

PRINCIPLES & TECHNOLOGIES INVOLVED IN REAL TIME AUTOMATED ENVIRONMENTAL MONITORING SYSTEM (RTAMS)

Three-day State level Workshop on

" Online Real-time Automated Environmental Monitoring Technology"

Organized by Madhya Pradesh Pollution Control Board, Bhopal

04-06th July 2017

Contents

- **Background**
- **Introduction to Real Time Environmental Monitoring System**
- **Policy Perspective for implementation of CEMS**
- **Initiative and Implementation Status**
- **Issues in Implementation**
- **Provision under Law**

Background

SN	Events	Date
01	DIRECTIONS UNDER SECTION 18(1)(b) OF THE WATER (PREVENTION CONTROL OF POLLUTION) ACT, 1974 and THE AIR (PREVENTION Et CONTROL OF POLLUTION) ACT, 1981 IN THE MATTER OF POLLUTION CONTROL IN 17 CATEGORY OF HIGHLY POLLUTING INDUSTRIES , CETPs AND COMMON HAZRDOUS WASTE 8 BIOMEDICAL WASTE INCINERATORSREGARDING SELF MONITORING OF COMPLIANCE	05.02.2014
02	Same as above	02.03.2015

- [Directions issued under \(NGRBA\) dated 27.03.2015](#)
- [Draft Notification on online monitoring protocol dated 19.04.2015](#)
- [Letters to Chairmen of SPCBs dated 29.05.2015](#)
- [Online Monitoring IT Protocol dated 11.06.2015](#)
- [Minutes of the Meeting with Industrial Associations dated 16.06.2015](#)
- [Guidelines on Effluent Monitoring dated 07.11.2014](#)
- [List of Revised Parameters](#)
- [List of CPCB Officers for 17 Categories](#)
- [List of 17 Categories of Industries alongwith Industry Codes \(Master List of 3260\)](#)
- [List of Instrument suppliers updated 30.06.2015](#)

Introduction to Real Time Environmental Monitoring System

What is real-time monitoring system?

What do Real-time environmental monitoring system cover?

Indian Experiences in Real-time monitoring systems

Need of Real Time Monitoring System

Components of Real Time Monitoring System

Real Time Environmental Monitoring System

The system composed of Equipment, Instrument to draw, condition, analyze the sample and provide permanent record of Emission/Effluent/Ambient Air Quality or process control parameters or any other matrix or substrate at real time basis (may or may not be continuous) is called Real Time **Environmental** Monitoring System

Coverage in Real Time Environmental Monitoring System

Matrices or Substrate

Fresh Water, Waste Water, Ambient Air, Emission and Noise (Air)

Indian Experience in Real-time monitoring systems

Started with CAAQM and AWQM in 90's primarily with research objective

Noise network initiated in 2009-10

River monitoring (Ganga) restarted in 2012-13

Effluent and Emission Monitoring introduced in 2014-15

Need of Real Time Monitoring System

Benefits of RTMS

- Provides real time data
- Remotely accessible to operator/regulator.
- Greater transparency in monitoring of performance.
- Continuous performance check of Air Pollution Control Devices or ETP or sudden changes in receiving environment (River) or Ambient air and optimization of resources.
- Time series analysis possible with continuous data.
- Reduction in regulatory cost as well as long term monitoring cost.
- Expected better compliance through self regulation by industry, hence lower emission.

COMPONENTS OF RTMS

- **Sample Collection system — sampling device**
- **Interface – Sample conditioning & transportation wherever required**
- **Analyzer — Specific to pollutants, generates an output signal proportional to the concentration**
- **Calibration devices – Analyzer control system, calibration gases or standards, recording etc.**
- **Data Acquisition – Data logging system record electrical signals in defined number of channels**
- **Data Handling System— Pick, calculate, record, transfer the data in report form to desired destination**

RTAMS Policy in India

Preparedness for transparent, self regulatory air pollution control regime in India

Initially Highly Polluting Industries 17 Categories Industries along with BMW and HWI were asked to install REAL TIME MONITORING SYSTEM by CPCB

MATRIX OF INTERESTS FOR REAL TIME MONITORING

Matrices or Substrate

Fresh Water, Waste Water, Ambient Air, Emission and Noise (Air)

PARAMETERS OF INTERESTS FOR REAL TIME MONITORING

FRESH WATER

TURBIDITY, pH, CONDUCTIVITY, DISSOLVED OXYGEN, TEMPERATURE (Recently BOD, COD got included in few Stations)

PARAMETERS OF INTERESTS FOR REAL TIME MONITORING –

WASTE WATER

FLOW, TEMPERATURE, pH, CONDUCTIVITY, TSS, BOD, COD

AMBIENT AIR

PM₁₀, PM_{2.5}, CO, O₃, SO₂, NO₂, NH₃ and Benzene

SOURCE EMISSION

PM, SO₂, NO_x, NH₃, TOC, Hg, F, HF, Cl₂

Others: CO, CO₂, O₂, Temperature, Moisture, Flow etc.

