Effective Management of Uncontrolled Discharges

GOBIERNO DE PUEBLA
SECRETARIA DE DESARROLLO RURAL SUSTENTABILIDAD Y ORDENAMIENTO TERRITORIAL

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"The automatic water quality monitoring stations in Atoyac River represent a unique and ground-breaking project in LATIN AMERICA."

Summary

Currently, Atoyac River suffers from an excess of pollutant discharges which surpass its natural self-purification capacity. Moreover, it is impossible to identify separate episodes of contamination due to uncontrolled industrial and urban waste spills, so there is no knowledge of the overall evolution of water quality in the river basin.

Traditional networks do not detect or act on clandestine episodes of contamination, as these take place during non-working times, when manual monitoring campaigns are not operational. Therefore, there is a clear need for a real time monitoring system which can effectively record uncontrolled discharges and generate history logs, as this will enable adequate discharge management and mitigation planning and actions.

Management Benefits

- Detect episodes of anomalous discharges in real time, reporting their exact start time, intensity and profile, locating their source, its nature and, consequently, providing alerts.
- Guarantee a rapid response to possible episodes of pollution, generating a deterrent effect against intentional spills.

Environmental and Social Benefits

- Protect the ecosystem, reducing the environmental impact and ensuring health conditions for the local population, flora and fauna.
- Guarantee public health through a comprehensive control of the scope of contamination in freshwater and groundwater, for subsequent use in crop irrigation and human consumption.
- Ensure quality of life for residents, mitigating bad smells and possible sources of disease derived from contact with the medium.

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Records

Figure 1. Discharge at the confluence of Barranca Honda – Atoyac River.

Atoyac River forms from melting ice in the Sierra Nevada glaciers, in Mexico's Puebla state. Unfortunately, the river is contaminated by the open air wastewater discharge from 50 towns in Tlaxcala and Puebla states, as well as over 1,000 businesses with defective or no treatment plants. This situation has caused the river to contain at least 25 harmful substances and become a source of infection.

Some of the main sources of contamination are urban sewage discharges, as well as wastewater from textile, food, chemical and petrochemical, drinks, mechanic, automotive and paper industries.

This context explains and justifies the need to have a water quality monitoring and control system. The general requirements for the system include:

- "Necessary" knowledge of the amount of circulating water in the river basin and, consequently, its condition and evolution at different times. This information serves as the basis to manage the river basin and the necessary resources.
- Ability to identify anomalous situations and their cause, as well as to assess their effects and forecast their evolution.
- Incorporating this information to the general knowledge about the river basin. Making a scientific use through correlation studies carried out periodically thanks to collaboration with several institutions, like the National Polytechnic Institute.

In general, the contamination of other water catchments similar to the Atoyac River has historically been resolved by programmes including periodic control campaigns through in situ records and sample collection for subsequent laboratory analysis. Such campaigns are usually sufficient for river basins with little pressure from human activity.

However, the specific situation of Atoyac, which suffers a considerable impact from multiple human activities located around it, has led the river to a drastic situation, requiring more extreme measures. This has generated a clear need for a real time monitoring and management network.

Figure 2. Discharge of industrial residual waters – Atoyac River.

Traditional networks, based on periodic data and sample collection campaigns, only enable a "periodic and programmed" knowledge of the network's condition. In some cases and in "reported" anomalous situations, they can provide valuable information about the long- and medium-term evolution, but they do not detect or act on episodes of contamination which, due to the nature of their source, are generated in a considerably dynamic and, especially, unpredictable manner, making it impossible to detect their real origin and estimate the response capacity.

Previously, most episodes related to industrial activities could only be known when a sampling campaign coincided with them by chance. In most cases, they only showed the effects, being unable to assess their intensity or correlate them to a specific source and, therefore, the origin of the discharge.

"Traditional networks are not capable of detecting or acting on individual episodes of contamination.
In most cases, they only show the effects, but are unable to establish a correlation with the specific cause and origin of the discharge."

Benefits

"Early detection enable an identification and action on the source. It is expected to reduce the maturity phase of pollutant discharges by over 60%, and to reduce their individual duration."

In addition to the benefits of traditional monitoring networks, a real time monitoring network, like that implemented in Atoyac River, also provide:

- Real time detection of anomalous discharge episodes, logging the exact start time, intensity and composition profile. All of it available 24 h / 365 days. The network takes samples which define the nature and composition of the spills and, crucially, their origin.
  The result is a deterrent effect against discharges, since the new strategy will enable a quick identification and response to illegal actions.

- Monitoring of water quality throughout the water catchment in daily cycles and its evolution (profile) in different periods over the year (dry/rainy season), detecting and evaluating the effects of upstream discharge episodes, assessing the extent of the impact, and quantifying the damage.

- Ability to quantify the results obtained by any actions implemented.

