A COMPUTER CONTROLLED SYSTEM FOR WATER QUALITY MONITORING

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This paper presents a data acquisition system that may be used to monitor some water quality parameters (such as temperature, pH and conductivity). The system is based on a Cobra3 CHEM-UNIT used in connection with the associated software (Phywe Systeme GmbH&Co) and a Toshiba 300 CDS Personal Computer and allows the automatic control, data acquisition and data storage of measured values. This assembly may be used as a fixed monitoring system (as it was used in this paper) or as a portable one.

Keywords: water quality monitoring, data acquisition

1. Introduction

Water quality can be described by several standard parameters. Generally, one has focused on physical and chemical measurements to monitor water quality. Commonly, one measures temperature, conductivity, *p*H, dissolved oxygen, nutrients and suspended solids in order to evaluate the degree of pollution and water quality [1, 2, 3].

Water supplied from tertiary treatment plants does not contain ionic species or organic materials of high toxicity and is supposed to be free of any biological loading so its quality may be assessed by measuring its conductivity (as an indicator of inorganic loading), *p*H (as a measure of its acidity or alkalinity) and temperature (for preventing thermal pollution).

Conductivity value highlights the presence or the absence of inorganic substances in water [2] and it is preferred as a non-specific measurement and as a first indicator that the technological process was carried out properly [4]. Should the case arise when something went wrong, based on the first alarm indication supplied by the increased value of conductivity, more specific detection methods such as ion selective electrodes or in-depth laboratory analysis may be carried out. Conductivity is given by ions present in water and it is a bulk property being affected by concentration, mobility of ions, temperature (hence the need to

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measure also the water temperature), oxidation state [4, 5]. One cannot measure the conductivity of a specific analyte, but that of the entire solution [6].

*p*H measurements offer a straightforward indication of water acidity or alkalinity, being particularly important as the *p*H greatly affects the solubility and the toxicity of other pollutants [7] leading to specific chemical and biochemical reactions in the aqueous media. *p*H values of the treated water need to be maintained within a narrow interval around the neutral value of *p*H = 7.

The temperature of treated water needs to be also monitored because an elevated temperature favours the development and growth of biological active material. Moreover, some parameters such as conductivity and *p*H are temperature dependent and one should present the measured values with reference to the actual temperature value taken during the measurement.

From the practical point of view, there are a lot of sensors and probes specifically designed to measure the conductivity and *p*H values. Anvari *et al.* [8] used several sensors available on market for water quality monitoring and found that their performance is similar [8]. U.S. Environmental Protection Agency (USEPA) also evaluated various types of integrated analyzers in order to check on their reliability. It was concluded that besides the need for the probes to be cleaned and calibrated quarterly and replaced annually, the measurement of conductivity, *p*H and temperature are standard compulsory measurements when trying to assess the water quality [4].

Sensors used in water quality monitoring should be long-lasting, calibration-free, if possible and scalable [9, 10]. The system used in conjunction with such probes should be able to show the values of measured parameters and their behaviour in time, preferably in the form of graphs and downloadable values. The choice of a sensor for water quality monitoring should take into consideration not only its performance, but also its price. One should be able to perform the experiment with accuracy and with a low operational and capital cost. Moreover, the selected sensor should be easy to replace and maintain, preferably with low resources and after a large period of application.

The major concern about water quality monitoring systems is that they should be able to show the behaviour of the measured values over time.

The aim of this paper is to present a versatile user friendly computer-controlled data acquisition system that may be used for quality monitoring of water resulting from the tertiary water treatment plants. The system consists of a *p*H-probe, a conductivity cell and a temperature probe and a data acquisition system, namely Cobra3. Various experiments were performed in order to determine the behaviour of the above mentioned system and its potential applications in water quality monitoring. The primary interest of the authors was to assess the ability of the system to measure the selected indicators during the variation of the experimental conditions. The monitored parameters were conductivity, *p*H and temperature.

2. Materials and methods

The experiments consisted of various measurements of conductivity, *p*H and temperature using specific sensors, namely a stainless steel conductivity cell for conductivity, a commercial *p*H electrode (EGA 30 H) for *p*H and a K-type temperature probe. Cobra3 CHEM-UNIT system, used in connection with the associated software (Phywe Systeme GmbH&Co) and a Toshiba 300 CDS Personal Computer allow the automatic control, data acquisition and data storage of measured values. In order to test various scenarios, tap water, modified by small amounts (below 0.1 ml) of NaCl 1% and HCl 0.01 M were added randomly to test the system response. The temperature was also increased in small increments.

3. Results and discussions

The above presented system provides a portable, stand-alone system for the measurement of the conductivity, *p*H and temperature of water resulting from tertiary treatment plant.

We have conducted a series of experiments based on various scenarios to determine the potential of using the system for water quality monitoring. During the experiments one has monitored the conductivity, *p*H and temperature variations and the system's ability to distinguish the variation of the above mentioned parameters.

Figure 1 presents a print screen showing the reaction of the system during different experimental scenarios (increase and decrease of conductivity, acidity, temperature), intentionally provoked to analyze the system's response. The range of values measured may be imposed by the user at the beginning of the experiment or may be set in automatic mode. As one may see from Fig. 1, the system is able to detect in a matter of seconds any variation of the targeted measurement.

The software allows real-time monitoring of water quality by displaying both the values of the measurements and their graphical representation. The software gives the real time variation of monitored indicators (Fig. 2) being able to trigger, if necessary, a preset alarm, if a threshold value is overcome. The system displays the actual values of the last measurement and stores the entire string of the measured values. Moreover, the acquired data can be displayed as a table (Fig. 3) and exported as a large variety of formats. This allows the user to process them further using either the Cobra3 or any other dedicated data processing software.

