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An approach for industrial wastewater treatment process

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Abstract. This paper aims at presenting an installation of wastewater treatment. It shows in detail a facility that processes water used in an industrial production process. Wastewater from this process contains traces of paint. Treatment process consists of three stages. The first step involves adding chemical substances in the reactor that produces the flocculation effect. The second step implies neutralizing the pH value. The last step consists in filtration of coagulated impurities. Water treated in this process is brought into the parameters required by the regulations in force in order to be discharged.
Key Words: wastewater treatment, pH neutralization, environmental care, process control.

Introduction. Wastewater treatment is an important function that affects all of us, it is vital to keep our living environment hygienic and healthy, our watercourses clean, and our manufacturing facilities compliant with regulatory standards (Pescod 1992).

Behind the scene, the wastewater treatment process combines microbiology and/or chemistry with mechanical engineering, instrumentation and automation techniques that offer high performance in a progressive way (Patterson 1985).

Wastewater stations or plants strive to be efficient, cost-effective and reliable (Horan 1990). Every facility needs to maximize its performance and availability. Fully automated wastewater treatment stations can significantly increase plant efficiency and reliability, decrease chemical and energy costs as well as running day after day without a large maintenance staff.

This paper is structured in four chapters. The firs one is a short introduction and the second one presents the wastewater treatment process from an industrial production process. The third chapter describes the control process of the system. In the last part of the work the paper conclusions are added.

Process description. This paper presents the wastewater treatment process from an industrial cardboard production process. Based on the knowledge of wastewater the design of the treatment plant can be determined taking into account the wastewater to be treated (Henze et al 2001). A simplified scheme of the process is presented in Figure 1.

Water enters the facility and passes through gluing and painting process. The next step in process flow is storing the water that exits the production stage in three tanks.

The control system feeds the buffer tank from these three tanks alternative so that none of the tanks are left to dry. These tanks are situated underground and have 10 m^3 capacity. In this stage water has passed through all production process and are full of other compounds. Due to these characteristics and in order to not affect the pipe system air is pumped in tanks for the mixing purpose. From this tanks water passes in a buffer tank and then enters in the wastewater treatment process. The process consists of two tanks that work alternative. After water is treated is passed through a press that collect all the impurities and then is stored in a clean water tank.

Water treatment consists in first adding a powder that has the purpose of coagulating the impurities in the water. The chemical composition of this powder depends on the production process. Powder is added using a motor with a worm shaft. Dosage amount is established and can also be changed by the operator regarding the feed composition; however this is done very rarely because the production process and the tank volume do not change. The air mixing process is started for 2 minutes.

