Guidelines for
Online continuous monitoring system
for Effluents

CENTRAL POLLUTION CONTROL BOARD

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1.0 BACKGROUND

Central Pollution Control Board vide its letter No. B-29016/04/06PCI-1/5401 dated 05.02.2014 issued directions under section 18(1)b of the Water and Air Acts to the State Pollution Control Boards and Pollution Control Committees for directing the 17 categories of highly polluting industries such as Pulp & Paper, Distillery, Sugar, Tanneries, Power Plants, Cement, Oil Refineries, Fertilizer, Chloral Alkali Plants, Dye & Dye Intermediate Units, Pesticides and Pharma Sector, Common Effluent Treatment Plants (CETP) and STPs, Common Bio Medical Waste and Common Hazardous Waste Incinerators for installation of online effluent quality and common emission monitoring systems to help track the discharges of pollutants from these units.

Directions were also issued to 11 Ganga Basin State Pollution Control Boards/Pollution Control Committees vide letter No.B-190019/NGRBA/CPCB/2011-12 dated 05.02.2014 for directing the industries discharging effluents directly into River Ganga or its tributaries for installation of real time water quality monitoring systems to monitor parameters such as pH, TSS, COD, BOD, Chromium, Arsenic , AOx, Ammonia. The directions envisage:

- Installation of online effluent quality monitoring system at the outlet of the identified units for the measurement of the parameters, pH, COD, BOD and other sector specific parameters (Annexure-I) as per the guidelines provided, not later than by March 31, 2015 and transmission of online data so generated to SPCB/PCC and CPCB as well.
- Installation of surveillance system with industrial grade IP (Internet Protocol) cameras having PAN, Tilt Zoom (PTZ) with leased line real time connection for data streaming and transmission of the same.
- Ensure regular maintenance and operation of the online system with tamper proof mechanism having facilities for online calibration.

2.0 GENESIS OF PROBLEM :

Chemicals (Pharmaceuticals, Organic/Inorganic, Fertilizers, Oil Refineries and Pesticides), Distilleries, Sugar, Pulp & Paper, Textile, Dying, Bleaching, Slaughter Houses, Tannery, Food & Dairy and other categories of industries located in states of Uttarakhand, Uttar Pradesh, Bihar and West Bengal have been discharging effluent directly or indirectly into the river Ganga and its tributaries (Ramganga & Kali-East) through drains, thereby causing deterioration of water quality of river Ganga and its tributaries.

The SPCBs and PCCs have prescribed standards for various pollutants emitted/ discharged by the industries as notified under the Environment(Protection) Act,1986. The compliance monitoring needs to be strengthened to ensure that treated industrial effluent complying with the stipulated norms is only discharged by the industries.

With rapid industrialisation, it is becoming a need and necessity to regulate and minimise inspection of industries on routine basis. Therefore, efforts need to be made to bring self-discipline in the industries to exercise self-monitoring & compliance and transmit data of effluent and emission to SPCBs/PCCs and to CPCB on continuous basis.

For strengthening the monitoring and compliance through self-regulatory mechanism, online emission and effluent monitoring systems need to be installed and operated by the developers and the industries on, 'Polluter Pays Principle’.

The ground truthing of the values indicated by the online devices need to be done. For proper interpretation of data measures need to be taken at the level of SPCBs/PCCs. For regulatory purposes and for purpose of actions to be taken against non-complying industries/facilities, the existing method of sampling, analysis and related procedures under the existing statutes need to be continued.

Various technologies are available for monitoring the effluent quality in terms of the parameters specified in the directions issued by CPCB. However, no guidelines on selection of the Real Time Monitoring Systems are available.

3.0 REAL TIME MONITORING

In recent years online water quality monitoring technology has received attention and interest in context of providing accurate and continuous water/waste water quality information. There are already commercially available systems for monitoring parameters such as Turbidity, Colour, Fluoride, Sodium, Ammonia, Chlorides, Nitrates etc.

3.1 Merits of on-line Monitoring Techniques

The major advantages of on-line monitoring systems over traditional laboratory based and portable field methods are:

a. Online 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.
b. All the major steps in traditional analysis like sample collection, preservation, transportation, sample pre-treatment, calibration, reagent addition and sample analysis procedures are usually automated in on-line analysers.
c. In case of sudden disturbance in the system, compared to conventional methods the on-line analysers provide timely information for taking immediate corrective/preventive steps.

3.2 Basic requirement of an efficient on line analyser

The major prerequisites of efficient online analysers are:

- Should be capable of operating unattended over prolonged period of time.
- Should produce analytically valid results with precision and repeatability
- The instrument/analyser should be robust and rugged, for optimal operation under extreme environmental conditions, while maintaining its calibrated status.

- The analyser should have inbuilt features for automatic water matrix change adaption.
- The instrument / analyser should have onboard library of calibration spectras for different industrial matrices with provision of accumulating further calibration matrices
- Should have data validation facility with features to transmit raw and validated data to central server.
- Should have Remote system access from central server provisioning log file access.
- 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 provision to record all operation information in log file.
- For each parameter there should be provision for independent analysis, validation, calibration & data transmission.
- Must have provision of a system memory (non-volatile) to record data for at-least one

year of continuous operation.

- Should have provision of Plant level data viewing and retrieval with selection of ethernet, wireless, Modbus & USB.
- In case of TOC analyser, the empirical relationship between TOC to COD or BOD must be authenticated for all industrial applications and the correlation calculation (for factor) provided.
- The correlation/interpretation factor for estimating COD and BOD using UV-Visible Absorption Technique shall be regularly authenticated/ validated and details provided.
- Record of calibration and validation should be available on real time basis on central server from each location/parameter.
- Record of online diagnostic features including sensor status should be available in database for user friendly maintenance.
- Expandable program to calculate parameter load daily, weekly or monthly basis for future evaluation with flow rate signal input.
- Must have low operation and maintenance requirements with low chemical consumption and recurring cost of consumables and spares.

