

ALTO DUERO SANITATION

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SUMMARY

The Spanish Royal Decree Law 11/95 of December 28th, transposes the Directive 91/271/EEC which establishes the applicable standards for the treatment of urban waste-waters, requiring a secondary treatment for the townships of more than 2,000 inhabitant equivalents and an appropriate treatment for the remaining populations. For the purpose of fulfilling this regulatory requirement, the Ministry of the Environment has signed an agreement with the Autonomous Community of Castilla León whereby the Ministry promised to undertake a number of actuaciones regarding waste-water treatment, among which is the Sanitation of the Alto Duero.

In the Alto Duero region which is located in Soria, Spain, Drace medioambiente has built five new waste-water treatment plants. They are serving more than 20,000 inhabitant equivalents during the summer and almost 8,400 during winter.

The sewage coming from the different townships is collected by means of a newly installed piping system that has a total length of 7,500 m, and for the waste-water treatment five new plants are required: Vinuesa, Covalada, Duruelo de la Sierra, Abejar and Molinos de Duero. The first four of them are SBR biological treatment facilities with extended aeration of the ABJ type, while Molinos de Duero has extended oxidation with lamella settlement.

The five WWTPs have a treatment capacity of 3,690 m³/day in summer and 1,675 m³/day in winter. The flows being treated in the plants range from 1,130 m³/day (Vinuesa) to 320 m³/day (Molinos de Duero) in summer, and 560 m³/day (Covalada) to 180 m³/day (Abejar) in winter.

INTRODUCTION

The commissioning of these five waste-water treatment plants has allowed an improvement in the water quality of the reservoir of La Cuerda del Pozo, which supplies several towns in Soria Province including the capital, by preventing the towns located upstream from discharging their untreated waste waters directly into the river Duero and its tributaries.

The Alto Duero is a region, located in Soria, Spain, with great tourist attraction, because of its very beautiful natural environment. The aim to conserve the quality of the water and this natural environment was the main objective of this project.

For this reason the design of the facilities was conditioned by the need to avoid that their appearance was that of an industrial installation. The main issue was to design new facilities respectful towards the natural environment. For this purpose, it was chosen for the design a variant of the SBR-type active sludge treatment system termed ABJ ICEAS (Intermittent Cycle Extended Aeration System), mainly

characterized by allowing an uninterrupted input into the biological reactor, even in the settlement and clarification phases.

In the Molinos de Duero WWTP, the solution adopted was an extended aeration with a secondary lamella clarification in a rectangular shape, due to problems with the relief of the land.

Both waste water treatment systems provide very compact solutions, designed to blend into the surrounding natural environment.

METHOD

In general terms, the waste water treatment process is similar for the five plants included in this project. The most substantial feature resides in the biological treatment.

For the four plants with most capacity which are Vinuesa, Covalada, Duruelo de la Sierra and Abejar, an ABJ-ICEAS SBR process has been implemented, while in the case of Molinos de Duero, the smaller one, the biological process consists of an extended aeration with lamella sedimentation.

The five plants together give service to 22,117 inhabitant equivalents during the summer and 8,389 during the winter.

Drace medioambiente has designed and installed all the piping systems that collect all the discharges from these municipalities, having an overall length that reaches 7,500 m. With this new infrastructure the collection of the outflows from the six municipalities is fully guaranteed, and the discharge of untreated waste water into the river is avoided.

The population and design flows of these five plants are indicated below in Table n°1.

Towns	Population (inhab. eq.)		Flow (m3/day)	
	Winter	Summer	Winter	Summer
Vinuesa WWTP	1,833	6,500	300	1,130
Covalada WWTP	3,080	5,953	560	940
Duruelo de la Sierra WWTP	2,250	3,000	450	600
Abejar WWTP	645	3,500	180	700
Molinos de Duero WWTP	525	1,600	185	320

Table n°1 Waste water treatment plants

For calculating the pollution loads, it was considered sufficient to take the following design parameters as the initial data:

60 gr BOD5/inhab.day

65 gr SS/inhab.day

10 gr N-NTK/inhab.day

The WWTPs of Vinuesa, Covalada, Duruelo de la Sierra and Abejar consist of two treatment lines: one for waste water treatment and another for sludge processing.

