A world designed to last

Wet air oxidation

Spent caustic treatment technology



T.EN TECHNIP ENERGIES

Wet air oxidation of spent caustic from ethylene and petrochemical plants

Technip Energies' Spent Caustic Treatment unit (SCTU) Technology is a commercially proven process that reduces the chemical and biological oxygen demand (COD/BOD) of the spent caustic effluent prior to discharge to a biological treatment system or public waste water treatment facility.

Applications

Technip Energies uses a proprietary medium pressure (MP) Wet Air Oxidation (WAO) reaction to treat spent caustic effluent. The WAO system can be used to process suitable spent caustic produced from ethylene and other petrochemical units. The technology provides a competitive balance between Total Installed Cost (TIC) and toperating costs, while operating at an intrinsically safer lower pressure and temperature compared to alternate high-pressure technologies. The installed hydrocarbon stripper can remove nearly all light organic COD/ BOD from the treated spent caustic.

Experience

Our first low pressure (LP) SCTU was built and commissioned in 1993 for BP Chemicals, in Grangemouth, Scotland. To meet tighter wastewater treatment standards and achieve a higher sulfide conversion, Technip Energies developed the MP WAO technology. The BASF-YPC (BYC) MP WAO unit in Nanjing, China, was commissioned in 2002. Currently we have 12 SCTUs in operation globally.

WAO unit under construction.

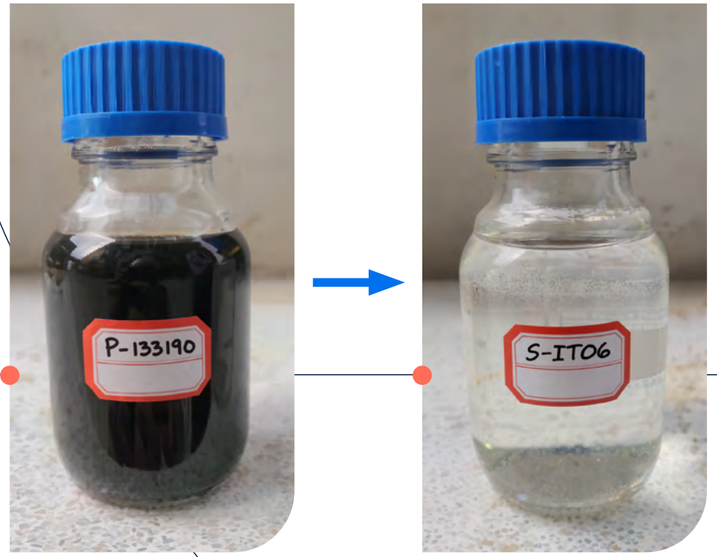
Background

Spent caustic effluent discharged from ethylene units typically has a high COD/BOD. Table 1 shows the composition of a typical spent caustic effluent.

Compound	Ethylene plant
NaOH	1.0- 4.0 wt%
Na2S/NaHS	0.5 – 8.0 wt%
Na2CO3	1.0 – 10.0 wt%
RSNa	< 1.0 wt%
Dissolved HCs	0.1 – 1.0 wt%
Carbonyls	50 – 500 wppm
Dienes	100 – 10,000 wppm
Total Aromatics	< 1.0 wt%
COD	10,000 – 100,000 mg/L
BOD	5,000 – 30,000 mg/L

Table 1: Typical spent caustic effluent composition.

The spent caustic effluent is environmentally hazardous and difficult to treat within a conventional biological wastewater treatment system without prior treatment. Technip Energies' SCTU technology reduces the COD/BOD of the spent caustic prior to the effluent being discharged to the wastewater treatment system.



Treated Spent caustic from SCTU, China

Technip Energies' MP WAO

Technip Energies has designed SCTUs since 1990. Several of the early units utilized the LP WAO reactor design, operating around 7 barg. Subsequently, the MP WAO process was developed, operating at around 13 barg, to provide higher sulfide conversion with the lowest capital cost. The TIC savings of the MP unit is significant when compared to that of high pressure (HP) WAO units which typically operate at >25 barg. Figure 1 illustrates a typical flow scheme.

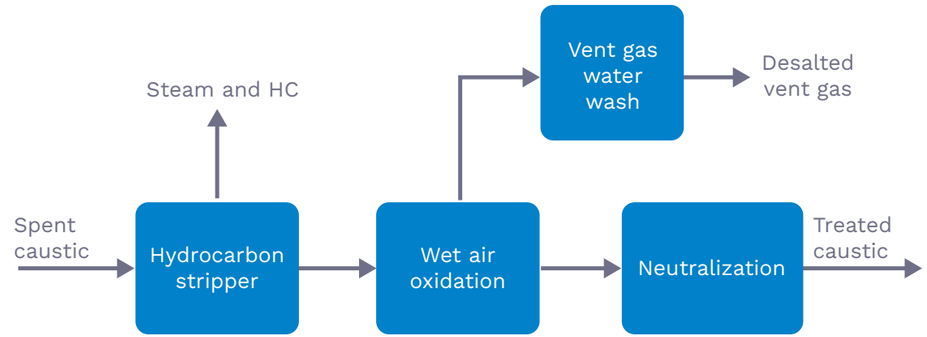


Figure 1: Technip Energies SCTU process flow scheme

Process Description

Spent caustic is pumped to the hydrocarbon stripper (HCS) where dissolved hydrocarbons (mercaptan, phenols, etc.) are stripped to nondetectable levels using LP steam. The HCS vent stream is routed to the quench system or to the wet flare. The HCS removes the light organic COD from the spent caustic. The heavy organic materials in the spent caustic will be continuously polymerized at the stripping temperature to form larger polymers, which are removed using a filter prior to the spent caustic being introduced to the WAO reactor.

The WAO process is designed to oxidize inorganic COD such as sulfides in the spent caustic. In the reactor, compressed atmospheric air is injected into the spent caustic solution, where it reacts with the oxidizable contaminants. The operation of the WAO reactor is optimized for sodium sulfate conversion and vessel metallurgy limits. The vent gas from the reactor system is routed back to the furnace firebox for disposal. The hot oxidized spent caustic from the reactor is cooled and neutralized before being discharged to a biological treatment system.

WAO Benefits

Some of the key benefits of the MP WAO operation over other technologies are:

- MP WAO operation is intrinsically safer than high pressure technologies
- MP WAO operation allows the use of lower cost alloys (316L or super duplex stainless steels) resulting in a lower TIC for the unit compared to other technologies
- The MP WAO operation allows the use of commercially available, oil free, centrifugal compressors
- The use of a centrifugal compressor means that a standby compressor is not automatically required. The SCTU can still be operated (at turndown) using plant air pressure in the event of compressor maintenance
- Unlike other technologies, the hydrocarbon stripper removes the organic COD/BOD from the spent caustic
- The vent from the MP WAO reactors can be routed to the furnace firebox for destruction. Other technologies require the stream be routed to an expensive and unreliable thermal oxidizer

The MP WAO unit can now be completely supplied by Technip Energies as modules in three sizes which can be mixed and matched to meet customer requirements and minimize costs.

Side view of MP WAO reactor modules at BYC, Nanjing, China

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