The Client

Arvia were approached by one of the world’s largest petrochemical companies who are involved in the processing, production and sales of petroleum refining and petrochemical products.

The company has a refinery in the East of China and was looking to improve its effluent treatment capacity to comply with environmental regulations and reduce operational maintenance of their on-site effluent treatment process.

The Background

Manufacturing facilities in China are under pressure to reduce water pollution and address their water usage as part of the ‘Water Pollution Prevention & Control Action Plan’, also known as the ‘Water Ten Plan’.

The key objective of the plan is to protect surface and ground water. Heavy polluting industries like the petroleum sector have been the focal point for enforcement. Facilities found to breach specified standards under the new law face significant fines and prison sentences for directors.

The effluent standards for the petroleum refining and petroleum chemistry sectors came into force on 1 July 2015. Specified limits differ depending on the sector and province but are usually between < 50 or < 30 mg/L chemical oxygen demand (COD).

Prior to the enforcement of the Water Ten plan, some sectors did not have any specified limits for effluent quality. This meant that discharging untreated wastewater into waterways was permitted and has resulted in facility management requiring the installation of a complete treatment process from scratch.

Since enforcement in 2015, treatment technologies have been integrated which in many cases are not advanced enough to reach the specified limits. Arvia have been partnering with companies in China since 2016, offering an environmentally sound and low-maintenance treatment alternative.
The Project

An engineering team from Arvia conducted initial treatability trials at the client's facility in Nanjing, China on samples of the recalcitrant refinery effluent. This effluent was from a reverse osmosis (RO) system, which concentrates harmful chemicals into a reject stream.

Using Nyex™ technologies, a COD reduction of down to 12mg/L was achieved on the concentrated RO stream, which entered the Nyex™ system at around 60mg/L.

After seeing the trial results, the client went ahead with the purchase of a full-scale Nyex™-a PLUS system to treat effluent at 60m³ per hour at their refinery facility. The purchased system consists of a set of submersible reactors which sit inside a large treatment basin and combine adsorption with electrochemical oxidation.

The concentrated RO stream will be gravity fed into the treatment basin containing the Nyex™ reactors. Once in the basin, atmospheric pressure drives the water into the base of each reactor and up through a bed of carbon-based adsorbent media. Due to the use of gravity and pressure, there is no need for pumping the water, which saves the end-user additional operational expense.

The carbon-based media inside each Nyex™ reactor localises the harmful organic chemicals onto its surface and these pollutants are simultaneously oxidised using an electrical current. The treated water overflows out of the top of the reactors and is directed out of the basin for further treatment.

The purpose of the Nyex™-a PLUS in this application is to remove the most persistent organic chemicals to protect the biological treatment step which is further downstream. If the chemicals from the RO stream were to react with the biology, this treatment step would be damaged and become ineffective.

See the full petrochemical treatment train in the image on next page:
Recycling Water

Tank

Coagulation

DAF

PAC

Adjusting Tank

Biological

Sedimentation

Filtration

Ozone

Treated Tank

Nyex-a PLUS

Reverse Osmosis

RO Reject Stream

Nutrient

Air

PAC

Sludge Tank

Sludge tankered

Backwash

This section is not yet in the treatment train and may be added in the future

Figure 1: Petrochemical plant wastewater treatment process
Due to the flexible nature of the Nyex™ process, it can be installed as above to support other treatment processes or installed as a final ‘polishing’ treatment step to remove any remaining recalcitrant chemicals from effluent prior to this being discharged.

**Next Steps**

Upon installation and integration of the Nyex™ reactors into this new treatment process, the partnership between Arvia and their client will develop across further manufacturing sites.

There are several sites across China owned and operated by this petrochemical company also in need of advanced treatment processes.

Arvia’s water treatment specialists work with each site manager on an individual basis, analysing and testing their effluent. This process will ensure that the team proposes the most efficient and cost-effective solution for each site dependent on their effluent quality and discharge targets.