3.3 Techniques/ Instrumentation for online measurement

Real time continuous measurements can be made by two methods:

- Online
- Inline or In situ

3.3.1 Online Analysers

In most cases online measurements are based on automated laboratory based measurement techniques. The sample is usually injected using rotation valves or peristaltic pumps to the instrument using flow injection analyses (FIA) or sequential flow injection techniques (SFI), via a separate analytical line which is connected to the main process stream. The sample is then extracted, pre-treated if required and presented to the analytical instruments for the analysis required. This system can be either calibrated online automatically, or offline by skilled operator. Online analysers usually require a suitable temperature and pressure, fixed background measurement conditions and frequent calibration to obtain analytically valid results.

3.3.2 In line Analysers

Inline analysers are simpler in design and can measure directly in the process line, using a probe that is chemically insensitive. However they are more susceptible to physical and chemical interference from the sample matrix as measurement backgrounds are more changeable and they usually require ex-situ calibration.

Despite their ability to acquire continuous real time data, their widespread application has been limited due to the inability to reliably obtain accurate, cost effective water quality data.

3.4 Photometric optical sensor

Photometric optical sensors are among the most commonly used measurement principles for online analysers. These methods are based on measuring the interaction of light with the sample and the measurement principle is usually based on Beer – Lambert Law which states about a linear relationship between absorbance and concentration of absorbing species. According to the law:

Absorbance $A = -\log(I/I_0) = \varepsilon * C * L$

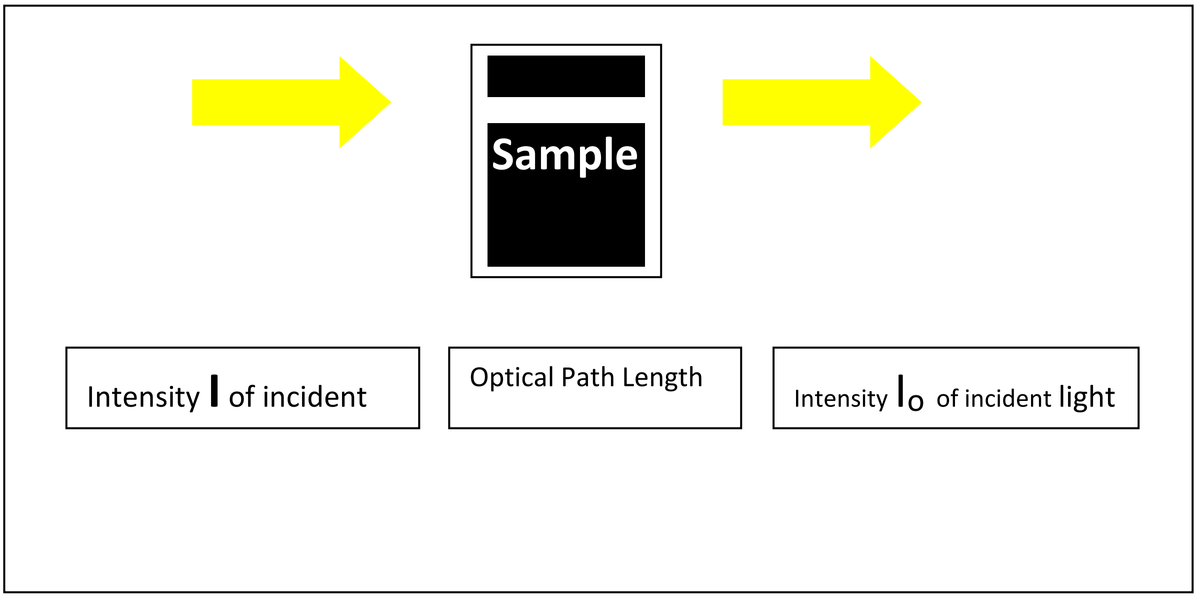
I = Intensity of incident light

I0 = Intensity of transmitted light

ε = Molar absorbtivity (L/mol/cm)

C = Concentration of solution (mol/l)

L = Optical path length (cm)



They are often employed for their simplicity and rapid response. The majority of commercially available photometric sensors fall into main three categories.

1. Colorimetric
2. UV Absorption and
3. UV Visible absorption

Optical sensors, such as non-destructive sensors arrays, have advantage over ISE (ion selective electrodes) for water quality monitoring as in these analysers gross fouling and potential problems or contamination can be detected by colour changes in the sample.

3.5 Ion Selective Electrodes (ISE)

ISEs are commonly employed as online sensors due to their speed and simplicity as well as low maintenance and purchase cost. With careful use, frequent calibration ideal measurement conditions being maintained, they can achieve higher accuracy and precision. Hence, in theory the configuration and embodiment of an ISE makes it an ideal sensing probe for on-site, real time monitoring applications.

Data obtained from online ISE measurements, although continuous, is usually semi-quantitative in nature. This is because the analytical signal of the ISE is known to be affected by matrix interferences, drift, contamination (e.g. by organic molecules), non-linear responses at the lower end of the detection, temperature in the non ideal measurement conditions. These factors in turn cause measurements errors. To improve its reliability, especially in the field, an ISE must be regularly calibrated with standards and samples should be analysed according to prescribed measurement conditions. However, the economic costs associated with calibration especially for instruments that require ex-situ calibration with skilled personnel, have greatly limited its adoption.

3.6 Colorimetric

These are largely based on direct adaptation of APHA standard methods, which use reagents to obtain desired complex ion formation to quantify the concentration at a specific wavelength. They require regular calibration with standard reagents using Beer’s Law to maintain their calibrated online status.

3.7 UV Absorption

The measurement principle is based on specific absorption at a specified wavelength in the UV range. They require conventional calibration according to Beer’s Law and standard reagents. The major application includes determination of parameters like DO and Turbidity.

