Waste Water Treatment

BP Refinery
Kwinana, Western Australia

The Kwinana Refinery has one of the best performing Waste Water Treatment Plants in all of BP's global operations, and the Refinery openly shares its successes with its peers

BP's Kwinana Refinery uses water at every stage of the refining process. The most common water use is for cooling hydrocarbons, however water is also used for cleaning and other purposes. Water is classified as 'waste water' if it could have come in contact with hydrocarbons or other contaminants.

The Refinery operates two systems for cleaning water prior, one of which is a multi-stage Waste Water Treatment Plant.

How is Waste Water produced at the Refinery?

Waste water is generated across the Refinery in the following ways:

- The Refinery's main input, crude oil, contains water from the oil drilling process. This water must be removed before the crude oil can be fed to the refining units.
- Water is used to wash the holds of the ships that deliver crude oil to the Refinery, so the ship can be loaded with its next cargo.
- Water is used within some refining processes, and some of this water comes into direct contact with crude oil, producing contaminated wastewater.
- The Refinery has many sealed surfaces that will collect storm water during a rainfall event; this water has the potential to be contaminated so is also captured for treatment.

Additionally, the Refinery has a cooling water system that uses salt water from Cockburn Sound to maintain hydrocarbons at steady temperatures as they travel through the refining units. The salt water is pumped through pipelines that wrap around tubes of hydrocarbons. Under normal circumstances the salt water does not come into contact with any contaminants however a process is in place to ensure the quality of cooling water.

What is in Waste Water?

Waste water streams from the Refinery can contain a number of chemicals which originate from crude oil. Typical contaminants include:

- petroleum hydrocarbons
- heavy metals
- phenolic compounds
- sulfides
- ammonia

Waste Water Treatment Facilities at the Refinery

The Refinery has advanced systems in place to treat contaminated waste water to standards set by the Department of Environment. The salt cooling water is treated differently to other waste water from the Refinery.

The Refinery's Waste Water Treatment Plant was commissioned in 1994, and was built in a dual train configuration, ensuring that the Plant can operate effectively at all times, even during maintenance.

The first stage of the treatment process is the API separator, which is named after the American Institute of Petroleum. As its name suggests, the separator physically separates the free oil and solids from the water. Gravity allows any oil in the water to rise to the surface of the separator and any solid particles to sink to the bottom. A continually moving scraper system pushes oil to one end and the solids to the other. Both are removed and the recovered oil is sent back to the Refinery for reprocessing.

In the second stage, small suspended oil particles are removed in the Dissolved Air Flotation unit. A polyelectrolyte chemical is added to the waste water to help bind the small oil droplets into larger ones, which will float. Air is also injected to lift the amassed particles to the surface where they can be skimmed off.

Both the API separator and the Dissolved Air Flotation Unit are covered processes, which prevents oil from evaporating and being released into the atmosphere. In this way, the refinery has greatly reduced its emissions of volatile organic compounds.

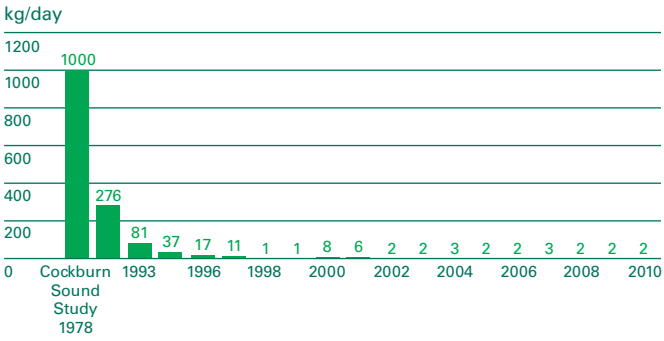
The third treatment step is the removal of dissolved organic contaminants and nutrients in the Activated Sludge Units (ASUs). In this process, naturally occurring microorganisms feed on the dissolved organics in the waste water, and convert them to water, carbon dioxide and nitrogen gas, which can be safely released into the atmosphere.

In the final stage, waste water enters the clarifying tanks, where the microorganisms settle to the bottom while the treated waste water flows away. An optional treatment step is to conduct further settling in the polishing ponds, or the water can be pumped back to the Activated Sludge Unit for retreatment.

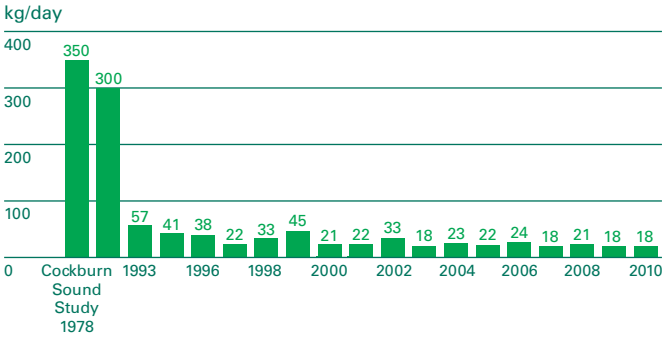
Once water is cleaned to the appropriate standard it is discharged directly to the Sepia Depression Ocean Outfall Line (SDOOL) which is owned and managed by the Water Corporation.

Salt water used as cooling water is not contaminated under normal circumstances, so is subject to a different treatment process. The heated water passes through three separators during which time it cools down prior to discharge to Cockburn Sound. If oil is visible in any cooling water, actions are taken to isolate the source of the leak.

Waste Water Emissions - OIL



Waste Water Emissions - NITROGEN



Performance and Control

Each step of the waste water treatment process is monitored and data recorded optimise the treatment process. Samples of the treated waste water, taken by automatic samplers, are analysed for:

- hydrocarbons
- sulfides
- heavy metals
- temperature
- chemical oxygen demand
- phenolics
- nitrogen
- pH
- biological oxygen demand
- total suspended solids

Results are recorded and reported to the Department of Environment and Conservation, who are the regulating body for the Refinery's environmental license.

Continuous Improvement

The Refinery has worked hard to improve the quality of its treated waste water and the figures above show a steady improvement in the average daily loads for oil and Nitrogen in waste water since the late 1970s. The Kwinana Refinery has one of the best performing Waste Water Treatment Plants in all of BP's global operations, and the Refinery openly shares its successes with its peers.

The link to Cockburn Sound

Since linking in with the Water Corporation's Kwinana Water Recycling Plant in 2009, BP no longer discharges any treated processed waste water into Cockburn Sound. Despite years of ongoing improvements in the quality of waste water, this is a significant step forward for the Sound.