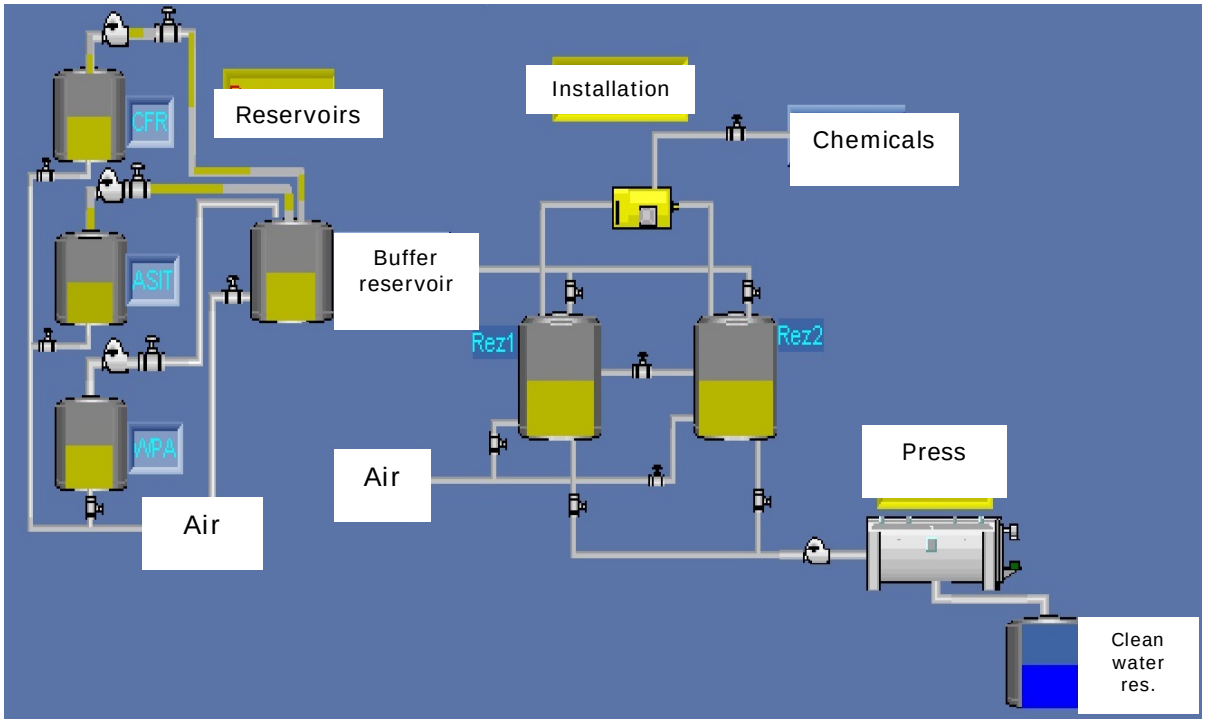

Figure 1. Process scheme.

The next step in water treatment process flow is neutralizing the pH value. The two tanks have a pH sensor attached at the bottom near the tank exit pipe. The controller reads the pH value and then establishes the amount of reactant to be pumped. The bubbling valve is opened and the mixing process takes 1 minute to perform. pH value is checked and if is needed another round of reactant is added and another 1 minute of mixing. The tank exit pipe valve is opened and the solution is pumped in a 24 layer press. All the coagulated impurities are retained in this process and the clean water is stored in a clean water tank of 10 m^3 capacity.

Before implementing this wastewater treatment process water that exits the process was collected and taken to the municipal wastewater treatment facility. Due to this wastewater treatment process implementation from this stage water is reused in the production process. From the clean water tank water is pumped in the glue preparation process.

This wastewater treatment process is composed of two tanks. While one of the tanks begins to discharge the clean water in the press the other one starts the same process from beginning. This alternative two-tank process was needed because the tanks capacities are of only 2 m^3. The tanks are connected with a pipe at the middle with the role of collecting a small quantity of the treated water. This step helps in the treatment process. The chemical dosage system is adapted to this alternative process. The worm shaft is rotated by the motor in both directions according to the tank that is in process at that time.

Monitoring and control system. This wastewater treatment approach is fully automated. The whole process is conducted by a programmable logic controller (PLC). This controller is V570 of Unitronics production and has a touch screen of 6 inch incorporated. The controller language is developed in Unitronics Visilogic software.

The Figure 2 describes the Unitronics control hardware. The first picture from the left is the controller, the second is the snap-in input/output extension module and the last one is also an input/output expansion module that works on controller area network (CAN) protocol bus. Most of input/output signals are digital. The actuators (pumps and valves) are pneumatic and are controlled with digital signals.

Figure 2. Unitronics Hardware.

This process works on automated mode and follows the process flow described in the previous chapter. In case of process abnormal behavior the operator has also the possibility of switching the process in manual mode.

The operator panel is structured in four main screens presented in Figure 3. The first screen (a) represents the system screen from which the operator can access all the process steps. The second one (b) is the feed tanks screen. This screen presents all the tank characteristics like water level, valve status, buffer tank characteristics, etc. When manual mode is activated the operator has the possibility of starting each of the pumps and valves by clicking on them. When a pump or valve is active it is represented with green color and when not in use with red color. The third picture (c) represents the wastewater treatment process. This screen has the same interactive properties as the other screens. From this screen when in manual mode the operator has the possibility to start the treatment process in either one of the two tanks, open and close pumps and valves. The last picture presents the chemical screen where the operator has the possibility to view and change all the characteristics. When in manual mode in order to control the pumps and valves the operator has to click the desired tank and a new screen appears. The new screen has start/stop buttons for each valve and pump associated with the tank.

Another screen from the wastewater treatment process that needs to be mentioned is the parameter screen. In this screen all the process parameters are preset. These parameters are: time of air mixing in all tanks, quantities of chemicals and reactant, timers for start and stop feed process and so on. This screen is available for operator in case of modifying one of this parameter is required.