3.7.1 UV Vis Absorption Spectroscopy

This spectrophotometer records light attenuation in the wavelength region between 200 and 750 nm. The measurement is performed in-situ, without sampling or sample pre-treatment, thus preventing errors due to sampling, sample transport and storage etc. A measurement cycle takes between 20 and 60 seconds, making possible a high measuring frequency and detection of rapid changes. In order to combine this high measurement frequency with high accuracy and sensitivity, the instrument is equipped with a Xenon flash lamp as a light source and a concave holographic grating matched with a 256 pixel diode array as detector. For long-term stability of the signal produced, a split light-beam design is used; one beam passes through the sample while the other travels along a parallel pathway inside the instrument and thus acts as an internal reference beam. This second beam is used to cancel out fluctuations and interferences. These instruments are available for wide range of applications, from ultra pure water (dissolved organics in the µg/lt range) up to concentrated wastewaters (organics and non-dissolved materials in tens of grams /lt range).

The spectra, referred to as fingerprints obtained with such on-line spectrometers are used for the characterization of the sampled water. The fingerprints are used to monitor changes in the water composition through analysis of the general shape of the spectrum or absorption at a specific wavelength. Furthermore, they are also used to derive more specific parameters, such as turbidity, TSS, Color, nitrate, concentration and sum parameters such as COD (chemical oxygen demand), BOD (biochemical oxygen demand) & TOC (total organic carbon) and (dissolved organic carbon) DOC in water analysis.

Turbidity, due to suspended substances, causes light scattering and shading, thus influencing the absorption over the entire fingerprint. This is an important factor that influences in situ measurements and requires compensation in order to obtain reliable and reproducible readings. Furthermore, it is also used to estimate the concentration of single (groups of) substances, such as benzene, phenol, xylene and toluene. The wavelengths used for determining all these parameters have been selected using various analysis. The use of such multi-wavelength algorithms allows higher specificity than can be achieved with conventional single, dual wavelength, Eight wavelengths etc. in UV range photometry.

The methods usually employ patterns recognition techniques (PRT) to quantify the absorption profile and convert it to an equivalent concentration for the particular water quality parameter of interest. Usually these methods do not require sample pre treatment or daily calibration at the monitoring site of interest. They are employed mainly because samples can be analysed with very little or no sample preparation, no chemicals are required, and they have low operational costs. Such methods have been developed for monitoring Chemical Oxygen Demand (COD), Total Organic Carbos (TOC), Biochemical Oxygen Demand (BOD) and Nitrate.

3.8 Total Organic Carbon (TOC) Methodology

The organic carbon in water and wastewater is composed of a variety of organic compounds in various oxidation states. Some of these carbon compounds can be oxidized further by biological or chemical processes, and the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) may be used to characterise these fractions. The presence of organic carbon that does not respond to either the BOD or COD test makes them unsuitable for the measurement of total organic carbon. Total organic carbon (TOC) is a more convenient and direct expression of total organic content than either BOD or COD, but does not provide the same kind of information. If a repeatable empirical relationship is established between TOC and BOD or COD, then TOC can be used to estimate the accompanying BOD or COD. This relationship must be established independently for each set of matrix conditions, such as various points in a treatment process. Unlike BOD or COD, TOC is independent of the oxidation state of the organic matter and does not measure other organically bound elements, such as nitrogen and hydrogen, and inorganics that can contribute to the oxygen demand measured by BOD and COD. TOC measurement does not replace BOD and COD testing.

3.8.1 TOC Analyser Configuration

Conductivity and Non dispersive infrared (NDIR) are the two common detection methods used in modern TOC analysers.

3.8.2 Conductivity based TOC analysers

Direct conductivity provides an all encompassing approach of measuring CO_2. This detection method uses no carrier gas, is good at the parts per billion (ppb) ranges, but has a very limited analytical range.

Membrane conductivity relies upon the filtering of the CO_2 prior to measuring it with a conductivity cell. Both methods analyse sample conductivity before and after oxidization, attributing this differential measurement to the TOC of the sample.

Conductivity analysis assumes that only CO_2 is present within the solution. As long as this holds true, then the TOC calculation by this differential measurement is valid.

3.8.3 Non Dispersive Infrared (NDIR) TOC Analysers

The principal advantage of using NDIR is that it directly and specifically measures the CO_2 generated by oxidation of the organic carbon in the oxidation reactor, rather than relying on a measurement of a secondary, corrected effect, such as used in conductivity measurements.

Merits

- The low temperature techniques have the advantage of allowing a large volume of sample to be analysed thereby improving the low limit of detection.
- Also the blank value is very low as long as the reagents are pure, which makes the analysis more accurate

Limitations

- Usually the particulates are more difficult to oxidise by nature or organics escape exposure to the reagents by being within the interstitial spaces of the particles.
- High molecular weight compounds such as proteins may be slow to oxidise with the low temperature techniques.

3.8.4 Combustion Technique

The combustion technique uses heat at 680^{o}C or higher temperature in a stream of air, oxygen or nitrogen and usually in presence of a catalyst. Dissolved organics and particulate organics are expected to oxidise fully to carbon dioxide under these conditions. The catalysts vary from cupric oxide, cobalt oxide or platinum on an alumina support.

Analysis range

The range of TOC measurement varies with oxidation method and detection technique. A combustion/TOD method may measure upto 100% carbon in a sample, whereas the NDIR and conductivity detectors vary in range from as low as 0.5ppb to 25,000 ppm.

3.9 Limitations of On-Line Analysers

In spite of the inherent advantages of on-line sensors/monitors, their wide application is still limited due to the following reasons :

- On-line monitoring suffers from more problems than laboratory-based methods because to date, the majority of on-line monitoring technologies developed are direct adaptations of traditional, laboratory-based analytical methods which were not originally designed for field applications.

Instead they are required to operate in extreme and variable measurement environments. Consequently, these methods require frequent calibration and maintenance.

