FULLY AUTOMATIC SAMPLING AND DATA MONITORING AUTOMATION FOR WASTEWATER TREATMENT PLANTS

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Abstract

After using clean water, giving it back to nature causes environmental pollution. Treatment processes are used to clean the used wastewater. The water passed through various processes is cleaned and given to the environment. Some organizations are in charge of providing and cleaning water in collective settlements. However, the inspection is carried out by a ministry from a single point. The sensor data of the wastewater treatment plants from a single point are continuously monitored and a sample request can be made from the treated water at any time. In this study, an automation has been developed by the Ministry of Environment, Urbanization and Climate Change of the Republic of Turkey to automatically monitor the wastewater treatment plant. This automation was operated by applying it to the treatment plant of Bursa Hasanağa Organized Industrial Zone.

Keywords: Wastewater, Automation, Automatic Sampling, Data Monitoring

INTRODUCTION

After the use of natural brandy, the wastes are given back to nature. The wastes that are given to nature without any cleaning cause environmental pollution. Nature has self-cleaning mechanisms. However, as the amount of pollution increases, cleaning cannot be achieved naturally[1, 2]. In addition, it is very difficult to clean the chemicals, oil and petroleum wastes in the wastes by themselves[3]. Such wastes need to be subjected to a special cleaning process[4]. Waste water treatment plants are established in order to clean the waste water generated after use in places where there is collective life and production[5]. In these plants, which treat biologically and chemically, the waste water is cleaned and given to the nature. During the operation of these facilities, discharge water is periodically checked and cleanliness is monitored[6, 7]. However, due to the problem occurring in some facilities, the waste water is given to the nature without being cleaned. Waste water treatment plants in Turkey are inspected by the Ministry of Environment, Urbanization and Climate Change. Instant inspection of facilities that are physically located in very different locations is physically very difficult. In addition, unannounced samples should be taken in wastewater treatment plants to determine the source of pollution in clean water resources.

In this context, the Ministry has established a permanent monitoring center. This center periodically collects instant sensor information in wastewater treatment plants. In addition, the Ministry can initiate sampling in the discharge water by triggering the sampling device at any time. In this study, integration to the continuous monitoring center was provided for the Hasanağa Organized Industrial Zone wastewater treatment plant in Bursa, Turkey. In addition, the sampling function was added to the automation of the wastewater treatment plant by integrating the sampling device. With the automation installed, the ministry is constantly monitoring the facility and will be able to take samples whenever it wants.

In the study, the wastewater treatment plant will be mentioned. In the next section, the continuous monitoring system and the received data will be discussed. Also, the sampling system will be mentioned.Finally, results and discussion will be given.

HASANAĞA WASTEWATER TREATMENT PLANT AUTOMATION

Hasanağa Organized Industrial Zone consists of 157 industrial enterprises. The clean water used in these enterprises is treated in the wastewater treatment plant located in the organized industrial zone. The Scada image of the wastewater treatment plant is given in Figure 1.

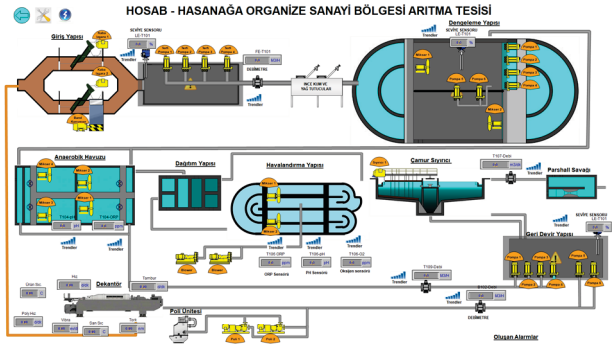

Fig. 1. *HOSAB SCADA*

As seen in Figure 1, the wastewater entering the facility is subjected to a purification process by passing through coarse screen and sand oil traps. The water cleaned in the facility is given back to the nature. Biological treatment is carried out at the facility. Water is decomposed by various beneficial bacteria. As a result of decomposition, the amount of dirt is stored as sludge[8, 9].

