DRACE medioambiente

Expansion of the Wastewater Treatment Plant of Sabadell – Riu Sec, Barcelona

The new membrane bioreactor of the WWTP of Sabadell designed and built by DRACE *medioambiente*, is currently the largest MBR installed in Spain, and it is a clear commitment of awareness and respect for the environment.

Location	**Sabadell, Barcelona**
Developer	**Government of the Generalitat of Catalonia**
Finishing date	**February 2009**
Capacity	**35,000 m^3/day**
Technology	**MBR**

The expansion of the WWTP of Sabadell – Riu Sec comprises the installation of the largest membrane bioreactor system in Spain.

The old WWTP of Sabadell - Riu Sec, was built in two phases. In the first one, a pretreatment and a primary treatment were built for 50,000 m^3/d. In the second phase, with a physical-chemical treatment prior to the primary decanting, a second treatment for 30,000 m^3/d was built, with a conventional biological system and a sludge treatment.

Due to the development of the municipality of Sabadell it has been recorded a gradual increase in the pollution loads reaching the plant, exceeding its design capacity. This situation could worsen with the additional wastewaters coming from the future urbanization areas.

From the environmental point of view, it should be pointed out that the river where the treated water of Sabadell's treatment plant is disposed, the Riu Sec, is a dry river and has been deteriorated. The course of the Riu Sec flows downstream passing through towns with special interest in recovering the river as a public recreation area. Also there is a need of reusing water for irrigation and industrial purposes.

Therefore the aim of this new installation is to remove nutrients and produce a treated effluent with an excellent quality to be able to reuse it. The capacity of this treatment will be 35,000 m^3/d and therefore, will environmentally recover the river area deteriorated during the past years and cover the needs of reutilization.

When evaluating the different treatment alternatives, there were two major determining factors that hampered the project development and execution of the works: first the WWTP of Sabadell is surrounded by land belonging to a new urban development, so it was the lack of available space within the plant was one of the critical factors, which caused the cancellation of other technically feasible solutions. Secondly the works had to be carried out while the plant was in operation.

The evaluation of these objectives and the determining factors have led **DRACE *medioambiente*** to choose as a solution the process called MBR: membrane bioreactor treating 35,000 m^3/d.

Expansion of the Wastewater Treatment Plant of Sabadell – Riu Sec, Barcelona

The bioreactor works under similar conditions to the conventional activated sludge reactor, where nitrogen is biologically removed. However, unlike the conventional processes, the solid-liquid separation will be done by filtration membranes submerged in the mixed liquor, instead of a conventional secondary decanter. The system provides a better retention and separation of the biomass, allowing the bioreactor to work with a solid concentration much higher than other conventional processes, between 8,000 and 14,000 mg/l of MLSS

The MBR process combines the unit operations of aeration, the biological treatment process, the secondary decanting and filtration, in a single system, producing a high quality effluent as the filtration is performed through a microfiltration membrane and considerably reduces the space requirements. By choosing the MBR process, we can guarantee an effluent low in nutrients and microfiltrated, and it that can be installed in the available space existing for the new works.

The water from the primary decanters is fed to the bioreactor by pumping. For this, four pumps have been installed with an overall flow of 2,233 m^3/h. .

Biological treatment

The old WWTP of Sabadell had two activated sludge bioreactors. When studying the retrofit and expansion of the plant, it was decided to leave one of them with the existing configuration and install the new MBR process in the other existing one and one of new construction.

The new MBR process, able to treat 35,000 m^3/d, is therefore dimensioned in two reactors an existing one, and another similar one of new construction. The existing bioreactor, that will not be retrofitted, has a double function.

First, while executing the expansion works to an MBR, it allows to treat biologically all the flow by the addition of oxygen, and later it will operate as a decanted water regulation tank in case of possible peaks or deviations from the design conditions of the MBR.

The decanted water is distributed in the two membrane biological treatment lines and it is pre-screened in four rotating perforated plate screen of 2 mm. Two screens have been installed for each reactor.

Membrane bioreactor

The biological treatment is carried out by two equal reactors of 8,945 m^3. Each reactor is divided into four treatment lines. Each treatment line is designed to treat an average flow of 182 m^3/h. The effluent quality requirements, conditioned the plant design with nutrient removal. Phosphorus will be removed by addition of chemical reagents and precipitation into the biological reactor. Nitrogen will be removed in the bioreactor through the nitrification and denitrification processes. For this purposes, it has been designed each of the 8 lines of the biological process with a first anoxic chamber where denitrification takes place, and a second oxic chamber where the reduction of organic matter and nitrification take place, and a third chamber where the membranes are located and the solid-liquid separation is done.

In each one of the two reactors, the screened water is distributed to each of the 4 lines by control valves. The water enters the first anoxic chamber of each line where it mixes with the sludge recirculation. In these anoxic chambers two submerged agitators have been installed to mix and avoid sedimentation of the mixed liquor in the tanks.

Then the water passes to the oxic chamber where the aeration systems have been installed to guarantee the aerobic biological

Expansion of the Wastewater Treatment Plant of Sabadell – Riu Sec, Barcelona

processes. The aeration is performed by blowers and fine bubble membrane diffusers of 9" diameter.

Finally, the mixed liquor enters the last chamber of each of the 8 separate lines, where the submerged membranes are installed performing the solid-liquid separation by filtration. The 192 installed membranes are flat sheet microfiltration membranes of chlorinated polyethylene, of Kubota.

The microfiltration membranes work submerged in a tank and in direct contact with the mixed liquor. The extraction of treated water through the microfiltration membranes is performed by self-priming pumps that create the depression needed to force the passage of water. Each group of membrane modules has two suction pumps, therefore, 16 permeate pumps are installed, two for each biological line, of 170 m^3/h.

The structural design of the membrane modules includes in the bottom part a grid of coarse bubble diffusers. When introducing air into the bottom part of the membrane module, it generates an upward sweep of the biomass between the cartridges and the surface of the membrane, controlling the cellular material layer growing on it. This homogeneous clean air diffusion prevents sludge deposits and controls the transmembrane pressure and permeates production. Flat membranes offer a robust system, that prevent clogging problems and facilitate the operation and maintenance work. The normal filtering operation is done by alternating permeate time period with other membrane relaxation time, where the permeate pump suction stops and the aeration is maintained.

The system allows independent cleaning of the modules' lines, not needing to empty the tanks nor stop the plant.

The air needed for the biological treatment is supplied by four groups of blowers of 7,600 m^3/h, and a fifth group installed on stand by.

Sludge recirculation and surplus sludge

The sludge recirculation in the membrane bioreactor is performed by a submergible pump of 1,100 m^3/h unit flow in each of the 8 lines.
For regulating and controlling the sludge concentration in the bioreactors, a surplus sludge extraction system is installed, to send the sludge to the existing sludge treatment line in the WWTP.

Buildings

To install all the mechanical and electrical equipment of the MBR, **DRACE *medioambiente*** has designed and built two new buildings. Each building is equipped with a completely soundproof room for the blowers.

Outside these buildings, a ferric chloride dosing system has been installed, thus to complete the removal of phosphorus by chemical precipitation. This dosing is done in the existing physical-chemical process prior to the primary decanting or in the biological reactor.

To feed the new MBR installations, it was necessary to install a new power station. This new power station is interconnected with the distribution station that currently feeds the WWTP.

The MBR of Sabadell is an example of applying the most advanced technological innovations by the Catalonian Agency, the City Council of Sabadell, and **DRACE *medioambiente*** which have a common goal: care, respect and protection of the Vallés Occidental (western part) of Catalonia.