"This will have an instructive and inhibiting effect on behaviours allowing the existence of activities which represent a serious hazard for the environment."

As an example, in a station like that located in Quetzalcóalt, affected by several spillages which were difficult to control, the monitoring network detected 3 or 4 highly anomalous discharges per week, which means an average of 150 to 200 episodes per year. In addition, considering that many of them are clandestine and take place outside business hours, the ability to detect them by manual means entails the need for excessive human and material resources.

Implementing and operating an automatic monitoring network requires a considerable investment and running costs, but these should be viewed objectively in relation to the cost/data ratio provided by an automatic network in real time versus a manual network, particularly in those cases where the goal is to detect and locate all the spillages taking place, 24 hours a day.

As mentioned, the deterrent effect of an automatic network inhibits those responsible for contaminating spills. In addition, it enhances the "instructive" effect and, following a damage assessment, enables economic resources to be recovered through penalties. The money collected through these fines helps to pay for the network's operation, thus applying the principle "those who contaminate, must pay".

"The results achieved are already translating into support for the defence of Atoyac River, materialising into active interdisciplinary collaboration between several agencies and even civil society."

Rodrigo Riestra Piña
Secretary for Rural Development, Sustainability and Land Management, Puebla State.
Mexico

"The implementation and operation of the automatic network has allowed us to gather information on discharges just as they take place and respond in real time. This unique tool will enable us to design a public policy for the sanitation of the high Atoyac river basin."

Value Proposition

- High operational performance of the system, through simple access and consultation via a user-friendly website.

- Constant and immediate knowledge of the environmental condition of the river basin.

- Instantaneous logging of traceable information on episodes of contamination, subsequently verified by approved laboratories.

Description of the Network

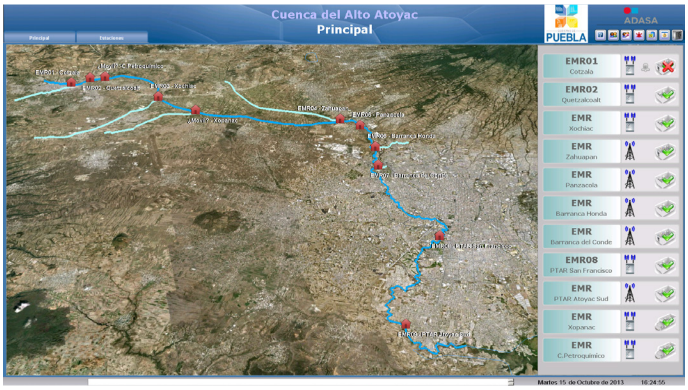

Figure 3. Strategic location of automatic water quality monitoring points.

The general configuration design of the network sought to place its stations at strategic control points, allowing it to control direct discharges and to know their evolution and impact on downstream waters. Some locations included “double stations” to control two streams – main and tributary – in order to determine the origin of discharges, either on the main riverbed or the secondary. The station at Barranca Honda is a good example, as it monitors discharges and the water quality of Atoyac River and also identifies discharges and logs the water quality in Barranca Honda which, incidentally, is the river basin with the highest contamination levels of the entire high Atoyac River.

Two mobile units have also been outfitted, in order to increase the network’s real time monitoring functionality. These units are able to control any point required in the network in a fully versatile manner. The results obtained through these mobile units help to discriminate the origin of contaminating loads coming from La Constancia residual water plant.

Figure 4. Mobile water quality monitoring units.

In terms of the parameters recorded, it was deemed essential to analyse the usual management variables in an automatic monitoring network – temperature, pH, REDOX/ORP, dissolved oxygen, conductivity and turbidity. In addition to these parameters, the network also registers the level and its correlation with the flow, making it possible to identify episodes and their intensity, defining the mass load they represent when associated to a parameter, like organic matter measured through SAC (spectral absorption coefficient) using the 254 nm absorption technique.

Figure 5. Interior view of station. Automatic water quality monitoring equipment.

Another parameter identified as highly important to control was BOD (biochemical oxygen demand). This is done by means of a completely innovative technology, which will revolutionise real time monitoring of contaminating discharges and spills of organic matter. The analyser employed returns a BOD result in just 90 minutes, which is extremely valuable in terms of studying the results and proving that the Atoyac network is the benchmark in Latin America.

In addition to the large volume of data gathered by the network, it is important that the installations are reaching a functional “stability” phase, currently obtaining data validity figures above 90% for the recorded parameters. Logging all of these “independent” parameters enables cross-sectional analysis and correlation of results. Thus, without being redundant, the various parameters recorded verify and validate the episodes logged by the network.

As an example, Figure 6 shows two consecutive episodes of contamination. The profiles of both discharges corresponded to spills originating from a textile industry. An increase could be observed in the conductivity, turbidity and organic matter values (higher in the second episode).