- In addition the analysers are often influenced from cross responses due to matrix variations between the standards and samples analysed, as the measurement conditions are not controlled.
- Changes in sample matrix affect on-line analysers making it difficult to obtain continuous, reliable measurement in the field.
- There are also significant economic and logistic costs associated with maintaining remote equipment, as it is difficult for operators to detect problems such as sensor fouling.
- The problems associated with conventional on-line analysers are due to the fact that univariate linear calibraton models derived from Gauss's theory of least squares are employed to determine unknown concentrations. Therefore, the samples and standards must be measured with equal care, under the same measurement conditions, to obtain reproducible and accurate results. Since such consistent measurement conditions are rarely present in the field this affects the operating conditions required for reliable performance and causes a high degree of unreliability in the results from online instrumentation.
- Due to this reason the users/regulatory authorities need to frequently validate their online results with laboratory based methods.
- The cost associated with maintenance of these conventional instruments has also greatly limited their wide spread application.

  NOTE : The industry must take full preview of available technologies while product selection and above referred limitations have to be curtailed.

3.10 System available

The pH is monitored using electrochemical sensors. High Turbidity interferes in pH measurements besides the values are also impacted by variation in temperature.

The total suspended solids in the effluent are measured using various techniques including scattered light method, UV visible absorption, comparative techniques like Nephelometric, etc.

The standards for industrial discharges as notified in the EP(Act) 1986 and the water Act 1974 specify BOD and COD as the controlling parameter besides other specific parameters. Limited instrumentation for direct monitoring of these parameters i.e. BOD & COD on real time basis is available. The methods available require intensive infrastructure, besides using chemicals in the process which are released/discharged and can be a likely source of pollution. Besides the measurement is in batches, as it may take upto 02 hours to analyze one sample depending upon the concentration.

These are indirect methods available for estimating BOD & COD. The 02 methods most commonly used for estimating BOD & COD in water and waste water samples are:

1) Deriving from TOC values and
2) Using UV Absorption spectrophotometry

In India TOC is not specified as a control parameter to industries or CETPs/STPs, therefore the values of BOD & COD has to be interpolated from TOC values.

In the first method TOC is measured and based on the laboratory validation as regards to the observed ratio of TOC:BOD & TOC:COD a correlation factor is established. The method of TOC measurement is approved. In the field TOC is monitored online using any of the approved principles i.e. persulfate or heated persulfate oxidation method, high temperature combustion method and assessment made through NDIR technique. Based on repeatable empirical relationship established between TOC, BOD or COD for a specific waste water source accompanying BOD or COD can be estimated from the recorded TOC values. This relationship between TOC:BOD & TOC:COD must be established for each set of matrix condition. Any change in waste water matrix impacts correlation between these pollutants and hence necessitates regular validation of the relationship between these pollutants.

Considering the need of skilled manpower, the requirement of gases and other peripheral requirements beside high O&M cost for operating TOC Analysers, need of an alternative method was felt.

The other method developed and deployed as a surrogate method is based on UV-Visible Spectrophotometry. This UV-Vis spectral absorbance technology has been found to be less labour intensive in comparison. The trade offs in the ability to compensate for the various interferences should be taken into consideration. Some Instrument Suppliers have incorporated features in their system to compensate for the interferences to improve their data quality.

Some of the systems based on UV-Vis spectrophotometry use a single wavelength (i.e 254nm) or few wavelength bands to estimateCOD/BOD values . These system have measurement limitations.. The method is suitable for fairly stable water matrix. Turbidity interferes in the measurements of COD and BOD. The measure is an indirect method as absorbance at specified wavelength is measured and correlated with COD & BOD.

Some other systems based on UV Visisible Spectrometry use the full spectrum involving measurement of organics over the entire spectrum starting from 200 nm to 750 nm with adaptive ranging capabilities. The system takes care of single bond organics also. Any change in matrix needs recalibration of the system to assess the factor for determination of COD & BOD. Preferred tools such as multi-wavelength dual beam scanning in UV-Visible range with library of industrial matrices in analyser with multi-point local adaptive calibrations help to have matrix change adaption seems better for analyser. The measured values are determined from the spectral data ._The calculation is based on methods and characteristics that were achieved from a multitude of measurement and long time analysis and the observation from UV spectra. Thus, correlations vary with the change in waste matrix and these characteristics need to be frequently established in the beginning for better data quality vis-à-vis the actual values monitoring using laboratory technique. Any change in the waste matrix requires revalidation of the characteristics.

Some manufacturers have developed COD Analyser working on the same principle as the Laboratory technique for monitoring of COD. Many other technologies using direct/indirect methods have been introduced for monitoring of BOD & COD.

Based on the discussion held with the instrument manufacturers/their Indian counterparts and the information available in CPCB, list of various technologies available for monitoring of the pollutants as specified in the directions given by CPCB under Section 18(1) (b) of the Water & Air Acts has been compiled and detailed in the table below:

