SOLUTION TO POLLUTION

A brief about online monitoring system

By Ajit Joshi & Amol Malode
WHY IS REAL TIME MONITORING SYSTEM REQUIRED?

- Self Monitoring mechanism within the industries
- Increased management responsibility for regulatory compliance
- Increased cost-effectiveness
- Fast corrective action
- Improved control over impacts on the environment
- Higher environmental awareness
- Increased public access to information (public
Understanding a Typical waste water plant

Influent Screening

Primary clarification

Aeration

Secondary clarification

Blending

Thickening

Digestion

Flocculation

Dewatering

Odour Control

Dirty air inlet

Treated air outlet

Make-up water

Acid

Bleach

Caustic soda

Thiosulfate

Final effluent

Disinfection

Filter backwash

Filtration

NITRIFICATION

DENITRIFICATION

DEPHOSPHATATION

NO₂, NH₃, NO₃, NH₄, MEOH, PO₄

pH, NO₃, PO₄

REDOX

TOC

pH + Temp.

Cl₂

NH₄, NO₃, PO₄, pH
- First CPCB directives released on Feb, 214 with 31st March 2015 target date.
- Pollution control in 17 types of highly polluting industries and sugar is one of them.
- Self monitoring of compliance.
- Need to inculcate habit of self monitoring mechanism within the industries for complying the prescribed standards.
- The ground trothing of the values indicated by the online devices need to be done before bringing them in public domain for proper interpretation.
- To connect and upload the online emission and effluent monitoring data at SPCBs/PCCs and CPCB server in a time bound manner.
- Temper proof mechanism having facilities for online calibration.
- Detailed guidelines for ETP & RMS provided on 7th Nov, 2014.
- Specified suitable Techniques & Technologies for ETP monitoring.
Monitoring Systems operated by Industries

**Air Pollution Monitoring System**
- Emission Monitoring Systems
- Ambient Air Quality Monitoring Systems

**Water Pollution Monitoring System**
- Effluent Monitoring Systems
**List of Parameters for in line monitoring**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Category</th>
<th>ETP Parameters</th>
<th>Emission Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminium</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, Fluoride</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>-</td>
<td>PM, NOx, SO2</td>
</tr>
<tr>
<td>3</td>
<td>Distillery</td>
<td>COD, BOD, TSS, pH</td>
<td>PM</td>
</tr>
<tr>
<td>4</td>
<td>Dye &amp; Dye intermediate</td>
<td>COD, BOD, TSS, pH</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Chlor Alkali</td>
<td>COD, BOD, TSS, pH</td>
<td>Cl2, HCL</td>
</tr>
<tr>
<td>6</td>
<td>Fertilizers</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, Fluoride, Ammonia</td>
</tr>
<tr>
<td>7</td>
<td>Iron &amp; Steel</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, SO2</td>
</tr>
<tr>
<td>8</td>
<td>Oil &amp; Refinery</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, CO, NOx, SO2</td>
</tr>
<tr>
<td>9</td>
<td>Petrochemical</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, CO, NOx, SO3</td>
</tr>
<tr>
<td>10</td>
<td>Pesticides</td>
<td>COD, BOD, TSS, pH</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Pharmaceuticals</td>
<td>COD, BOD, TSS, pH</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Power Plants</td>
<td>pH, TSS</td>
<td>PM, NOx, SO2</td>
</tr>
<tr>
<td>13</td>
<td>Pulp &amp; Paper</td>
<td>COD, BOD, TSS, pH</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td><strong>Sugar</strong></td>
<td><strong>COD, BOD, TSS, pH</strong></td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Tannery</td>
<td>pH, TSS</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Zinc</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, SO2</td>
</tr>
<tr>
<td>17</td>
<td>Copper</td>
<td>COD, BOD, TSS, pH</td>
<td>PM, SO2</td>
</tr>
</tbody>
</table>
• pH : 6.5 ~ 8.5
• COD : < 250 ppm
• BOD : < 30 ppm
• TSS : < 100 ppm
Measurement Technologies specified by CPCB

- UV VIS Absorption Spectroscopy,
  - Based on Beer-Lambert Law which states about linear relationship between absorbance and concentration of absorbing species.

