ENERGY OPTIMIZATION OF AERATION OF SEWAGE TREATMENT PLANT BY INCORPORATING NEW TECHNOLOGIES

Isabel Tormos Fibla[1], David Castell[1], Mairena García Ventoso[1], Carlos Ferrer [1]

[1] **FACSA:** Mayor 82-84, 12001 Castellón. Tel.: 964 221 008, Fax: 964 727 150, Correo-e: cferrer@facsa.com, Internet: www.facsa.com

[2] **EPSAR:** Mayor 82-84, 12001 Castellón

Abstract

Electric power for aeration in wastewater treatment represents one of the most important costs of the process. The aim of the present study is to compare the functioning of a conventional blower with rotary pistons with a high speed turbo-compressor with magnetic levitation bearings.

The parameters to contrast are: energetic consumption, acoustic pollution and maintenance cost. After diverse studies, it can be observed that the averaged energy consumption of the magnetic levitation turbocompressor as aeration system is lower than the conventional rotary piston blower. In addition, the use of the turbocompressor reduces the noise emission and the maintenance cost by up to 42 %, compared to conventional blowers.

Keywords

Rotary pistons blower, magnetic levitation turbo-compressor, energetic consumption, acoustic pollution, energetic efficiency

Introduction

Energy cost in business activities is continuously rising, becoming one of the most significant components in the companies cost structure, which reflects the upward trend in electric energy prices. The financial importance of energy is patently seen in a wastewater treatment installation, where the energy spending stands from 15 to 30% of the total operation cost.

The energy required is predominantly electric energy; analyzing the energy consumption in a water treatment plant, it can be determinate how each single process contributes to the whole operating cost. At the same time, this study permits defining the pattern of consumption and its related variables (flow, concentration of dissolved oxygen, etc.). After evaluating the energetic balance of the whole treatment process, it can be said that the 44% of the consumed energy corresponds to aeration, 23% to dehydration, and 33% to pre-treatment.

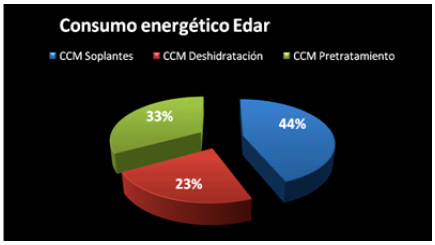

Figure 1.- Diagramc balance in a water treatment plant.

Method

The experience was carried out in a Wastewater Treatment Plant located in Castellon, Spain. This plant treats an average treated water flow of 41.265 m3/day and has a total installed potency of 1.370 kW. The biological treatment consists in two water-lines of 4200 m3 volume each, the air is injected by five rotary piston blowers with thin bubble air diffusers.

The comparative study makes use of a levitation turbo-compressor with similar capacity to the previously installed system. The selected system was a turbo-compressor brand ABS, model HST-6000 (figure 2).

Figura 2.- Magnetic levitation turbo-compressor

To ensure the quality of the study and minimize the error, it was necessary working with two water-lines with the same characteristics. As a solution it was decided to treat the same water flow alternating both machines. It had two advantages, avoiding variations due to constructive parameters and the possibility of normalizing the results, as both equipments were working with the same MLSS; hence the two kWh/KgDBO5 ratios obtained could be compared. An analyzer measured the consumed energy at 15-minute intervals.

The acoustic pollution emitted by the machines was determined through the use of a sound level meter, Koban brand, KS6701 model. For a good quality measurement, the rest of machinery placed in the area was turned off and the acoustic testing points were the identical in both installations.

The analysis of the maintenance cost was theoretically estimated comparing all the preventive actions required by the equipment.

Results

Contrasting the average DBO5 Kw/Kg ratios, it is observed that the turbo-compressor consumes 0,78 Kw/Kg DBO5 in contrast to 1,10 Kw/DBO5 spent by the conventional blower; that is a saving equal to 0,32 KW/KgDBO5. The figure 5 shows how the average operating cost (€/day) of the blower with rotary pistons (258.08 €/day) is greater than the magnetic levitation bearings cost (233.60 €/day), hence the new system lead to economic savings

Preventive and corrective measures needed by the mechanical elements of the turbo-compressor are practically null. On the other hand, the rotary pistons blower consists of bearings and gears requiring exhaustive control. Therefore, it can be said that the new system imply less maintaining costs.

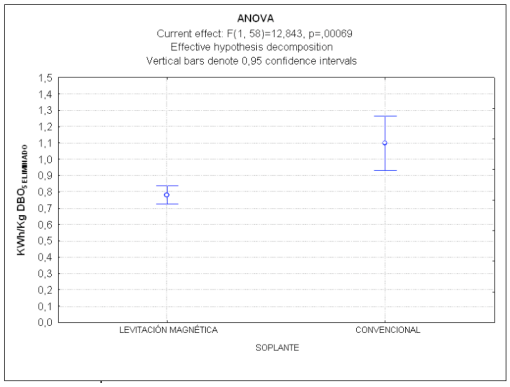

Figura 4.- ANOVA representation of KWh/Kg DBO5 ELIMINADOS

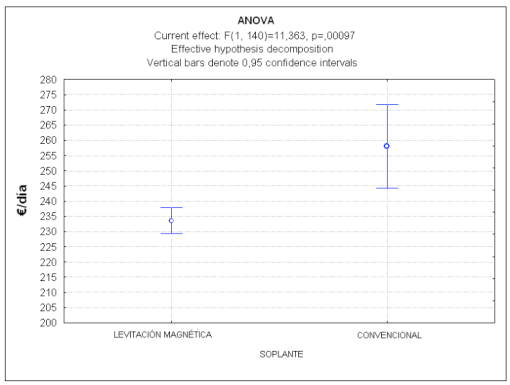

Figura 5.- ANOVA representation of €/day

The main characteristic of the turbo-compressor is the magnetic field produced by the induction bearings, which make levitate the only mobile element of the equipment. This element consists of an axle-shaft with impulse turbine, a rotor of the electric motor and a refrigeration fan of the mechanical device. Namely, this kind of blower working through magnetic levitation implies zero friction, resulting in a lower acoustic pollution than the produced by the rotary piston blower. This conventional system implies friction and vibrations for the reason that is composed by gears, bearings and transmission elements, which generates considerable noise.

Conclusion

The introduction of new technologies (high speed turbo-compressor with magnetic levitation bearings) in contrast with conventional aeration systems (blower with rotary pistons) in waste water treatment, could imply relevant energetic savings (30%), lower maintenance costs (42%), acoustic pollution reduction and decreasing surface necessities, therefore less infrastructure for its installation.

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