TABLE-1: TECHNOLOGIES AVAILABLE

Available Technologies	Parameters Measured	Applications

UV Spectrophotometry (Single/two/four wavelengths)	**COD, BOD**	**Fresh Water & Waste Water analysis with constant matrix in water source**
UV-Vis Spectrophotometry 40 wavelength	**COD, BOD, TSS**	**Fresh Water & Waste Water analysis with Constant matrix in water source**
UV-Visible Spectrophotometry (Single Beam)	**COD, BOD, TSS**	**Fresh Water & Waste Water analysis without interference check and compensation**
UV-Vis Spectrophotometry (Double beam with entire spectrum scanning)	**COD, BOD, TSS**	**Fresh water to Waste water analysis Interference check for color and turbidity and compensation.**
Combines Combustion Catalytic Oxidation at 680°C and NDIR Method	**TOC (Co-relation with BOD & COD)**	**Fresh Water and Waste Water analysis**
UV Persulfate NDIR Detector	**TOC (Co-relation with BOD & COD)**	**Fresh Water & Waste Water analysis**
Persulfate Oxidation at 116-130degC NDIR Detector	**TOC (Co-relation with BOD & COD)**	**Fresh Water & Waste Water analysis**
Measuring COD using Potassium dichromate($K_2Cr_2O_7$) + Calorimetric	**COD**	**Fresh Water & Waste Water analysis**
Electrode /Electrochemical method	**pH**	**Fresh water & Waste Water analysis**
Scattered Light Method (IR)	**TSS**	**Fresh water & Waste Water analysis**
Nephelometry Method	**TSS**	**Fresh Water & Less turbid water analysis**
Colorimetric (645-655nm)	**NH3**	**Process stream & Waste Water analysis. Turbidity interference is there which can be overcome**
Ion Selective Electrode method With temp correction	**NH3**	**Process stream & Waste Water analysis. Turbidity interference is there which can be overcome.**
UV Absorbance or Multiple Wavelength UV Absorbance Spectrophotometers (200-450nm)	**NH3**	**Process stream & Waste Water analysis. Turbidity interference is there which can be overcome.**
Colorimetric method Reaction of Cr-VI with diphenyl carbazide in acid solution	**Chromium**	**Fresh Water & Waste Water analysis.**
Voltammetry (Anodic Stripping Voltammetry)	**Chromium**	**Fresh Water analysis.**

Dual Beam UV-Visible Spectrophotometry	**Chromium Hexavalent and Trivalent**	**Fresh water & waste water analysis.**
Voltammetry (Anodic Stripping Voltammetry)	**Arsenic**	**Fresh Water analysis.**

3.11 Assessment of technology

The various Monitoring Technologies presented or informed by the Instrument Manufacturers/their Indian counterpart were recorded and based on the information available efforts made to assess the suitability of the technologies/instrumentations for monitoring the effluent quality in different matrices , keeping into considerations the limitations of the technologies, the varying Indian environmental conditions and also the chemical attributes in the effluent channels of the industries or the water bodies. Issues related to the use of reagents, maintenance required, operating costs, etc., wherever available were also considered. Table 2 compiled based on the information provided by vendors/ Indian counterpart , indicates the suitability of the available technologies/ instrumentation for monitoring different pollutants in varying matrices.

TABLE 2: SUITABILITY OF TECHNOLOGIES FOR DIFFERENT MATRICES

Available Technologies	Parameters Measured	Applications	Limitations
UV Spectrophotometry (Single /two /four wavelengths)	**COD, BOD**	**Fresh Water analysis with constant matrix**	**Suitable for fresh water and not for waste water analysis. Interference of colour & high turbidity. Suitable for stable matrix. Single bond organic compounds are not measured.**
UV-Vis Spectrophotometry 40 wavelength	**COD, BOD, TSS**	**Fresh Water & Waste Water analysis with constant matrix**	**Many organic compounds are unattended due to lesser scanning of UV spectra. Suitable for stable matrix. Any matrix change would require revalidation of factor. Sample pumping limitation.**
UV-Visible Spectrophotometry (Single Beam)	**COD, BOD, TSS**	**Fresh Water & Waste Water analysis.**	**Interference due to colour & high turbidity affects the analysis. Reference beam compensation not available. Suitable for stable matrix. Any matrix change would require revalidation of factor.**

UV-Vis Spectrophotometry (Double beam with entire spectrum scanning)	**COD, BOD, TSS**	**Fresh water to Waste water analysis.**	**Interference of colour & turbidity is compensated in visible spectrum.** **Any matrix change would require revalidation of factor.**
Combines Combustion Catalytic Oxidation at 680°C and NDIR Method	**TOC (Co-relation with BOD & COD)**	**Fresh Water and Waste Water analysis.**	**-Carrier gases required** **-Continuous High power requirement** **-For Analyser: Infrastructure is required** **-More than 10-15 minutes sampling frequency.** **-Only TOC can be measured.** **-Any matrix change requires fresh correlation to COD & BOD**
UV Persulfate NDIR Detector	**TOC (Co-relation with BOD & COD)**	**Fresh Water & Waste Water analysis.**	**- Carrier gases required** **- Continuous High power requirement** **-Analyser: Infrastructure required.** **-More than 10-15 minutes sampling frequency.** **-Only TOC can be measured.** **Any matrix change requires fresh correlation to COD & BOD.**
Persulfate Oxidation at 116-130degC NDIR Detector	**TOC (Co-relation with BOD & COD)**	**Fresh Water & Waste Water analysis.**	**Applicable for moderate polluted effluent.** **-Carrier gases required** **-Analyser: Infrastructure required** **Any matrix change requires fresh correlation to COD & BOD**
Measuring COD using Potassium dichromate($K_2Cr_2O_7$) + Calorimetric	**COD**	**Fresh Water & Waste Water analysis.**	**Discharge of hazardous chemicals.**
Electrode /Electrochemical method	**pH**	**Fresh water & Waste Water analysis.**	**--Electrode life**
Scattered Light Method (IR)	**TSS**	**Fresh water & Waste Water analysis.**	**---**
Nephelometry Method	**TSS**	**Fresh Water & Less turbid water**	**Fresh Water analysis with Low turbidity**
Colorimetric (645-655nm)	**NH3**	**Fresh Water & Waste Water analysis.**	**Turbidity interference is there which can be overcome.**

			3-15 min cycle time
Ion Selective Electrode method With temp correction	**NH3**	**Fresh Water & Waste Water analysis.**	**Interference from Potassium.** **Requires additional measurement of potassium for compensation.**
UV Absorbance or Multiple Wavelength UV Absorbance Spectrophotometers (200-450nm)	**NH3**	**Fresh Water & Waste Water analysis.**	**Turbidity interference is there which can be overcome.**
Colorimetric method Reaction of Cr-VI with diphenyl carbazide in acid solution	**Chromium**	**Fresh Water & Waste Water analysis.**	**Experience in Indian condition is not available.**
Voltammetry (Anodic Stripping Voltammetry)	**Chromium**	**Fresh Water analysis.**	**Experience in Indian condition is not available**
Dual Beam UV-Visible Spectrophotometry	**Chromium Hexavalent and Trivalent in full spectrum**	**Fresh water & waste water analysis.**	**Experience in Indian condition is not available**
Voltammetry (Anodic Stripping Voltammetry)	**Arsenic**	**Fresh Water analysis.**	**Experience in Indian condition is not available**