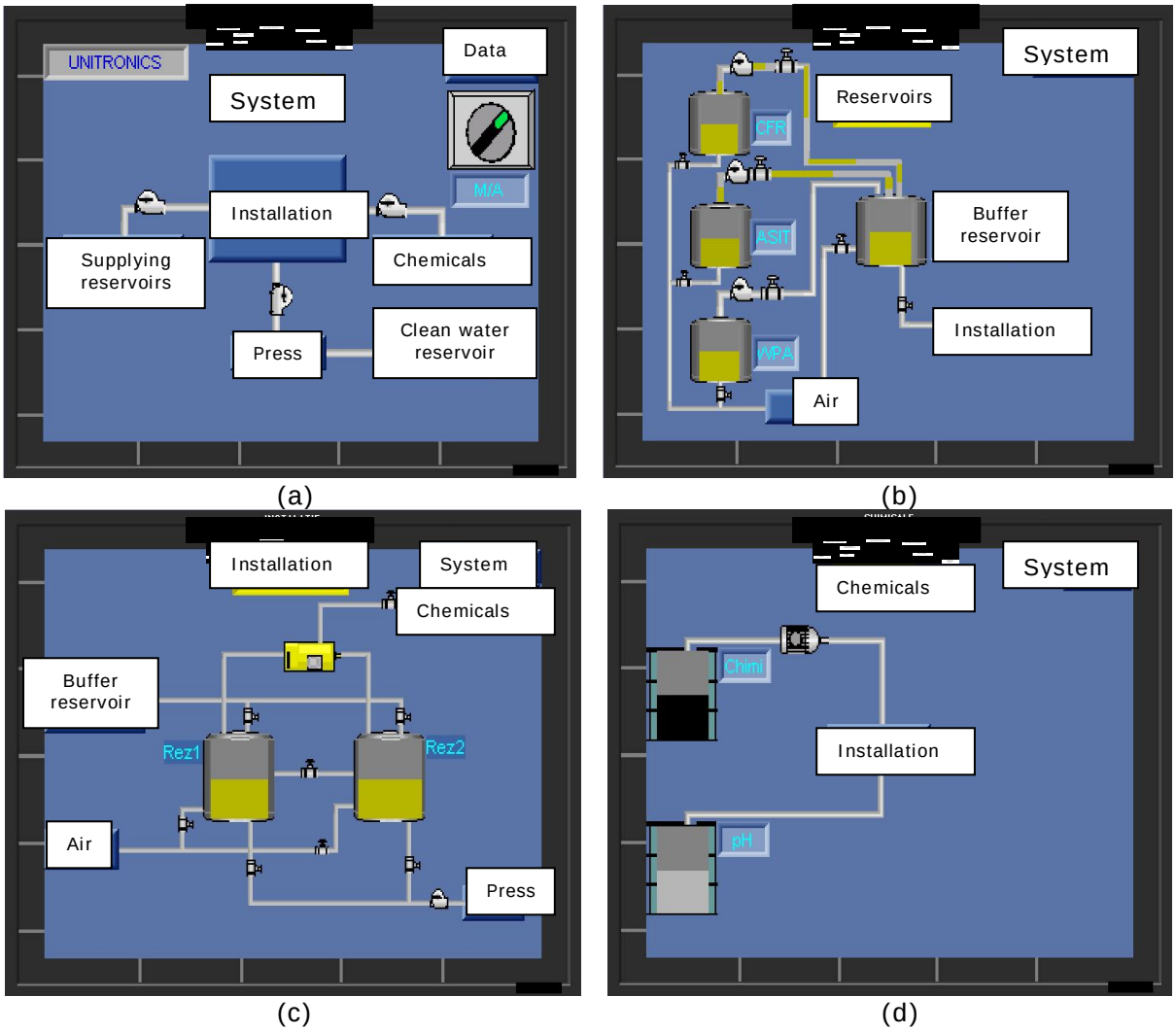

Figure 3. Operator main screens.

Conclusions. This paper presented an approach to wastewater treatment process. This approach was implemented in an industrial production process. The proposed method is fully automated, cost efficient and environmental friendly. The treatment process flow is explained and also the control process is detailed. Initially water that exits the process was collected and taken to the municipal wastewater treatment facility. After implementing the treatment process water that exits the process is reused and pumped back in the production process. This saves water consumption and other costs and helps protecting the environment.

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