Online wastewater monitoring in India: An overview.

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Abstract:

Water crisis in India is becoming critical as the population and its dependence upon the existing water bodies is increasing due to the improvement in the lifestyle. On one side lifestyle is improving and on the other side, there is mismanagement and misuse of the water resources. Considering the seriousness of water stress all over the country, water re-use, recycle and Zero Discharge regulation needs to be strictly implemented. For the implementation of such policies along with the introduction of advanced wastewater treatment technologies, monitoring of treated wastewater is equally important to achieve the objective of reuse and recycle of wastewater. The main aim of the article is to present the overview of the online monitoring of the wastewater in India and the efforts Centeral Pollution Control Board, Delhi has taken to implement such monitoring system. Article also discusses the benefits of the online monitoring system over the conventional methods and the challenges faced during the adaptation of it.

Introduction:

The water crisis in India has become very critical and millions of people are directly or indirectly affected by it. According to FICCI Water Mission Survey[1], India is projected to move into the category of water-stressed nations by 2020. In 2019, Bihar and Assam faced severe flooding, while in West Bengal Jharkhand went through drought-like conditions. This provides evidence that the water crisis in India is not due to the natural disaster but due to the mismanagement and misuse of water resources, lack of awareness among people and industry towards conservation of water, and apathy to the magnitude of the water crisis.

Considering the seriousness of the water stress in the country, water re-use, recycle and Zero Discharge regulations have been passed. But, due to the recent changes in the national standard for the treatment of wastewater, the implementation of such initiatives has become a challenge[2]

To mitigate the issue of water stress, proper management of water resources, and treatment of discharged wastewater is desired. The expert committee (experts from CPCB and NEERI) supported the need for revised and stringent standards for discharged water from the STPs. In the report submitted by CPCB to the NGT [3] states the need for online monitoring and the stringent wastewater discharge standard. The report also discussed the economical benefits of adopting reuse

and recycle policy, stating: " If the treatment of wastewater is not carried out with intention of reuse and recycle expenditure on conveyance/long-distance transport of water/sewage will be much higher. Even as on today in many cities the cost of conveyance of water is much higher than the treatment of sewage to make it fit for most uses including domestic uses. For example, the cost of transporting water from Narmada to fulfill the water supply needs of Indore city (approximately @ Rs. 20/cum) is much higher than the cost of treating sewage to the tertiary level." [3]

Background and Discussion:

With the rapid industrialization in the past few decades, heavy use of chemical fertilizers in agricultural practices, construction, and other development activities has contributed to deteoration of quality of water and its availability has drastically reduced. Therefore, to avoid the further degradation of water resources, regulation on such activities becomes a crucial task. To get the best result, efficient water and wastewater treatment technology along with its monitoring is equally important and must be carried out synergistically. It is well known that the conventional field sampling method, is not only time consuming and expensive but also faces significant data reliability issues from both qualitative and quantitative aspects. To overcome the shortcomings of conventional monitoring systems, efforts have been made through various technological interventions. The purpose of such efforts was to bring self-discipline among the industries and to exercise self-monitoring through the continuous transmission of effluent data to the SPCBs/CPCB.[4] The first guidelines for continuous online monitoring were published by CPCB in November 2014 [5]. It provided direction to the industries to select the right kind of monitoring system, its installation, and the management of the data.

(a) Online Continuous Wastewater Monitoring System

Continuous Effluent Quality Monitoring System (CEQMS) is the name given for the real-time monitoring of water pollution. A continuous monitoring system is comprised of sampling, conditioning, and analytical components and software designed to provide direct, real-time, continuous measurements of pollution in the water. It is an important tool for better compliance enforcement through credible pollution monitoring and reporting practices. Once installed properly,

these systems help in getting accurate and real- time water quality data at high frequency with minimal manual intervention to strengthen the pollution control regime [4].

During the past few years, online water quality monitoring technology has received attention as it provides accurate and continuous wastewater quality information. In 2014, directions for the installation of online monitoring were circulated by CPCB to SPCB to plan a comprehensive program for the prevention, control or abatement of the polluted streams[4]. India, in 2014, initiated the installation of CEMS and CEQMS in 17 categories of highly polluting industries and common water treatment facilities. Besides, polluting industries located on the Ganga basin are also required to install CEQMS for monitoring and reporting of effluent quality on a real-time basis. The central pollution control board (CPCB) had issued directions to state pollution control boards (SPCBs) and pollution control committees (PCCs) to mandate the installation of CEQMS in industries [4]. The initiative is seen as closely aligned with the Clean Ganga mission.

Since the technology and instrumentation are relatively new, complex, and expensive, their proper installation and other implementation associated risks are high. To comply with the standard proposed by the CPCB, proper implementation of CEQMS is not only limited to the selection of the correct technology but also the installation, operation, maintenance, and data acquisition and its handling. Hence, proper knowledge dissemination and skill development for CEQMS are crucial for all stakeholders.

