

WASTEWATER TREATMENT

Salvador Ruiz-Lopez, Repsol Quimica, S.A., Spain, and Clayton B. Maugans, USFilter Zimpro Systems, USA, discuss the application of the combined wet oxidation/PAC solution to treat Repsol Quimica's varied wastewater streams.

Repsol Quimica, S.A., located in Tarragona, Spain, is the chemical division of Repsol YPF. The chemical processing company built an industrial wastewater treatment facility (WWTF) to support the company's 678 000 tpy propylene oxide/styrene monomer (PO/SM) and derivatives chemical production plants.

When designing the facility, Repsol considered several factors, including stringent environmental regulations and effluent discharge standards. The selected treatment processes also had to treat the facility's four wastewater streams, some of which are high in aromatic and polyolic compounds.

Repsol initially considered using solvent extraction or incineration for handling the more difficult to treat wastewater, and conventional biological treatment for treating the remainder of the facility wastewater. However, tests with solvent extraction demonstrated high losses of solvent, insufficient extraction, high solids content, high colourations, and a high chemical oxygen demand (COD) value in the final effluent. Likewise, tests with incineration showed insufficient energy content in the wastewater for economical operation, with the wastewater's high salt content further complicating incineration operation.

After evaluating several technologies, Repsol decided to treat its high strength wastewater with a combination of wet oxidation and non-conventional biological treatment. The chemical company then consulted with USFilter Zimpro

Systems who, in turn, conducted several tests using wet oxidation, powdered activated carbon and wet air regeneration. Pleased with the results, Repsol integrated USFilter's full-scale system into its new WWTF (Figure 1).

The heart of the system

Prior to being discharged into the Mediterranean Sea, liquid wastes and rainwater from Repsol's Tarragona facility pass through the wastewater treatment system that includes a wet oxidation process, powdered activated carbon treatment (PACT®) system, wet air regeneration system and Hydro-Clear® sand filtration system, all from USFilter Zimpro Systems.

The wet oxidation process is simply an oxidation process that occurs in liquid water. Large and difficult to biologically treat molecules readily break apart and spontaneously oxidise with dissolved oxygen at an elevated temperature. The wet oxidation process treats the PO/SM combined wastewater (ACC) stream, as well as the biologically untreatable polyol ether wastewater (POE) stream.

The process destroys most of the COD content in the wet oxidation reactor, reducing the high organic loading going from the ACC stream to the PACT® system. Additional fuel is not needed to treat the POE stream, as the high COD loading of the ACC stream provides sufficient reaction heat for autothermal operation to occur. The



Figure 2. Repsol Quimica uses a wet oxidation system from USFilter to treat high strength styrene monomer and polyol ether wastewaters.

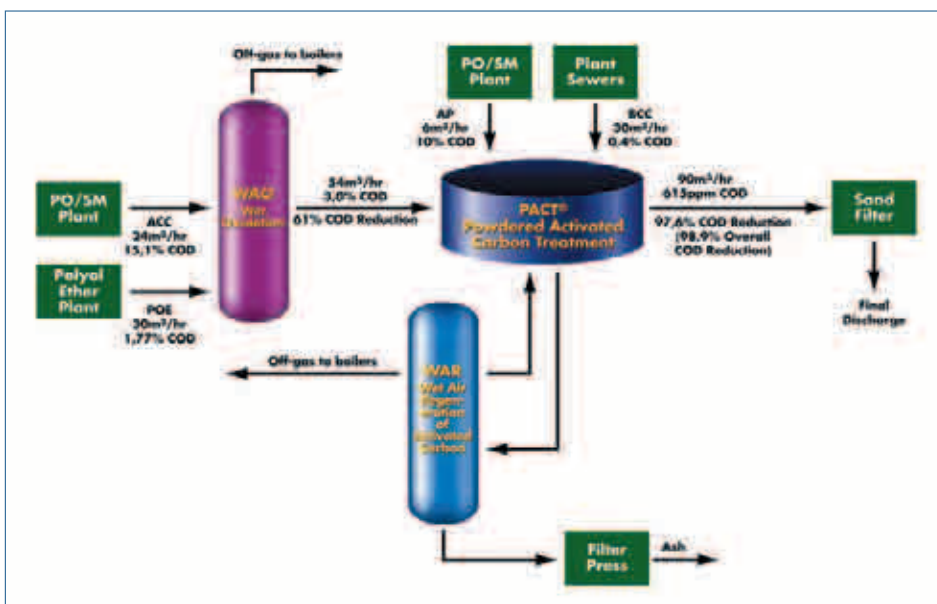


Figure 1. Repsol Tarragona wastewater treatment plant process flow diagram and design conditions.