- TOC Based Methodology
  - Based on combustion, oxidation and IR measurement.
Measurement technologies specified by CPCB

- **UV VIS Absorption Spectroscopy,**
  - Based on Beer-Lambert Law which states about linear relationship between absorbance and concentration of absorbing species.

- **TOC Based Methodology**
  - Based on combustion, oxidation and IR measurement.

**On line Type**

**In line Type**
• **TOC Based Methodology**
  – Based on combustion, oxidation and IR measurement.

On line Type
TOC Based COD/BOD Analysis

TOC measurement technology

SAMPLE CONDITIONING → INORGANIC REMOVAL → OXIDATION → DETECTION

TOTAL CARBON MEASUREMENT

\[ TC = TOC + IC \]
Features:

- The TOC measurement is a Global parameter, measuring all organic species.
- True online Analysis of TOC; COD & BOD are co-related/ derived from TOC.
- Cycle time is 5~7min or more
- Utilities: Two to three reagent & carrier gas (instrument Air/Nitrogen) required.
- Frequent calibration may be required
- Micron level filtration is required.
- TSS and pH has to be separately measured
Measurement technologies specified by CPCB

• UV VIS Absorption Spectroscopy,
  – Based on Beer-Lambert Law which states about linear relationship between absorbance and concentration of absorbing species.

On line Type

In line Type
In accordance with DIN38404-C3 standard and can be considerate as an alternative method referring to AFNOR XPT90-210 standard.
Measurement technologies specified by CPCB

- UV VIS Absorption Spectroscopy,
  - Based on Beer-Lambert Law which states about linear relationship between absorbance and concentration of absorbing species.

On line Type
Principle: UV-Vis Absorption Spectroscopy – On line type

The measuring principle is based on the UV VIS Absorption Spectroscopy.

\[ [C] = k \log \left( \frac{I_{\text{in}}}{I_{\text{out}}} \right) \]

With \([C]\): sample concentration

\(k\) : absorption coefficient (specific to each molecule)

\(I_{\text{in}}\) : light intensity at the input of the sample

\(I_{\text{out}}\) : light intensity at the output of the sample

Turbidity, suspended solids or dirt on the flow cell is automatically compensated by a differential measurement with a second detector at a reference wavelength.

- **COD measurement**: UV Vis Absorption Spectrophotometry type.
- **TSS measurement**: UV Vis Absorption Spectrophotometry type.
- **BOD measurement** Correlation type
- **pH measurement** using combination type pH sensor.
COD/BOD/TSS/pH Analysis

Principle: UV-Vis Absorption Spectroscopy – On line type
On Line Measurement technology
On Line Measurement technology
Features of online type analyzer

- No reagents or consumables.
- Auto Zero during cleaning cycle.
- Quick Response time.
- No Air supply.
- No filtering required.
- Non-Contact type optical system.
- Non metallic wetted parts.
- Compensation for Turbidity and colored samples.
- 10-years lamp life.
- Built-in peristaltic pump.
- Automatic Cleaning facility with freely programmable time period with DM water for cleaning.
• UV VIS Absorption Spectroscopy,
  - Based on Beer-Lambert Law which states about linear relationship between absorbance and concentration of absorbing species.
Principle: UV-Vis Absorption Spectroscopy – In line type

The measuring principle is based on the UV VIS Absorption Spectroscopy.

\[
[C] = k \log \left( \frac{\text{lin}}{\text{lout}} \right) \quad \text{With} \quad [C]: \text{sample concentration}
\]

\[k : \text{absorption coefficient (specific to each molecule)}
\]

\[\text{lin} : \text{light intensity at the input of the sample}
\]

\[\text{lout} : \text{light intensity at the output of the sample}
\]

Turbidity, suspended solids or dirt on the flow cell is automatically compensated by a differential measurement with a second detector at a reference wavelength.

