ENERGY OPTIMIZATION OF THE AERATION SYSTEM OF BIOLOGICAL TREATMENT OF THE WWTP OF CEUTÍ

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Summary

This paper describes the methodology used for energy optimization of the aeration system of biological treatment of the WWTP of Ceutí (Murcia), where it was intended to reduce the energy consumption of this stage of the purifying process, which represent 60% of the whole plant consumption. The actions have consisted essentially of; a) minimizing oxygen requirements by adjusting the sludge age to work according to the temperature of the water b) adjustment of the main set-points for improving the oxygen transfer efficiency c) minimization of the air net pressure d) implementation of an adaptive predictive expert control system for the aeration system. Following the execution of these actions, the energy consumption resulting from the aeration has been reduced in a 28%, which has meant a savings of 10% of the overall operating costs of the WWTP.

This article focuses on the use of an adaptive-predictive expert system (ADEX), where it has implemented a control strategy capable of achieving stable values very close to the established oxygen and pressure set-points.

Keywords

Biological treatment, sludge age, oxygen transfer, head loss, aeration system.

Introduction

Energy costs are more than a one-third of operating costs in a Wastewater Treatment Plant, this is why, in order to approach operating cost minimization, we have to pay special attention to energy consumption. This last aspect becomes to be special important if you take into account that heavy overall increase of energy consumption in developed countries, joined to its association to climate change as principal cause of it, makes fundamental to carry out an available energy resource optimization for developing a Sustainable Management at all levels. In the case of water sector, with a high weight in total energy consumption, this premise must become priority for all its component agencies.

Methods

In this work it has been realized a series of modification in aeration system in the Wastewater Treatment Plant in Ceutí, address to improving and optimizing aeration process in the Plant:

I. Oxygen system needs.
II. Oxygen transferred efficiency from gas phase to liquid phase in order to minimize aeration needs.
III. Air supply pressure, so that you can avoid energy over-consumption for the same airflow.
IV. Process control system, implementing a system Adaptive Predictive Expert (ADEX)

First effort to optimize aeration stage at the Wastewater Treatment Plant in Ceutí, has been realized to obtain microorganism oxygen requirement minimization. Firstly we must indicate that microorganism oxygen requirements are the sum of synthesis process requirements (that is a function of organic matter wastewater), oxygen requirements for elimination of nitrogenous matter (that is function of concentration of nitrogen in wastewater) and oxygen requirements for endogenous respiration processes. As first two factors are a consequence of inlet water characteristics, the only thing we can act on, in order to minimize oxygen requirements, is endogenous respiration consumption, you can obtain it minimizing Sludge Age, or the same, concentration of solids in the reactor.

Results and discusión

Once you get to minimize oxygen requirements for microorganisms purify wastewater properly and can obtain a correct sludge stabilization, next step is to minimize airflow that must be supplied to the system for microorganisms having accessibility to oxygen requirements. So that, we have noticed the value of Standard Oxygen Transfer Efficiency (SOTE- %) that inter relates amount of oxygen (KgO2) transferred to body water per amount of oxygen (KgO2) that supplies the diffusers for clean water.

Summing-up

It has been proved that process, with two reactors working together, allows to increase efficiency of transference and then to reduce air consumption, moreover we have confirmed that process with low level of oxygen permits to improve oxygen transference without affecting to effluent quality.
We have proved, too, that this way of working, with two reactors, decreases pressure loss in distribution pipes, so as diffusers, that allows to reduce energy consumptions in air compressors.
For the last, we have showed that implementation of a system Adaptive Predictive Expert, allows to improve stability of process.
All modifications together permit to reduce all installation consumptions on a 28%, that undoubtedly contributes to improve profitability of installation, given that energy consumptions are approximately a 35% of total operating costs.

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