CHALLENGES IN REAL TIME MONITORING – TECHNOLOGY SELECTION

- ❖ **Sample Matrix**
- ❖ **Sampling**
- ❖ **Representativeness**
- ❖ **Varied analytical ranges**
- ❖ **Accuracy issues**
- ❖ **Other physico-chemical Factors**
- ❖ **Incorporation of different technologies in single platform**
- ❖ **Operation and Maintenance**
- ❖ **Calibration and QA/QC**
- ❖ **High capital and recurring Cost**
- ❖ **Data acquisition and transfer**
- ❖ **HR and skill development**

PRINCIPLES AND TECHNOLOGY OF REAL TIME MONITORING

- ❖ Most of the methods involved are not reference methods to measure respective parameters online
- ❖ Indirect measurement always invite expert judgment to make the results close to Reference Methods
- ❖ It should be taken as granted that in online measurement the measurement uncertainty is higher than the conventional methods
- ❖ Cleaner matrix have more closeness to actual data and thus ambient air quality or freshwater quality monitoring are more easy than wastewater of emission monitoring

PRINCIPLES AND TECHNOLOGY OF REAL TIME MONITORING

- ❖ Fundamental for online measurement relies on generation of electrical signal by using any physical, chemical, electrical, optical or elemental properties of respective measurand in a given sample
- ❖ The second important issue is to make these signal detected and establish linear correlation with the concentration of measurand; here the question of calibration comes
- ❖ The widely used technologies in any online monitoring are based on optical measurement (Spectrometry) using different properties of light like, Absorption, Transmittance, Scattering, Tindal effects etc.
- ❖ Parameters like pH, Conductivity use Electrical principle

PRINCIPLES AND TECHNOLOGY OF REAL TIME MONITORING

- ❖ Understanding on Spectrometry is the key for selection of technology for majority of pollutants to be measured by online measurement
- ❖ Cross interference issues of two or more constituents present in sample is the major limiting factors to randomly select any product using any technology
- ❖ Issues of selective light source, required intensity of light, Wavelength selection, removal of interfering signals, stray lights, linearity, range selection all are important for procurement as well as operational aspects.

MAJOR PROBLEM IN RTMS IS IT ALWAYS GIVE RESULTS (DIGITS); SO THE ISSUE OF AUDIT ARISE WHICH IS CHALLENGING TO REGULATORS

PARAMETERS WISE METHODOLOGY OPTIONS

FRESH WATER

- **TURBIDITY – NEPHELOMETRY (TINDAL EFFECT)**
- **pH – Electrical (Electrode Based)**
- **CONDUCTIVITY - Electrical (Electrode Based)**
- **TDS – Extrapolated from Conductivity**
- **DISSOLVED OXYGEN – Electrical (Electrode Based)**
- **TEMPERATURE – Thermometer**

PARAMETERS WISE METHODOLOGY OPTIONS

WASTE WATER

- **FLOW** – Flow Sensors (Pressure, Level sensors in V-Notch, Rotameter etc.)
- **TEMPERATURE** – Thermometer
- **pH & CONDUCTIVITY** – Electrical (Electrode Based)
- **TDS** – Extrapolated from Conductivity
- **TSS** – Correlated to Turbidity Measurement

NEPHELOMETRY (TINDAL EFFECT)

- **BOD** – Either calculated from TOC or UV photometry
- **COD** – Either calculated from TOC or UV photometry

AMBIENT AIR

PM_{10} , $PM_{2.5}$ – BAM, TEOM

CO - NDIR

O_3 – UV Photometry

SO_2 -- UV Fluorescence

NO_2 – Chemiluminiscence

NH_3 – Chemiluminiscence

Benzene – GC FID or GC PID

SOURCE EMISSION

PM – Transmissometry, Light Scattering, Electro-dynamic, Light Scintillation, Tribo-electric (in-situ)

BAM, Light Scattering, Scintillation for Extractive

SO₂, NO_x – IR (IR, NDIR, FTIR, IR – GFC etc) UV photometry, DOAS etc.

NH₃ – TDLAS, UV Photometry, FTIR, IR

TOC – FID, FTIR

Hg (TGM) – Sir Gelard method, UV photometry with Zeemann Correction

F, HF, - FTIR, TDLAS

Cl₂ - UV photometry

CO, CO₂ – NDIR, Electrochemical

O₂ – Zirconium Oxide, Paramagnetic

Flow – Differential Pressure (Pitot Tube), Ultra-sonic, Laser, Thermal

Temperature, Moisture



THANK YOU

Abhijit Pathak
apathak.cpcb@nic.in
43102348, 9971566700