3.12 Issues with real time monitoring systems

The initial Indian experience of real time monitoring systems has not been very satisfactory. In most of the cases the data obtained is either not reliable or is non- existent, since the systems are neither operated nor maintained properly. The operation of real time system needs dedication and initiation, both from both the Industry as well as the instrument supplier. It has been observed that due priority is not given by the industry to operation of real time monitoring system and at the same time the necessary support from the vendors is also not forthcoming. Effective operation of the real time systems requires appointment of a dedicated person by the industry with responsibility to maintain and operate the system by the Industry and the instrument supplier also considers its responsibility to ensure trouble free operation of the system. It is therefore essential that the responsibility of both the industry as well as the vendor needs to be clearly specified.

4.0 Site selection

For online RT EQMS, the location of the sensors is important and submersible In-situ sensors as preferred option. If site does not permit then system with flow cell or extraction may be opted, even though this would have been expected given the issues with sample conditioning which may affect the measurement accuracy sometimes with a significant degree of variability.

The discharge point from ETP has to be selected to fix the insitu sensors or pump to extract the sample for cabinet system. The insitu installation are preferred where sensor can be fixed directly in the treated effluent channel.

4.1 Quantification

Instrument Calibration: The following frequency has to be used for calibration of analyser

- pH – once every week or as specified by manufacturer whichever is earlier
- COD – once every week or as specified by manufacturer whichever is earlier
- BOD – once every week or as specified by manufacturer whichever is earlier
- TSS – once every week or as specified by manufacturer whichever is earlier
- TOC – once every week or as specified by manufacturer whichever is earlier
- Temperature – once every month or as specified by manufacturer whichever is earlier

The software must keep all calibration data points in memory for interpretation of matrix change adaption.

4.2 System Validation

Online instrument operation will be evaluated using the known buffers, traceable standards and laboratory techniques. By validating sensors and probes with known standards such as KHP (potassium hydrogen phthalate) for COD & TOC, Formazin equivalent standard for TSS & pH buffers have to be used to calculate a running variance of the measurements. When the variance is outside of the set points, this can be an indication the monitor requires calibration and service.

4.3 Parameter validation

Each parameter is validated with reference to standard laboratory analysis and known standards.

Parameter Accuracy: Allowed Variability

The relative difference between online and laboratory measurements has to be between

- COD Accuracy ± 10%
- BOD Accuracy ±10%.
- pH Accuracy ±0.2 pH
- TSS Accuracy +/- 10%

4.4 Operation & maintenance

- Daily Check – GPS Transmission, System Diagnostic alarms.
- Monthly Check – Sensors & system cleaning, data backup, Parameter Calibration as specified in calibration schedule.
- Periodic Check – System validation with known standards, Laboratory & Online parameters Comparative.

5.0 Reporting

The RT EQMS suppliers have to provide central server at CPCB and SPCB with latest software to view the data in graphical/ tabular format and also to compare the data features. One minute data average must be transmitted/retrieved to servers every 30 minutes. In the event of transmission loss the time stamped data in the datalogger memory must be transmitted to fill from the last transmission break with a stamp of time delay. The software should have two way communication, so that data from the system can be seen whenever desired and remote of controller/data logger can be taken to visualize the immediate status of the system.

5.1 Data Management

Considering the heterogeneity of real time monitoring systems industries are required to submit real time data through their respective instrument suppliers. This mechanism has helped in consolidating the data avoiding the complexity of different technologies and availability of monitored data in different data formats and at the same time involving the instrument suppliers in data transferring mechanism. The system enables two way communication required to manage such real time systems.

The basic functional capabilities of such software systems shall include:-

- The system should be capable of collecting data on real time basis without any human intervention.
- The data generation, data pick up, data transmission; data integration at server end should be automatic.
- The submitted data shall be available to the Boards, SPCBs/PCCs and CPCB for immediate corrective action.
- Raw data should be transmitted simultaneously to SPCBs /PCCs and CPCB.
- In case of delay in collection of data due to any reason, the data transmission should be marked delayed data and reports of delayed data should by displayed on the portal
- At no point of time, manual data handling should be permitted. Data validation should be permitted only through the administrator and data changes recorded with date and time stampings.
- Configurations of the systems once set up (through remote procedure) and verified, should not be changed. In case any setting change is required it should be notified and recorded through the authorized representatives only.
- The data submitted electronically shall be available to the data generator through internet, so that corrective action if any required due to submission of erroneous data can be initiated by the industry.
- The software should be capable to verify the data correctness which means at any given point of time the regulatory authorities/data generator should be able to visualize the current data of any location’s specific parameter.

- A system for data validation shall be incorporated in the software with two stage/three stage validation and fixed responsibilities of stakeholders as below;
  a. **Data Generator**:
  b. **SPCBs/PCCs**:
  c. **CPCB**:

  CPCB will help in data validation till such time, adequate expertise for data validation is developed in the SPCBs/PCCs,)

- Change Request Management: window for requesting data changes due to actual field conditions shall be provided to the industry in line to SPCB to consider the request or not.
- The site surrounding environmental conditions shall also be recorded along with other environmental parameters, as these have the potential to affect the system adversely and corrupt the data generated.
- System should have capability to depict data at the actual location of industry over the map. CPCB and or SPCBs shall develop a map based system for data integration at a single location.
- The software should be capable of analyzing the data with statistical tools and shall have the following capabilities:
  i) Statistical data analysis (customizable) for average, min., max., diurnal variation.
  ii) Comparison of parameters of different locations in user selectable time formats i.e. in graphical and tabular formats compatible to MS Excel, MS Word, *.txt etc.
  iii) Capability of comparison of data with respect to standards/threshold values.
  iv) Auto report and , auto mail generation etc.
  v) Providing calibration database for further validation/correction of data.
  vi) Transmitting data to different locations as per EC,CTE/CTO, and other directives in force.
  vii) Channel configuration for range, units etc.
  viii) Providing data in export format on continuous basis through central/station computer system to other system.
- Data transmission through different media like GPS, CDMA, Normal phone line, Datacards, Broadband, 3G etc. (at least any two media supported).
- Data Storage for next five years.
- System should be connected to a backup power source with adequate capacity to avoid any power disruption

Considering the large volume of data required to be collated, compiled, processed and interpreted a software system will be developed in future at CPCB in consultation with all SPCBs/PCCs exploring common data format to collect data from different servers to a common server.