The flow rates of the dirty water entering the facility and the clean water leaving the facility are measured. In addition, in certain sections, data such as oxygen levels, pH, ORP conductivity, temperature are constantly monitored by SCADA and the necessary pumps operate automatically. The facility is operated and monitored locally. The pollution level of the clean water is checked with the sample taken periodically, and if the pollution is high, necessary corrections are made. The supervision of the local operation by the ministry is carried out by the continuous monitoring system. If there is a problem in the facility, if dirty water is supplied to the environment, this ministry can also be inspected unannounced by remote sampling. In addition, the amount of water entering and leaving the facility is constantly monitored by the ministry.

For this, an application has been developed and integrated into Scada. In the next section, the Application developed for the Continuous Wastewater Monitoring System will be mentioned.

CONTINUOUS WASTEWATER MONITORING SYSTEM

A permanent monitoring center was established by the Ministry of Environment, Urbanization and Climate Change of the Republic of Turkey. In this center, businesses that provide wastewater and gas to the environment are requested to transfer the data to the center via a web application. The data is monitored by the center and intervened in case of any problems. In this center, data is obtained from 470 wastewater treatment plants, 725 emission measurement facilities, and 347 air quality monitoring units. In this study, a web application was developed for the continuous wastewater monitoring system and the wastewater treatment plant was integrated. A web application was run for the Hasanağa organized industrial zone treatment plant in Bursa. With this application, periodic sensor data is sent to a center in Ankara over the web. The data is monitored instantaneously through a website. The facility information and location on the website are shown in Figure 2.[10]

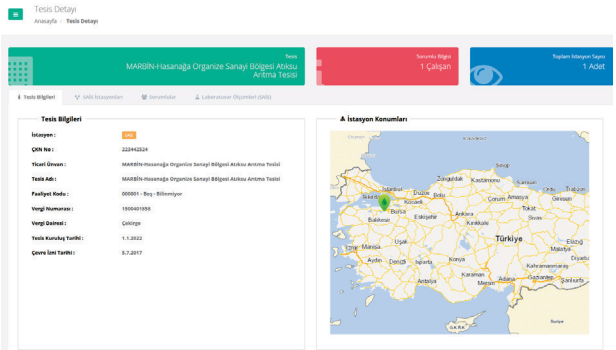

Fig. 2. *The Facility Information and Location*

The data transmission status of the facilities is monitored instantly via the interface. Data that does not send data or incomplete data are tracked. Figure 3 shows the web interface where station information and data transmission status are monitored.

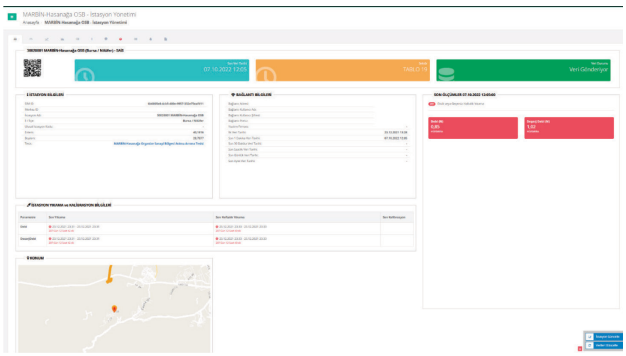

Fig. 3. *Central web interface*

Both the business and the inspectors follow up and intervene in any negative situation. In addition to monitoring, samples are taken from the facility whenever requested and stored for analysis by ministry officials. The sampling device is shown in figure 4 (Hach AS950)[11]. When sampling is requested, the device will operate and take samples independently of the facility operation. This sample will be kept locked until ministry officials arrive. Authorities will have information about the status of the facility by analyzing the sample taken. The facility operator will not be informed of the sampling process.

Fig. 4. *Hach AS950 Samples Device*

Some information is required depending on the size of the facility. The minimum amount of dirty water entering the facility and clean water leaving the facility is monitored periodically. Periods can be selected remotely as minutes, seconds and hours. Instantly received information can also be viewed from the web interface. The information received in Figure 5 is shown graphically and in Figure 6 as a table.

