installations of the SM-3 until now (Germany, Austria, Hungary, USA, Korea, China). In order to meet the particular conditions found in coal fired power stations as well as the criteria provided by the regulatory requirements (USEPA Part 75; PS-12A) the further advanced SM-4 was developed. The experience and knowledge of numerous installations in various types of stacks (cement kilns, municipal and industrial waste incinerators, sewage sludge incinerators, coal boilers) were incorporated into the SM-4. The SM-4 has successfully been tested at wet stack coal-fired power stations, dry stack power stations (before and after mercury absorbers), rotary kilns of cement plants,

smelter gas for sulfuric acid production and industrial waste incinerators. The tests show satisfactory results under realistic conditions.
The SM-4 has successfully passed QUAL1 approval and been certified by German TÜV (Rheinland) according to DIN EN 15267-1:2009, DIN EN 15267-2:2009, DIN EN 15267-3:2008 and DIN EN 14181:2004).

4. Low converter temperature or high converter temperature: which is better?

In order to get mercury in a detectable form all different species of mercury have to be transformed into the elemental state. This happens in the converter. There are different converter designs and operation principles known:

(a) wet chemical reduction devices where the sample gas is brought into contact with a reducing reagent. This method was common by first generation instruments but is rarely used now because it has several disadvantages.

(b) Dry converters. These are systems, which use either thermal conversion or catalytic conversion of the mercury. The 100% thermally based method requires higher temperatures in the range of 800°C – 1000°C, whereas catalytic systems have working temperatures starting at 200°C, some instruments reaching 700°C (in this case one would speak rather of a thermal system than a catalytic one).
Higher converter temperatures generally show following negative effects: deactivation of the catalyst, enforcing unwanted reactions like formation of SO3 from SO2, boosting the recombination of elemental mercury with halogens, oxygen or sulfur, long cooling durations for service. These negative points can be avoided using lower operating temperatures. Only special catalysts work at such low temperatures, the catalyst used in the SM-4 has especially been developed to meet these criteria.

5. Can instruments applying gold-amalgamation techniques capture strong variations of mercury levels in the sample?

Yes: they can! The SM-4 works with a continuous flow of sample which is permanently diluted and flowing through the sampling system and the sample line to the detector. Quick and drastic changes of the mercury concentration in the sample are transported with the same speed to the detector as it would be the case for a direct reading instrument. The response of the whole CEM system to a fast and strong change of Hg concentration is mainly determined by adsorption and desorption processes between mercury and surfaces in contact with the sample. Here it is crucial to select the right materials and surface temperatures of the sample wetted parts like tubing, fittings, filters, and so on.

MERCURY INSTRUMENTS
Analytical Technologies
Liebigstrasse 5
85757 Karlsfeld (Germany)
mail@mercury-instruments.de
www.mercury-instruments.de

Approved and certified by TÜVRheinland