6.0 **Available monitoring matrices Sector specific**

Considering the technological limitations and issues related to installation, data management and operation of real time systems efforts have been made to prepare a compilation of technologies (Table-3) that can be considered by industries for installation. Table 3.0 also provides approximate cost of installing such systems and communicating data to SPCBs/PCCs & CPCB on real time basis.

TABLE-3: DETAILS OF PARAMETERS AND FEASIBLE TECHNOLOGIES REQUIRED TO BE INSTALLED FOR REAL TIME CONTINUOUS EFFLUENT MONITORING SYSTEMS IN DIFFERENT CATEGORIES OF INDUSTRIES IN INDIA.

Category No.	Category Name	Parameter to be monitored	Available Technologies	Number of Vendors	Approx. Cost in Rs. Lakhs	Remarks
1	Aluminium	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
2	Cement	Nil	--	--	--	No real time monitoring required for Effluent.
3	Distillery	1. pH	1. Electrode Method	>10	0.75	

		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	In case of unit has achieved ZLD condition 1 & 2 of the notes after the table shall have to be complied.
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
4	Dye and dye intermediate	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method(TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	

			3. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Cr	1. Colorimetric method	>3	12.00	Cr – Process Specific Experience in Indian conditions is not available.
			2. UV-Vis Spectroscopy (Entire spectrum scanning)	>4	10.00	
		3. Flow	1. Magnetic /Ultrasonic	>4	0.75	
5	Chlor Alkali	1. pH	1. Electrode method	>10	0.75	
		2. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectrophotometry (Single Wavelength)	>4	3.00	
6	Fertilizers Urea Plant	1. pH	1. Electrode Method	>10	0.75	
		2. Ammonical Nitrogen	Ion Selective Electrode method With temp correction	>	3.00	
			UV Vis Spectrophotometers (Entire spectrum scanning)	>4	3.00	
		3. Flow	1. Magnetic /Ultrasonic	>4	0.75	
	Fertilizers (DAP)	1. pH	1. Electrode Method	>10	0.75	
		2. Flow	1. Magnetic /Ultrasonic	>4	0.75	
	Fertilizers	1. pH	1. Electrode Method	>10	0.75	

	(Phospheric acid & SSP)	2. Fluoride	-	-	-	Fluoride -Since reliable real time monitoring systems are not available, manual monitoring system as practised shall be continued
		3. Flow			0.75	
7	Iron Et steel	1. pH	Electrode method	>10	0.75	Cynide & Phenol -Since reliable real time monitoring systems are not available, manual monitoring system as practised shall be continued
		2. Phenol	-	-	-	
		3. Cynide	-	-	-	
		4. Flow	1. Magnetic /Ultrasonic	>4	0.75	
8	Oil refinery	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	

			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
9	Petro-chemicals	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
10	Pesticides	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	

			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		6. Chromium	1. Colorimetric method	>3	12.00	Chromium&Arsenic– Experience in Indian conditions is not available.
			2. UV-Vis Spectroscopy (Entire spectrum scanning)	>4	10.00	
		5. Arsenic	1. Voltammetry	>2	20.00	
		6. Flow	1. Magnetic /Ultrasonic	>4	0.75	
11	Pharmaceuticals	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Chromium	2. Colorimetric method	>3	12.00	

			2. UV-Vis Spectroscopy (Entire spectrum scanning)	>4	10.00	Chromium&Arsenic– Experience in Indian Conditions is not available.
		6. Arsenic	1. Voltammetry	>2	20.00	
		7.	1. Magnetic /Ultrasonic	>4	0.75	
12	Power Plants	1. pH	1. Electrode Method	>10	0.75	
		2. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		3. Tempe-rature	1. Electrode Methods	>10	0.75	
13	Pulp & Paper	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. AOx	1. UV-Vis Spectrophotometry	>1	20.00	AOx – Process Specific. Some vendors claim that AOx can be monitored on real time basis. But there is no experience in Indian conditions.

		5. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		6. Flow	1. Magnetic /Ultrasonic	>4	0.75	
14	Sugar	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
15	Tannery	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	

			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Cr	1. Colorimetric method	>3	12.00	Cr – Process Specific Experience in Indian conditions is not available.
			2. UV-Vis Spectroscopy (Entire spectrum scanning)	>4	10.00	
		6. Flow	1. Magnetic /Ultrasonic	>4	0.75	
16	Zinc	1. pH	1. Electrode Method	>10	0.75	
		2. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		3. Flow			0.75	
17	Copper	1. pH	1. Electrode Method	>10	0.75	
		2. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		3. Flow	1. Magnetic /Ultrasonic	>4	0.75	
18	Textile and Bleaching (GPI)	1. pH	1. Electrode Method	>10	0.75	
		2. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	12.00 (COD+TSS) +Controller & DAS & Data Transmission	

			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	24.00 (COD) +Controller & DAS & Data Transmission	
		3. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		4. Flow	1. Magnetic /Ultrasonic	>4	0.75	
19	Dairy (GPI)	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
20	Slaughter House (GPI)	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	