At the end of the experiment, all the data collected may be displayed in graphical form (Fig. 2) or as an exportable table (Fig. 3).

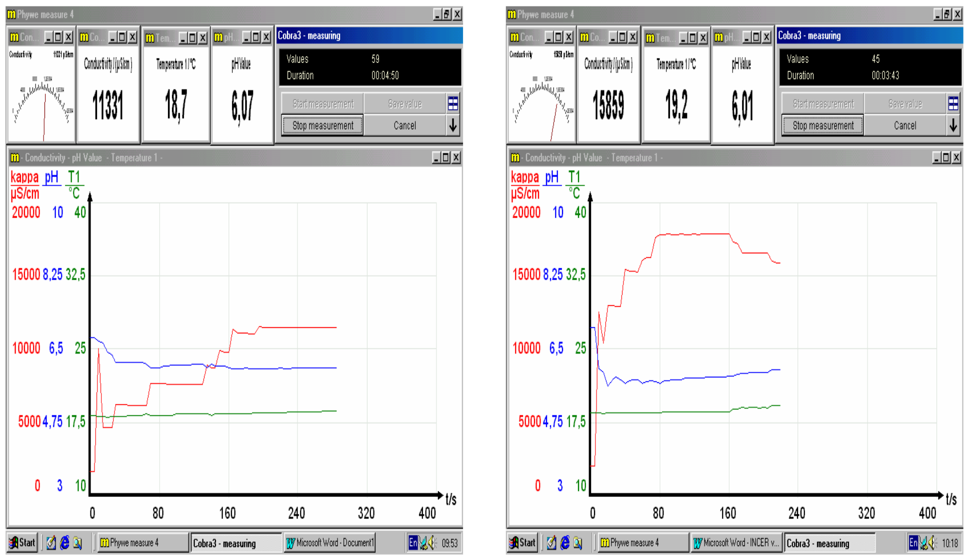

Fig. 1: A depiction of system display (print screen) during an experimental scenario

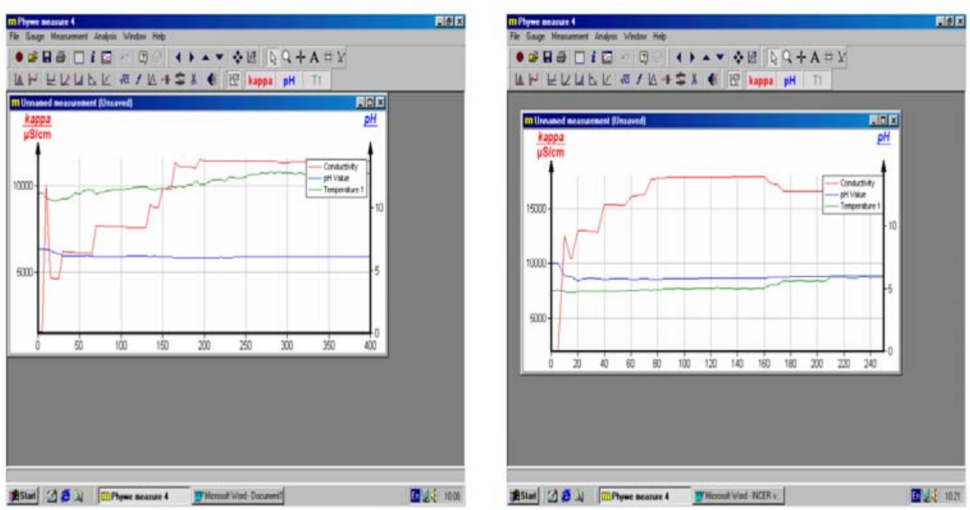

Fig. 2: Graphical representations of data obtained using Cobra3 CHEM-UNIT Software

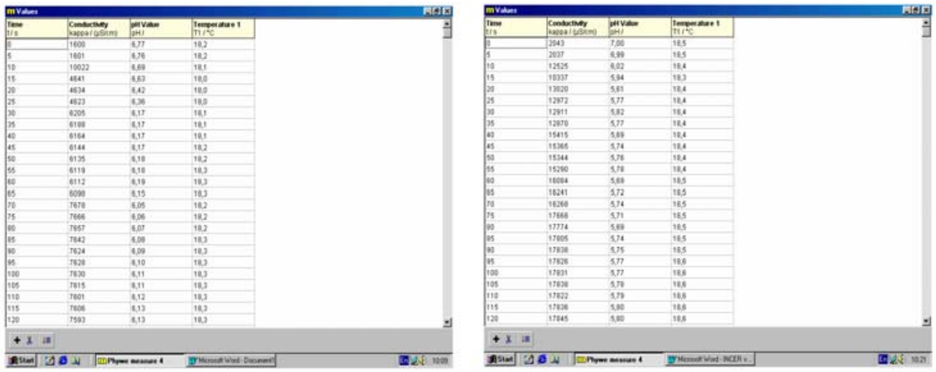

Fig. 3: Actual data values obtained during the experiments displayed as a table format

4. Conclusions

The low-cost computer-controlled system used for the monitoring of conductivity, *p*H and temperature reacted swiftly in any experimental induced scenario proving that it may be successfully used for water quality monitoring resulting from tertiary treatment plant.

This system may be used as an independent device or as a primary data acquisition. Further experiments should be performed to assess the system potential for using also other types of probes.

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R E F E R E N C E S

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