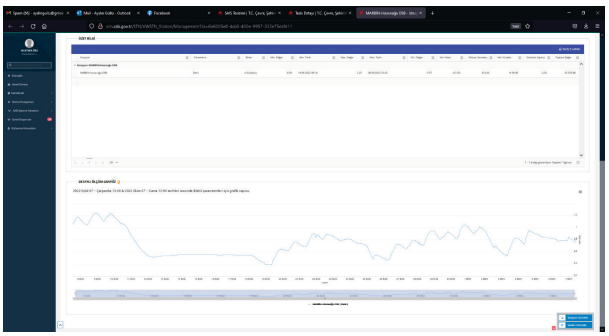

Fig. 5. *Central web interface*

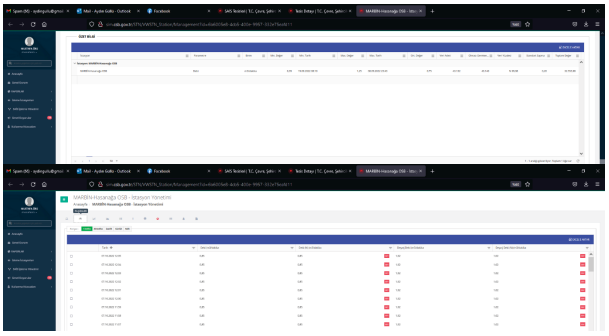

Fig. 6. *Central web interface*

Figures 3,5 and 6 are of the web interface provided by the computer connected to the continuous monitoring center. SCADA works on the computer in the station. In addition, an application has been developed on this computer. The application works in conjunction with both SCADA and continuous monitoring center. The data received through automation is sent to the ministry via web application. Here, it is monitored that the data is sent and which data was sent last. If there is a problem in the system, missing data is sent automatically. For this process, the station and central clocks must be synchronized. Synchronization is also constantly checked. In addition, control is provided for the sample request, and if the request is received, it gives a command to the automation and starts the sampling process. When this process starts and is completed, information is sent to the relevant units via e-mail. If there is a problem during sampling, an e-mail is sent as an error again. In the automation system, data receiving and sending is done with Siemens S7 315 PLC. WinCC was used as SCADA.

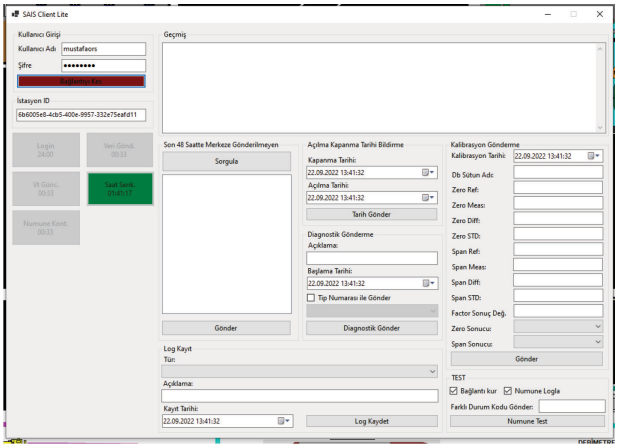

Fig. 7. *Continuous Monitoring Center Client Application*

All data is kept in a database. If there is a problem with the central computer, the missing information is pulled from the database and sent. MongoDB is used as the database. The application was developed in visual studio c#. The interface developed on the local computer is shown in figure 7.

CONCLUSION

An application has been developed to monitor the instantaneous incoming dirty water and outgoing clean data of wastewater treatment plants from a central location. This application does not work depending on the SCADA and automation devices in the station. It stores the sensor data received from the field locally and sends it to the center. The data sent to the continuous monitoring center are tracked instantly over the web. In addition, the sampling process can be started by sending a signal from the facility to the sampling device at any time from the center. In this way, control can be provided for any negativity. The application developed for the continuous wastewater monitoring center was implemented for Turkey Bursa and Hasanağa wastewater treatment plants. The data received from this facility was automatically sent to the continuous monitoring center of the Republic of Turkey Ministry of Environment, Urbanization and Climate Change. Developing software checks for missing data and automatically sends missing data when any problem occurs. When the application running on the computer and SCADA are open, any data receiving and sending process is provided automatically.

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