Oil/Water Separators Exceed Regulatory Requirements

BAPCO Takes a Step Toward Meeting Capacity and Environmental Goals

CASE STUDY

Location: ***Awali, Kingdom of Bahrain***
Owner: ***Bahrain Petroleum Company (BAPCO)***
Engineer: ***Japan Gasoline Corp. (JGC)***

Problem

The Kingdom of Bahrain is home to Bahrain Petroleum Company (BAPCO), which is the small island nation's only petroleum refinery.

Most of the equipment in place at the refinery today has been in use since the early 1970s, when the plant's last expansion and upgrade took place. BAPCO currently produces 265,000 barrels of oil per day. The company hopes to complete an expansion that will allow the refinery to process up to 380,000 barrels, a 42-percent increase.

With neither odor nor emission controls, the refinery's pre-upgrade oil/water separators were essentially open pits wherein residual oil in the wastewater floated to the surface and eventually floated to a chamber for collection. In addition to increasing its production, BAPCO hoped to become one of the most environmentally compliant oil refineries in the Middle East.

The Government of Bahrain has specific effluent and air-quality requirements that the refinery would need to reach. Upgraded American Petroleum Institute (API) 421-compliant oil/water separators will play a critical role in BAPCO's ability to meet these requirements.

The refinery also faces environmental challenges of another sort. It pulls seawater from the Persian Gulf for its processes. Because seawater is naturally high in chlorides, the upgraded oil/water separators must have the ability to withstand the water's corrosive effects.

Recommended Solution

The Government of Bahrain hired a consortium of companies to work on the overall refinery expansion. As part of the project, the consortium hired Japan Gasoline Corporation. (JGC) to completely revamp the API separators for the wastewater treatment system. JGC ran the project from its office in the Kingdom of Saudi Arabia and chose WesTech Engineering to supply the equipment – including:

- Three API 421-compliant oil/water separators (each almost 32 meters long) with covers to meet emission standards
- Three air-operated double-diaphragm (AODD) sludge pumps, all controlled by a programmable logic controller (PLC)

The skids were to remove sludge from the sludge hoppers in the separators and pump it to a sludge collection facility. In addition to separating oil from the wastewater stream, the separators also use an internal chain-and-flight mechanism to push suspended solids to a sludge-collection hopper.

The three pump skids remove sludge from the separators' sludge hoppers.

Implementation

Implementing this project presented a number of challenges for WesTech, including highly corrosive water, brutal heat, high UV exposure, high internal pressure in the tank covers, and language barriers.

WesTech®

Swire Water

The oil/water separators are constructed of corrosion-resistant materials inside and out.

In addition to designing the large separators to API standards – which define the length, width, and depth of the units based on temperature, specific gravity, viscosity, and other process conditions – WesTech worked with local fabricators to construct the tanks and covers using materials that could withstand a high level of chlorides. After extensive research in materials and associated fabrication requirements (including material-specific welding techniques), WesTech used carbon steel that was compliant with the National Association of Corrosion Engineers (NACE) MR0175 specification. High-chrome stainless-steel was used for the internal components of the API separators. The design also included cathodic protection on the inside of the tank to protect the separators from premature corrosion.

In addition, WesTech had to design the tank covers to accommodate a nitrogen blanket that the refinery would pump in at higher-than-normal pressure. The tank covers were designed to comply with a maximum internal pressure of 1 psi(g), with the nitrogen blanket pressure being between 0.3 and 0.4 psi(g). Typical internal pressure is designed to a maximum of 0.36 psi(g). The nitrogen blanket protects the tanks from the hazards of volatile organic compounds (VOCs), keeping the vapor space between the surface and the tank covers safe from explosion or fire.

The AODD sludge pump skids and piping also required special materials to meet local conditions. WesTech fabricated the pump skids in the USA because certain parts were not available in the Middle East. The AODD pumps were manufactured using Kynar, a material that withstands the punishing impacts of strong sunlight in this desert nation better than other materials and is compatible with chloride-rich water. The piping material was manufactured using glass reinforced epoxy (GRE), which is likewise compatible with chloride-rich water.

Using these specialized materials required extra design, sourcing, and shipping time.

Language and culture barriers made for additional challenges. Working on a project half a world away, not to mention working during a pandemic, required flexibility and patience.

While most people spoke English as a second language, certain technical terminology was not always the same between English and Arabic speakers. This necessitated more extensive explanations and double-checking the designs.

Although the pandemic limited travel options, WesTech was able to surmount these difficulties by developing a relationship with a highly qualified team in Bahrain. This team quickly interpreted the specialized terminology for electrical requirements at the refinery and enabled us to build the PLC in Bahrain. The collaboration reduced lead times required for factory acceptance testing, shipping, and installation at the site. The support structures for the tanks stood 3 meters off the ground and were supplied through a different contract. WesTech partnered with an in-country fabricator to confirm that our tanks and the support structures fit together seamlessly.

Results

After mitigating the challenges through key partnerships with the customer and vendors, we were able to efficiently move our part of the project to completion.

The upgrade will help the refinery meet regional effluent and air-quality standards and increase its capacity by 42 percent.

The effluent requirement for total suspended solids (TSS) was less than 100 mg/L; after performance testing, the actual effluent was on average less than 50 mg/L. The effluent requirement for free oil and grease (FOG) was less than 80 mg/L; after performance testing, the actual effluent FOG was on average less than 70 mg/L.

An important result of this project was the relationships that WesTech built with industry people in Bahrain. By working closely with these key suppliers and fabricators, learning from them, and successfully completing the project, WesTech hopes to be the equipment supplier of choice as the country's focus on sustainability requires other wastewater treatment initiatives.

WesTech partnered with local fabricators to build the tanks and covers.

Tel: 801.265.1000 | **westech-inc.com**

WesTech®

Swire Water