Application Note

AN04WQ0411

Online the water quality: WQS - Water Quality Smart System

Introduction

This application note introduces an innovative control system "aware" of water quality, both primary and wastewater, ensuring the "continuity of quality": WQS – Water Quality Smart System.
WQS system consists of a multi-parametric probe, which allows on-line detection of process parameters, ensuring continuously the quality of water treatment service.
In addition, this system, unlike other systems on the market, offers a kit for wireless data PC/handheld, allowing always updated measurements: data can be received directly on your handheld first and then comfortably transferred it to PC.

Why?

One of the operational and technological limitations on the ability to continuously ensure the quality of service for wastewater treatment, depends on the availability of real-time detection, or even in advance ("Early Warning"), of the events, of the operating efficiency trends and of the symptoms that typically come before the occurrence of critical events of the process (with reference to process parameters) and/or of the plant (with reference to the equipment in the field). When there is a problem in a wastewater treatment plant, we have to attend in emergency costs, that are not always expected or predictable when we establish a budget, in addition to the possible serious consequences for administrative, criminal and environmental impact.
The WQS system is based on the development of the following principles:

1. *waters belonging to a known class* (civil purified water): between parameters of quality of natural or pseudo-natural water there is a subset of values that if some of them are out of bounds, so all are out of bounds;
2. *WQI index of water quality applicable to the reference class*: we used the NSF-WQI (Water Quality Index), developed in the United States in 1970 by the National Health Foundation (NSF) for natural waters, with some corrections by introducing a complementary quality index that takes into account any outliers of the basic parameters, such as, for example, pH and dissolved oxygen in saturated conditions. For the wastewater we used instead WPR (Water Pollution Rate index), index derived from an appropriate knowledge base and that allows a multi-clustering measure on-line;
3. *detectability of a minimum level of quality reference*: through the first two principles it is possible to identify a set of reference against which compare the deviation of the incoming and outcoming water quality compared to a minimum acceptable value. In particular, the deviation of the outcoming water is evaluated against the limits of the law;
4. *detectability of indicators of process efficiency*: each of treatment processes that make up the system can be described by a single indicator of efficiency standard (0.1), which links the operating parameters on the process (chemical and physical parameters, etc..), with the results, in terms of removal, that you are actually achieving;
5. *detectability of Early Warning and a dynamic Troubleshooting*: on the basis of the fourth principle, performance indicators provide a reporting process that is not only on time (normal/critical), but they give the information to detect trends that operating situations that are progressing in a critical stage and therefore are able to produce a warning (early warning). Exploiting this principle of early warning can provide a troubleshooting that, from the identification of the diagnosis of a possible malfunction, is used to indicate timely checks and corrective action;
6. *control of the performance decay of the measurement instrumentation*: all the principles, I to V, are only valid if you can keep the primary information (hardware directly detected by the sensors), valid and reliable over time. Thus it is introduced the principle of performance decay of the measuring instrumentation, primarily on the basis of aging and the operating conditions (fouling) and the theory life cycle, provided by the manufacturer;
7. *wireless data transmission*: the system allows the wireless transfer of data: the probe can be left in place and data can be transmitted wirelessly to your handheld whenever it's needed.

Features

WQI is one of the most widely used quality indicators, developed in 1970 by a hundred experts in water quality, from the EPA (Environmental Protection Agency PROTECTIVE) and NFSI (National Sanitation Foundation). With it you can measure the change in water quality in certain stretches of a river and compare the water quality in different rivers. This index is also based on the overall project monitoring of our rivers proposed by GREEN (Global Rivers Environment Education Network). WQI is used to monitor changes in water quality from a wastewater treatment plant.

The scale used by the WQI for the evaluation of water quality goes from 0 to 100, where water of excellent quality will take a value of 100. The index is calculated using on-line detection of 9 parameters (eight chemicals and one bacteriological): BOD5, DO, pH, temperature (T), TDS, Turbidity, Total Nitrogen (TN), Total Phosphorus (TP) and Fecal Coliform (FC). Given the diversity of ways of expressing the data and the diversity of units it is not possible a comparison among them and it is also difficult to evaluate the importance to be assign to each parameter. So, it is performed a normalization procedure, transforming the collected data in comparable values (Q value). When you have calculated the index WQI for the water from the treatment plant, it will make a comparison with legal limits.

In order to solve the problem concerning the on-line/real-time monitoring of wastewater quality, it is suggested an on-line multi-clustering measure (not just multi-parametric) based on WPR (Water Pollution Rate) index, an index derived by an appropriate knowledge base. In fact, for the collection of on-line data, in order to decide if an effluent can be reused or must be sent to a wastewater treatment plant (WWTP), it was defined an index for the evaluation of pollutant in the water and this index has been given the name of WPR.

This index has a normalized mathematical expression, that considers in addition to pH, salt dissolved, organic matter dissolved, suspended solids and parameters used to calculate the WQI. WPR allows to evaluate the wastewater quality and it is "trained" during the Sturt-up (based on the final treatability of the effluent, evaluating and monitoring environmental impact on water reuse, cost analysis , etc..) in order to better control the flow selected. WPR will assume values between 0 and 1: it goes to 0 when the water is of good quality, otherwise it tends to 1. WQS system, based on the macro indicator WPR, will decide if an effluent must be reused or sent to a WWTP, and decide all the operations necessary to achieve the goal of maximizing the reuse of water, within the limits of final discharge.

Advantages and Innovation

The WQS system, unlike other systems, allows on-line evaluation of water quality. The procedure is based on:

- Validation based on knowledge of the obtained data;
- Index for evaluating of water quality both primary (WQI) and wastewater (WPR);
- Continuous monitoring and Early Warning in case of critical events;
- Wireless transfer of data collected.

The use of a knowledge based system, to validate the data, allows, unlike other existing systems, a monitoring of water quality considered infallible. The process diagnosis allows to continuously monitor water quality, making it possible to detect critical events and launch of "Early Warning". In particular, the system takes into account the class of source water: in this way means that, for example, deep water to be treated differently than surface water, as they have different characteristics. You can use any sensor in this trade, as long as multi-parametric.

Conclusion

WQS system consists of a multi-parametric probe, which allows on-line detection of process parameters, ensuring continuously the water quality of a treatment service.

The system is interfaced with the serial port of the choosen probe: the kit will provide to transfer data wireless mode to PC/Handheld. In this way you can have quickly updated data. In addition, direct comparison with the limits of the law, allows to obtain a water always acceptable also from point of view of compliance with these limits.

References

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