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Tesis

**Design of a PID control system for a
wastewater treatment plant**

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Design of a PID Control System for a Wastewater Treatment Plant

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Abstract—This paper presents the design and control of a wastewater treatment plant with mechatronic systems. In this work, a control is developed for each level of treatment in order to optimize time and resources in construction. The development of the project shows that the application of a level sensor and a suction and exhaust pump is feasible in each of the treatment tanks. A heater was also added in the activated sludge treatment to increase the temperature and control the sludge faster. In addition, a reduction in the time for the system to stabilize can be visualized, including a PID control in all processes, managing not to cause overflows in the tanks and having a stable control. The optimal values obtained from the controller for the first system are 36, 0.00036, and 598450, for the second are 30, 0.02, 15 respectively. The implemented control will help to have a preventive and controlled maintenance of the entire system and avoid losses.

Keywords—*ID control; wastewater treatment plant; stable system; mechatronic systems*

I." INTRODUCTION

The effectiveness of a wastewater treatment plant is and will be one of the greatest challenges faced by specialist professionals in this area, since they must ensure that the systems implemented work correctly with new technologies and new equipment [1]. The combination of poorly performing pumping and process equipment, with poor water management practices, can lead to higher operating costs and, even more, low revenue in all collection. All this problem definitely has a negative impact on the final objective of the treatment plant. For this, the following problem arises: What will be the control design of a wastewater treatment plant based on adequate mechatronic systems for the city of Huancayo?

In previous studies [2] a computer system was proposed for the Estimation of the Environmental Impact Produced by Urban Projects. For the development of this system, artificial intelligence was used as part of the process, obtaining as a result estimates of possible negative consequences when carrying out an urban project. In a similar case [3] a simulation system of the biodegradation process of wastewater from the meat industry is described using an artificial neural network and multilayer perception, where it was possible to determine the variation of proteins for a reduction of these. In addition, a prototype of a sensor system for environmental monitoring based on Neural Networks [4] was designed, identifying the composition of the censored agent after training. Another

study raises the need for the design and implementation of an expert system for the supervision of the control of an activated sludge wastewater treatment plant [5], achieving optimal control for optimization that allows the monitoring and automatic control of the plant. In a similar case, control strategies were developed for a wastewater treatment plant for a city of 250,000 inhabitants [6]. In this study, a specific effluent (BSM1) was defined and 5 strategies were developed with conventional controllers. In the latter, the modeling of artificial neural networks was carried out for the elimination of fecal remains in an extended aeration system in a wastewater treatment plant [7].

Starting from the prototype of a wastewater treatment plant with mechatronic systems and artificial vision in the city of Huancayo, it is desired to obtain an optimal control of the resources and the optimization of processes in each of the levels [8]. In addition, reduce pollution and increase the resources of farmers and ranchers who use treated water.

II." MATERIALS AND METHODS

The treatment plant will have 3 levels to purify the wastewater. In the first level, the sewerage will transport the water to the screen, where there will be a sieving, grinding and a degreaser. In this process, sensors and actuators will be added to increase the amount of waste to be treated in a shorter time and to facilitate their handling through a camera that will identify when there is a large amount of solid waste. The second level will consist of a decant with rotary motors and pumps to transport the fluid from the water and the sludge, then it will go to a biological treatment tank that will work with sensors and a chemical pollutant detector that will identify what type of pollutant exists in the water to remove it. Then it will go to a physicochemical tank in which all toxins will be removed from the water. In the third level there will be a dehydration of the sludge and a drying of the same [9]. In addition, an inspection camera will be included at all levels along with a control panel that will indicate if there are faults in the system. To dry the sludge, a heater will be used to raise the temperature and thus achieve optimum control. The population in this research is considered to be the wastewater treatment plants of the central region and as a sample, the wastewater treatment plant projected for the city of Huancayo has been selected.

For the calculations the capacitance equation of a liquid level system was used: