1 INTRODUCTION

- Continuous Emission Monitoring System (CEMS) is an integrated system of equipments and softwares which assures credible and transparent pollution monitoring and reporting from industries

- It enables industries and regulators to obtain real time and accurate air pollution data that can be used to take preventive and corrective measures on time

- It is an important tool to strengthen environment compliance enforcement systems, which can lead to a market-oriented pollution control and self-regulation regime in future. To achieve this, the system needs to be quality assured, robust , properly maintained and tamper-proof

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A Continuous Emission Monitoring System (CEMS) is comprised of the equipment necessary to determine gas and particulate matter concentration and emission rates, using analytical measurements and a computer programme to produce results in units of the applicable emission limit or standard. The monitors for many other flue gas characteristics like temperature and pressure etc. can be part of it. All these are integrated with a data acquisition and handling system (DAHS) which is basically a computer software system that gathers data from analyzers as analog outputs and records it. As per a recent change in law, DAHS must include special modules for data treatment and further data communication to the central data server located in the regulators office. Most industrial facilities do not employ analyzer specialists, though, there is a legal requirement of continuous observation, operation and maintenance of CEMS.

BENEFITS OF CEMS

CEM systems are used to fulfill legislative requirements for plant operators to control and monitor emissions from industrial processes and stacks. The major advantages of on-line monitoring systems over the standard reference methods performed by laboratories and portable field methods are as follows:

- On-line monitoring systems provide continuous measurement of data for long periods of time, at the monitoring site of interest, without skilled staff being required to perform the analysis.
- All major steps in traditional analysis, like sample collection, transportation, conditioning, calibration and sample analysis procedures are usually automated in on-line analyzers.
- In case of a sudden disturbance in the system, on-line analyzers provide timely information for taking immediate corrective or preventive steps.

These advantages help in reducing emissions and keeping them within legislative limits. These limits are generally expressed as maximum gas concentration (in ppm or mg/Nm^3, maximum dust concentration (mg/Nm^3) and maximum mass emission. Concentration limits are typically given over a specified period of time (e.g. hourly or daily average) and are normalized to standard temperature and pressure, and combustion oxygen conditions to ensure that dilution air is not used instead of the actual pollution abatement.

With maximum mass emission calculations, data acquisition systems take inputs from both flow and concentration analyzers to calculate the number of tonnes emitted by an industrial source over time. In certain cases, the mass limit is expressed in terms of the mass emission per tonne of production output from the industrial process.

GENERAL CONCEPTS OF CEMS

- The European standard EN-14181, describing the quality assurance procedures needed to ensure that CEMS are installed, calibrated and operated to measure emissions into air within the uncertainty requirements of measured values as required by law. The standard is of relevance to the Indian market—since the concept is universal, even if the standard itself varies in its detail from country to country.
- The reference methods have to

be defined to substantiate the accuracy and precision of the CEMS.
- Quality assurance procedures must be used to evaluate the quality of data produced by the CEMS that is used for determining compliance with the emission standards on a continuous basis, as specified in the regulations.
- The performance specifications also have to be used for evaluating the acceptability of the CEMS at the time of or soon after installation and whenever specified in regulations.
- The CEMS has to include continuous quality check for zero and for scale (span) points, preferably without human intervention, to ensure continuous data validity and credibility. Zero check on gas CEMS must be achieved by internal or external zero air supply, automatically and periodically. Zero and span checks are performed on flow and dust analyzers using surrogate materials (e.g. optical filters and scattering bodies).
- Calibration check on gas CEMS must be achieved by internal or external calibration gas supply, preferably using reference gas with concentration certified by external body.
- The operation of real time systems needs dedication and initiation, both from the industry as well as the instrument supplier. It has been observed that due priority is not given by the industry for operation of real-time monitoring systems. At the same time, necessary support from vendors is also not forthcoming.

It is essential that the responsibility of both the industry as well as vendors be clearly specified.

The major prerequisites of efficient CEMS are as follows:
- Should be capable of operating unattended over prolonged periods of time. The minimum period between manual interventions should be at least three months.
- Should produce analytically valid results with precision and repeatability.
- The analyzer should be fit for the intended application and measuring objective.
- The analyzer should be robust and rugged, for optimal operation under extreme environmental conditions, while maintaining its calibrated status.
- The analyzer should have in-built features for automatic sample matrix change adaptation and, if necessary, correction.
- The analyzer should have on-board zero and span check capability and methods for checking linearity with reference materials.
- Should have data validation facility with features to transmit raw signal or calibrated output along with status of instrument validity to the central DAHS.
- Should have remote system access from central server provisioning log file access under secure code.
- Should have provision for multi-server data transmission from each station without intermediate PC or plant server.
- Should have provision to send system alarm to central server in case any changes made in configuration or calibration.
- Should have provisions to record all operation information in log files either in the analyzer or on remote PC.
- For each pollutant, there should

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be provisions for independent analysis, validation, calibration and data transmission.

- Must have provisions of system memory (non-volatile) to record data for at least one year of continuous operation. This is often provided by the DAHS system to which the CEMS is connected.
- Should have provision of plant level data viewing and retrieval with selection of optional Ethernet, Modbus and USB.
- Record of calibration and validation should be available on real-time basis on central server for each pollutant and parameter measured.
- Record of online diagnostic features including analyzer status should be kept electronically for user-friendly maintenance.
- Must have low operation and maintenance requirements with low cost of consumables and spares.