			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	
21	Other Engineering units like Electroplating	1. pH	1. Electrode Method	>10	0.75	
		2. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	12.00 (COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	24.00 (COD) +Controller & DAS & Data Transmission	
		3. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		Ni	1. Voltametery	>1	20.00	Ni, Cr – Process Specific Experience in Indian conditions is not available.
		Cr	1. Colorimetric method	>3	12.00	
			2. UV-Vis Spectroscopy (Entire spectrum scanning)	>4	10.00	
		3. Flow	1. Magnetic /Ultrasonic	>4	0.75	

22	Other units of Soft Drinks and Food	1. pH	1. Electrode Method	>10	0.75	
		2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission	
		3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD	
			2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD	
		4. TSS	1. Scattered light IR Method	>4	3.00	
			2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00	
		5. Flow	1. Magnetic /Ultrasonic	>4	0.75	

Notes:-

1. Industries claiming Zero discharge and not discharging effluent outside the premises will have to install Camera and flow meter in the channel / drain provided for carrying the effluent from within the industry premises.
2. For industries achieving Zero Liquid Discharge by utilizing effluent for irrigation/gardening will have to install Real time monitoring systems.
3. In case of parameters specified in Consent to Operate/Environmental Clearance and where real time monitoring technology is not well established, the parameters will be analysed using established laboratory methods atleast once in three months or as per the frequency specified in Consent to Operate/EC whichever is more.
4. The table/matrix will be updated in April, 2015, incorporating any new technology/instrumentation.

7.0 Observations

Online analyzers are a better tool to extend in-time information on compliance of ETP and CETP to the prescribed norms to regulator. The real time measurement for important parameters will give detail information continuously which laboratory instruments fail to give as random once in a month or quarter information is too less to understand discharge compliance.

8.0 Conclusions

1. The industries falling in 17 category of highly polluting industries, the grossly polluting industries discharging directly/indirectly into river Ganga or its tributaries, Common Effluent Treatment Plants (CETP) and Sewage Treatment Plants (STPs), Common Bio Medical waste and Common Hazardous waste incinerators have to install real time effluent quality monitoring system. The installation of the system should be completed by March 31,2015.
2. The parameter i.e. Flow, pH, TSS, COD, BOD, and Ammonia will be monitored by installing Real Time Monitoring Systems. Other parameters specified in the consent to operate/Environmental Clearance will be monitored on quarterly basis using the established laboratory methods.
3. In case of industries having adopted Zero Liquid Discharge (ZLD) the units shall install IP camera with PAN, TILT Zoom, 5x or above focal length, with night vision capability and flow meters in the channel/drain provided for carrying the effluent from within the premises of the unit.
4. The industries meeting ZLD norms by utilizing the treated effluent for irrigation shall install real time monitoring system at the outlet of ETP, to monitor the quality of treated effluent.
5. As the data from real time systems is monitored at very short duration, regular fluctuation will be observed 10% exceedence of values over the prescribed norm shall not be considered for action presently. In case of regular noncompliance by the units the existing method of sampling, analysis and related procedure under the existing norms need to be continued for regulatory purpose and for purpose of actions against the unit.
6. The software will give alarm, in case of the concentration of parameter exceeds the prescribed norms by 10% continuously.
7. The responsibility of data submission lies with the Individual units. The instrument supplier will facilitate data transmission on behalf of industries. Industry will ensure at least 85% data availability from the system installed.
8. The vendors/instrument supplier shall install their server in SPCB/PCCs and CPCB for transferring data from the real time system.
9. CPCB in consultation with SPCBs/PCCs shall explore the possibility to identify a common protocol, so that the data from the real time systems can be transferred directly to the server installed by SPCBs/PCCs and CPCB in a compatible form.
10. The vendor/instrument supplier shall make provisions to provide data continuously at least 04 locations in SPCBs/PCCs, RO/DO of CPCB, and industry directly from the analyzers.
11. In case of system requiring pumping of samples, the instrument supplier/vendors has to ensure that dilution of sample is not possible and in case of any dilution, the system gives alarm.
12. The SPCBs/PCCs will identify a team of officials for plausibility control of data received. The team members will be responsible for validating, interpreting and interpolation of data on daily basis.
13. The vendor /instrument supplier will regularly cross check the data obtained from real time system with that of the samples collected manually and analyzed using approved laboratory

techniques and revalidate the factor for interpolation/extrapolation of COD/BOD values essential for generating better quality data. The industry will take responsibility of establishing co-relation factor.

14. The industries shall ensure that the monitoring systems are covered under Comprehensive Maintenance Contract with the vendors/ authorized Indian service partners of the instrument manufacturer for atleast during the next 05 years after the installation.
15. The authorized Indian service partner/instrument manufacturer shall ensure that any problem in monitoring system/data acquisition and transfer system does not persist beyond 72 hours.
16. The vendors/instrument manufacturers shall ensure availability of spare parts for at least 07 years after installation of the system.
17. The industry should take Bank Guaranty (BG) equivalent to 25% of the cost of the Real Time Monitoring Systems from the manufacturer of the system or its authorised Indian counterpart. The BG is taken to ensure optimal performance of the system including 85% data captive rates, providing reliable & accurate data.
18. As nearly all the RTEQMS are manufactured abroad, the Indian Bidder has to provide copy of the authorization from the original instrument manufacturer for bidding on his behalf
19. Role of manufacturers/supplier authorised Indian Service Partner:
    - Supply and install equipment suitable to monitor the effluent quality in the available matrix
    - Supply all the supporting equipment, analysers and software
    - Supply equipment/instruments capable of monitoring/measuring the parameters identified in the range of occurrence in the industrial unit
    - Supplied software should establish two way communication sending diagnostics of instruments on demand, with central servers at SPCBs/PCCs and CPCB
    - The software should be capable of transmitting the data along with diagnostics of the instrument

Note : Efforts have been made to include all available monitoring technologies /instrumentation in the document. In case any technology /instrumentation is not covered or is introduced subsequently the details be forwarded to CPCB, so that the same can be incorporated while reviewing this document after a few months.