The water line consists of the intake system with safety spillway, coarse trash rack with twin-valve scoop, raw water pumping station set with 3 centrifugal pumps, measurement and regulation of the flow to be treated.

The pre-treatment is done by the screening of fine solids in rotating units.

The biological treatment with nutrient removal is designed using an ABJ ICEAS SBR process that employs blowers and an arrangement of fine bubble diffusers for the aeration system. Afterwards there is a flow measurement and the storage of treated water. The final effluent is finally discharged into the river Duero in the case of Covalada and Duruelo de la Sierra, the Revinuesa stream in the case of Vinuesa, and the Hormalla stream in the case of Abejar.

The ABJ ICEAS SBR biological process is an extended aeration biological system based on time control, and intermittent cycles. The processes of biological oxidation, nitrification, denitrification, phosphorus removal and liquid and solid segregation are carried out alternately in the same reactor, but in separated phases. In contrast to the conventional SBR process, the selected SBR has a volume of preliminary reaction that allows the continuous feed of waste water into the biological reactor. This is a very important advantage for small facilities.

The nitrogen removal is controlled by the length of the cycles.

The phosphorus removal is mainly carried out by biological treatment and simultaneous precipitation, adding ferric chloride if it is necessary.

The sludge line is formed by the thickening of the excess sludge in a dynamic thickener. Afterwards there is mechanical de-watering of thickened sludge by centrifuge and the storage of the de-watered sludge in a container of 5 m³, for later disposal.

The sludge produced in the waste water treatment process is 1,200 kg/day in summer and 460 kg/day in winter, for the four plants together.

The Molinos de Duero WWTP consists of a coarse trash rack and a raw water pumping station. The waste water flow is regulated by means of power-driven valves, and the pre-treatment is done with screening of fine solids in a rotary unit.

The biological treatment is carried out by means of an extended oxidation in two lines that use three blowers for aeration. The phosphorus removal is carried out by adding ferric chloride and precipitation. The secondary clarification is carried out in two lamella settlement tanks. The treated water is discharged into the river.

The sludge treatment is formed by excess sludge thickening in a rotary thickener, mechanical de-watering in centrifuge and storage in a container for later disposal.

In all cases the whole facility has been installed inside a single multi-purpose building with the exception of the biological reactor. All the facilities have an active carbon tower to provide deodorisation.

The architectural design of the building has been done with the issue of hiding the treatment plant and trying to conserve the natural beauty of the landscape.

To guarantee the operation and continuous monitoring of the five WWTPs, the plants have a generator set, surveillance cameras, ADSL connection and SCADA supervision system, with interconnection between plants via internet.

RESULTS AND DISCUSSION

After a brief period of commissioning the facilities, the operational period of the facilities was started by Drace medioambiente. After a year of running the five WWTPs of Alto Duero jointly, the treatment of the waste waters from the six municipalities has been attained and the required performance figures satisfactorily reached.

After this period, we can guarantee the correct operation of these innovative processes, since the facilities are working at 180% of their mean hydraulic treatment capacity, as reflected in the outflow parameters obtained and shown in the following table, Table n°2.

	BOD5		SS		NTK		Flow
	I/O value (mg/l)	% Reduction	I/O value (mg/l)	% Reduction	I/O value (mg/l)	% Reduction	(m ³ /day)
Design values	365/ ≤25	93%	365/ ≤35	90%	56/ ≤ 15	73%	604
Current values	107/ 11	97%	170/ 11	95%	22/ 8	86%	1016

Table n°2 Operation and maintenance

CONCLUSIONS

The installation of the SBR system (ABJ ICEAS) is confirmed as a good treatment system for small municipalities with appropriate integration in the natural surroundings of the region.

As a whole, the five Alto Duero waste water treatment plants guarantee the quality of the effluent send back to the river Duero.