(b)Advantages of CEQMS

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

- Online monitoring systems provide continuous measurement of data for long periods, at the monitoring site of interest.
- All the major steps in a traditional analysis like sample collection, preservation, transportation, sample pre-treatment, calibration, reagent addition, and sample analysis procedures are usually automated in on-line analyzers.
- In case of sudden disturbance in the system, compared to conventional methods the on-line analyzers provide timely information for taking immediate corrective/preventive steps

(c) Basic requirement for efficient CEQMS

The major prerequisites of efficient online analyzers are as follows

- Should be capable of operating un-attended over a prolonged period of time.
- Should produce analytically valid results with precision and repeatability
- The instrument/analyzer should be robust and rugged, for optimal operation under extreme environmental conditions.
- The analyzer should have inbuilt features for automatic water matrix change adaption.
- The instrument/analyzer should have an onboard library of calibration spectra for different industrial matrices with the provision of accumulating further calibration matrices.
- Should have data validation facility with features to transmit raw and validated data to the 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 web server.
- Should have provision to send system alarm to the central server in case any changes are made in configuration or calibration.
- Should have provision to record all operation information in log file.
- Should have 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) shall be provided.
- The correlation/interpretation factor for estimating COD and BOD using UV-Visible Absorption Technique shall be regularly authenticated/ validated and details should be transmitted online.
- That the Record of calibration and validation should be available on real time basis on central server from each analyser.

- 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.

(c) Available Technology for monitoring various water/wastewater quality parameters

Based on the survey conducted with the manufacturer certain technologies were identified by the CPCB that are available for the monitoring of the pollutant.

Table 1: List of Available technologies

S. no	Available Technology	Parameters Measured	Applications
1	UV Spectrophotometry (Single wavelength)	COD, BOD	Fresh Water analysis with constant matrix in the water source
2	UV-Vis Spectrophotometry	COD, BOD, TSS	Fresh Water & Waste Water analysis with Constant matrix in a water source
3	UV-Visible Spectrophotometry (Single Beam)	COD, BOD, TSS	Fresh Water & Waste Water analysis without interference check and compensation
4	UV-Vis Spectrophotometry (Double beam with entire spectrum scanning)	COD, BOD, TSS	Fresh water to Wastewater analysis Interference check for color and turbidity and compensation

5	Combines Combustion Catalytic Oxidation at 680°C and NDIR Method	TOC (Co-relation with BOD & COD)	Fresh Water and Waste Water analysis
6	UV Persulfate NDIR Detector	TOC (Co-relation with BOD & COD)	Fresh Water & Waste Water analysis
7	Persulfate Oxidation at 116-130degC NDIR Detector	TOC (Co-relation with BOD & COD)	Fresh Water & Waste Water analysis
8	Measuring COD using Potassium dichromate(K2Cr2O7) + Calorimetric	COD	Fresh Water & Waste Water analysis
9	Measuring COD using Potassium dichromate(K2Cr2O7) + Potentiometric Titration	COD	Fresh Water & Waste Water analysis
10	Scattered Light Method (IR)	TSS	Fresh water & Waste Water analysis
11	Nephelometry Method	TSS	Fresh water & Waste Water analysis
12	Colorimetric (645-655nm)	NH3	Process stream & Waste Water analysis. Turbidity interference is there which can be overcome
13	Ion Selective Electrode method With temp correction	NH3	Process stream & Waste Water analysis. Turbidity interference is there which can be overcome.
14	UV Absorbance or Multiple Wavelength UV Absorbance	NH3	Process stream & Waste Water analysis. Turbidity interference

	Spectrophotometers (200-450nm)		is there which can be overcome.
15	Colorimetric method Reaction of Cr-VI with diphenyl carbazide in acid solution	Chromium	Fresh Water & Waste Water analysis.
16	Voltammetry (Anodic Stripping Voltammetry)	Chromium	Fresh Water analysis.

Summary:

To ensure compliance with the regulatory regime concept of online water monitoring was introduced. First Online Continuous Monitoring System was installed at Indraprastha Power Plant. Subsequently, online effluent quality monitoring was installed in other parts of India. In 2014, the Central Pollution Control Board(CPCB) directed 17 most polluted industries to install online continuous monitoring systems and online effluent quality monitoring systems to track their discharges at their outlet. Recently as per the National Green Tribunal (NGT) industries are directed to comply with the strict effluent discharged standard at their outlet. To monitor such standards being executed properly, an online continuous monitoring system is the best approach. It is not only monitoring the discharge from the industries but also helping in making the concept of reuse and recycle successful.

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