- **COD measurement**: UV Vis Absorption Spectrophotometry type.
- **TSS measurement**: UV Vis Absorption Spectrophotometry type.
- **BOD measurement** Correlation type
- **pH measurement** using combination type pH sensor.
In-situ measurement

using a spectrometer sensor

Continuous measurement

=> fast response time,
suitable for control strategies
In Line Measurement technology (Probe Type)
Features of In line type analyzer

- The sensor measures directly in the process medium.
- No sample transport, no sample preparation necessary.
- No lag-time between sampling and result of the measurement.
- Current values immediately available.
- Compensation of interferences and turbidity based on the spectral information.
- Long operation periods by automatic air cleaning or ultrasonic cleaning for almost maintenance-free.
- Optical system works without consumables with low costs of ownership.
<table>
<thead>
<tr>
<th>UV VIS Absorbance type</th>
<th>TOC based COD/BOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No reagents/ Chemicals.</td>
<td>Costly, hazardous &amp; difficult to handle chemicals.</td>
</tr>
<tr>
<td>Response time : &lt; 1 mins</td>
<td>Response time : 6 -10 mins.</td>
</tr>
<tr>
<td>No regular maintenance.</td>
<td>Regular replacement of parts such as tubes &amp; pumps.</td>
</tr>
<tr>
<td>No air supply/ Nitrogen Supply.</td>
<td>Air or Nitrogen as carrier gas.</td>
</tr>
<tr>
<td>Can handle all type of samples. Non metallic MOC for harsh chemicals &amp; applications</td>
<td>Pre-treatment of sample with high chloride values.</td>
</tr>
<tr>
<td>Effective cleaning of flow cell being Non-contact type sensor</td>
<td>Difficult to achieve appropriate cleaning.</td>
</tr>
<tr>
<td>No filtration.</td>
<td>Needs primary filtration</td>
</tr>
<tr>
<td>Maintenance free analysis</td>
<td>Would require AMC to achieve max. uptime.</td>
</tr>
<tr>
<td>It uses sample quantity of less than 1cc</td>
<td>It uses sample quantity of less than 1cc</td>
</tr>
<tr>
<td>Separate sensor for TSS.</td>
<td></td>
</tr>
</tbody>
</table>
ON line vs In line type measurement

**On-line Type**
- Non Contact type design
- Automatic zero offset correction
- Effective cleaning of flow cell via DM water solution (+5% H2SO4)
- Can handle all type of samples. Non metallic MOC for harsh chemicals & applications
- Turbidity & color compensation to achieve accurate measurement.
- In place calibration facility
- Better cleanability
- Sample need to be fetched to the analyzer
- Time required for the sample to reach the analyzer depending upon the distance of the sampling point and its pressure.

**In-line Type**
- Contact type
- OFF line Zero calibration.
- Cleaning type -Air-Jet/ Ultrasonic
- Difficult to handle dirty and corrosive samples.
- Has aging effect of sensor (light source), cable etc.
- Suitable sensor MOC to be selected
- Flow sensitivity
- Sample temperature limitation
- Direct Measurement via probe
- Additional time not required for sample to travel till the analyzer.
Components of monitoring system

- Recommended Instrumentation/Monitoring Methodology
- Calibration
- Sampling Location
- Empanelment Of Laboratories
- Data Acquisition System
- All the measurement technologies mentioned in the presentation are equally acceptable as per CPCB guidelines.

- The user has to select the best applicable technology as per their own application and needs based on the merits of the proposed system and supplier.