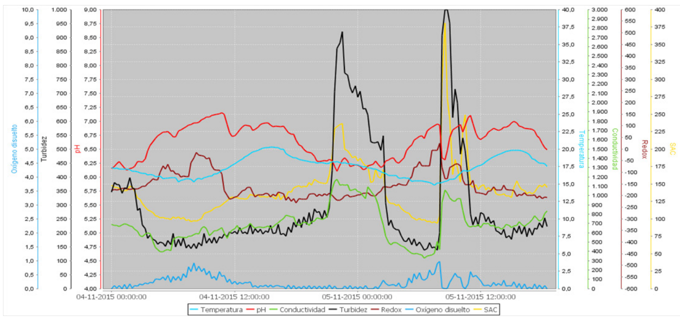

Figure 6. Discharge at Quetzalcóalt.

Figure 7 presents three different kinds of episodes. The first had a considerable level of organic matter, but low turbidity, and REDOX/ORP and dissolved oxygen values decreased until reaching anoxia. In the next two, the level of organic matter and turbidity reached higher values.

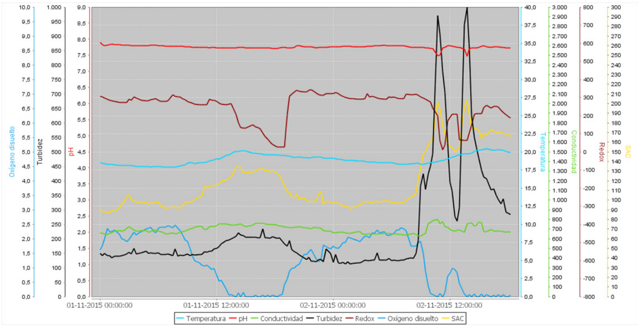

Figure 7. Discharge at Barranca del Conde.

Lastly, Figure 8 illustrates the trend correlation between BOD and SAC, which register organic matter, whereas dissolved oxygen presents, as would be expected, an opposite trend to the SAC and BOD parameters, since the presence of organic matter entails a consumption of dissolved oxygen.

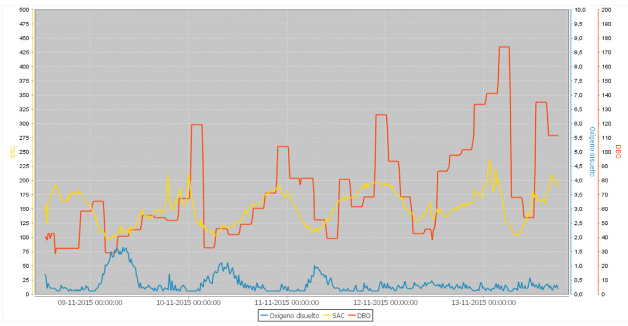

Figure 8. Evolution chart of BOD (biochemical oxygen demand).

Results

"At present, after analysing a year of continuous results, we can know the river's "EKG" and its problems in a way that was previously unavailable."

Currently, although the ideal situation would be to have results indicating a reduction of severe spills, the reality is that we are still in the initial phase.

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"At present, after analysing a year of continuous results, we are in a position to know the river's "EKG" and its problems in a way that was previously unavailable" said José Alfredo Julián, Legal General Manager of the Secretary for Rural Development, Sustainability and Land Management (Puebla State). "Following this period, and thanks to the support and coordination with various related agencies, as well as the participation and awareness of civil society, we are currently involved in the start of a new phase, in which we expect to reduce contaminating discharges by 60%. We also count on recovering economic resources that will enable the network to become self-sustaining", concluded José Alfredo Julián.

In this regard, the challenges faced by this network's operation make it a unique case worldwide. In general, this kind of networks tackle mature management systems, whereas in the case of Atoyac River, the baseline scenario includes very scarce identification of the origins of contamination, which translates into notable improvements, beyond what would be expected in a mature system.

José Alfredo Julián Peral
Legal General Manager.
Secretary for Rural Development, Sustainability and Land Management, Puebla State.
Mexico

"The results achieved have already translated into actions to protect Atoyac River, such as the creation of working groups including all three legs of government: federal, state and municipal, and even civil society."

About Adasa

Founded in 1988, Adasa is a recognised engineering company that offers advanced water quality monitoring solutions. We understand the needs of water and wastewater applications and have proven capabilities in all facets of design, manufacturing and maintenance of major control systems, communication, monitoring equipment and application software.

Adasa products and solutions can help you to: detect pollution alerts and uncontrolled spills, improve WWTP process efficiency by making treatment decisions based on real time water quality conditions, make informed decisions in water discharges, protect the drinking water treatment plants catchments and understand the dynamic of reservoir, dams and deposits of water, allowing management resolutions depending on end use and demand (fish life, bathing water, drinking water, irrigation...).