	COD	Flow
PO/SM combined wastewater (ACC)	Strong	High
Polyol ether wastewater (POE)	Mild	High
PO/SM acid purge (AP)	Strong	Low
Mixed low strength wastewaters (BCC)	Low	High

	Design value	Actual value (2000 - 3)
WAO system flowrate	60 m ³ /h (380 000 gal./d)	60 m ³ /h (380 000 gal./d)
PACT system flowrate	90 m ³ /h (570 000 gal./d)	90 m ³ /h (570 000 gal./d)
WAO % COD removal	61%	55 - 75%
PACT % COD removal	97%	98.5 - 99.9%
WTP overall % removal	98.85%	99.85 - 99.99%

wet oxidation process produces no NO_x or SO_x emissions, and hydrocarbons are converted to CO₂ and water or biodegradable short chain organic acids.

The resulting ACC/POE effluent, along with PO/SM acid purge (AP) and mixed low strength wastewaters (BCC), is then treated in a large two stage PACT® system. This enhanced biological treatment process uses powdered activated carbon suspended in an aerated solution to increase and improve resistance to shock loads, sludge settling/thickening, and removal of organics, VOC/odour, colour and metals. Aeration tanks from USFilter Jet Tech Products and clarifier rakes from USFilter Envirex Products are incorporated into each stage. The final effluent filters through a Hydro-Clear® sand filtration system before it is discharged into the Mediterranean Sea.

Compared to conventional waste activated sludge biological treatment, the PACT® system allows for higher performance in a shorter hydraulic retention time. With the PACT® system, organics undergo both adsorptive and biological treatments, remaining in the treatment zone for the hydraulic retention time and the sludge residence time of the system.

The spent carbon, adsorbed organics and biomass are then treated in a separate wet oxidation reactor, known as the wet air regeneration system. This system is similar to the wet oxidation process, but uses compressed

air instead of oxygen to simultaneously recover powdered activated carbon and to destroy the biological sludge. The regenerated activated carbon is returned to the PACT® system while ash byproducts from the regeneration process are periodically dewatered in a filter press from USFilter Dewatering Systems before they are sent to landfill.

Approximately 10% of the powdered activated carbon is oxidised during the regeneration process. To compensate for this loss, fresh carbon is added to the second

stage PACT aeration tank from a carbon silo.

Operational results

The wastewater treatment plant handles an average flow of 570 000 gal./d: two thirds of which is pre-treated by the wet oxidation system. The remaining one third raw waste flow is combined with the wet oxidation effluent and fed into the PACT® system.

For COD removal, the wet oxidation system can remove 61% COD. Similarly, the PACT® system can remove approximately 98% of the COD from its feed. According to the initial design, this yields a final effluent of 615 ppm COD, with an overall reduction of almost 99%; however, system performance normally exceeds this value. And in the Hydro-Clear® sand filter effluent, COD values average 450 ppm COD and at times, daily averages near 200 ppm.

The plant has achieved this high performance while constantly keeping the process flowrate to the unit at 570 000 gal./d and strengths at or higher than the design conditions. This has resulted in a global COD reduction of 99%.

The average COD in the plant effluent is consistently below the specification limit.

The senior project manager at USFilter Zimpro Systems commented that since starting up more than two years ago, the guaranteed treatment values have been achieved, and the facility has far exceeded performance results specified by local administration authorities.

Other benefits

The facility saves approximately US\$ 3 million a year by reusing powdered activated carbon and by destroying the majority of adsorbed organics and biomass that would otherwise require dewatering and landfill disposal.

As for environmental stewardship, Tarragona's local authorities are satisfied that Repsol's treatment processes and resulting effluents meet the area's strict environmental requirements. And Repsol is pleased to report that its WWTF has complied with discharge permit requirements from the time of startup.