- The user may also verify for the number of satisfactorily working installations of the supplier and the number of year of their experience.
To ensure proper functioning of the instrument/analyser system for generating reliable and accurate data, the specified protocol shall be adopted by the Industry/Instrument Manufacturer/Supplier:

- Effluent Quality Monitoring
EFFLUENT QUALITY MONITORING

FREQUENCY OF CALIBRATION FOR:
- pH, COD, BOD, TSS, TOC – Weekly Basis
- Temperature – Monthly Basis

TARGET ACCURACY:
- COD, BOD, TSS: ± 10%
- pH: ± 0.2

against the standard

VALIDATION OF DATA:
Parameters validated against standard reference laboratories

DATA CAPTURE RATE:
More Than 90%

CALIBRATION FREQUENCY:
- Based on the performance of CEMS / CWMS data suggested frequency of calibration for both A monitoring systems will be reviewed after six months
CALIBRATION

Calibration & Validation of COD:
- Against authorized Lab reading of the sample as per the approved Lab technologies.
- Using Potassium hydrogen Phthalate/KHP (CAS 877-24-7) 851mg to 1L of DI water for 1000ppm COD. You can dilute the same to prepare any standard of lower value (as per APHA standards).

Calibration & Validation of TSS:
- Against Lab reading of the sample as per the approved Lab technologies.
- Kaolinite powder can be used to prepare a standard solution for calibration and verification of total suspended solids. This solution gives better results when kept overnight and stirred continuously. (as per APHA standards).

Calibration & Verification of pH:
- Using standard buffer solution of 4.01/7.00/9.21 pH
The analysers/ instruments/ sensors have to be installed as per the specified sampling criteria so as to have representative sampling of the treated effluent discharges. While collecting samples for verification and comparison of the values recorded by real time monitoring systems i.e. analysers/ instruments/ sensors, representative sampling shall be ensured by the empanelled laboratories.
To ensure a representative sample of the all plant effluent is captured at the analyzer inlet or at the probe installation.

All the sensors/ analyzers for real time monitoring shall be installed in a defined channel, without any turbulence or eddy current.

In case more than one channel joins the common discharge channel, the sampling system shall be installed after proper mixing of the one (or more) streams.
Important check points for regulators

- All optical sensors require frequent cleaning in waste monitoring applications.

- There are several types of cleaning systems commonly used for UV-VIS analyzers:
  - Automatic cleaning
  - Compressed air cleaning
  - Automatic wiper cleaning
  - Automatic brush cleaning
  - Ultrasonic cleaning

- To ensure proper sampling point for Lab/Local analysis and compatible Lab measurement technologies for comparison.

- *Installation of analyzer/ indicator should preferably under a shade for efficient operation of the system.*
Regulator during the visit should validate the sample pickup point or sensor installation location to ensure representative sample.

Repeatability should be considered apart from the accuracy of the system.
Components of monitoring system

Functioning of the system

INDUSTRIES

Existing Systems

New Systems

Delayed Checks

SPCBs/PCCs

Data Transmission

Data Synchronization

Scrutiny

CPCB

Data on Website

Records

1. Continuous Data
2. Validation events
3. Calibration
4. Cross verification issues

WEB

Data available for Policy makers/Public
Zero Liquid Discharge systems employ the most advanced wastewater treatment technologies to purify and recycle virtually all of the wastewater produced, leaving zero discharge at the end of the treatment cycle. The ZLD process involves an advanced wastewater treatment method that includes ultrafiltration, reverse osmosis, evaporation/crystallization, and fractional electrode ionization.

Need for Metering and Monitoring in ZLD Plants

Every industry claiming zero discharge has to follow strict norms and is prohibited from discharging any liquid waste originating from its facilities. To meet the necessary regulations, for difficult to treat wastewaters, or in situations where scarcity of water demands water recovery (recycle/reuse) – KROHNE MARHALL offers the ideal solution for metering and monitoring in ZLD plants, helping you achieve norm compliance, reduce your carbon footprint, create positive public perception, and avoid environmental pollution.
Solution for ZERO LIQUID DISCHARGE Plants

IP Camera: Network Video Recorder

1.3Mp HD Cost-effective Network IR PTZ Dome Camera

- 20x optical zoom
- H.264 & MJPEG dual-stream encoding
- Max 240°/s pan speed, 360° endless pan rotation
- Up to 255 presets, 5 auto scan, 8 tour, 5 pattern
- Micro SD memory, IP66
- IR Distance up to 100m
- DVR for data recording
SITE VISIT
Thank You

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