

DEMANDING CHALLENGES MET

BY ALLWEILER® PUMPS AT USED-OIL TRANSFER



Process plant HyLube2

Puralube Germany GmbH operates two refineries according to the innovative UOP HyLube process. Total throughput is 150,000 metric tons per year with used oil as feedstock. The plants are located in the Zeitz industrial park, approximately 40 km south of Leipzig, Germany. Since beginning production at the world's first refinery of this type in mid-2004, the Zeitz site has been producing high-quality API Group II and III base oils. In late 2008, a second plant was brought on line at the same location. Each year, the two plants consume approximately 150,000 metric tons of feedstock. They produce about 90,000 metric tons of base oils and another 50,000 metric tons of other mineral oil products. Currently approximately 110 employees work in production, quality assurance, sales, and administration at this location.

Abrasive components

The pumps used in production must fulfill special requirements that vary depending on the step in the process. At first glance, this may be surprising since the lubricity of oil makes it one of the easiest liquids for pumps to handle. However, the feedstock delivered in tank trucks places high demands on the pumps used to move that material: First, the chemical composition can vary. Second, the presence of solid components in the form of dirt or metal particles is also probable. A coarse screen collects larger solids, but medium-sized and smaller abrasive components can still get into the pumps. The pumps move the feedstock from the tank trucks or tank railcars to a holding tank where samples



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Progressing cavity pump in the main used oil unloading station.

are taken. The pumps used for these tasks must resist chemically aggressive materials like benzols and naphtha while remaining insensitive to solids. Furthermore, all the pumps must have strong suction capabilities in order to draw the sometimes very viscous oil from the tanks. If the feedstock meets the minimum requirements for processing, it is pumped from the holding tanks to storage tanks. From there it moves into the high-pressure portion of the refinery. The pumps must move the material across distances of up to 500 m, sometimes overcoming a counterpressure of up to 2 bar created by a cushion of nitrogen in both holding tanks.

At PURALUBE, progressing cavity pumps fulfill all of these requirements. The company has chosen ten single-stage pumps of the AE-E series from manufacturer Allweiler®, which is part of the CIRCOR corporate group.

The pumps operate at a capacity of up to 65 m³/h and a pressure of up to 8.7 bar. In order to reach this high pressure, the pumps are equipped with elastomer walls of uniform thickness.

Aggressive components

The widely varying characteristics and compositions of the used oil feedstock place extraordinary demands on progressing cavity pumps. They must be able to reliably move liquids containing solids without incurring excessive wear, while at the same time resisting chemically aggressive components contained in the oil. In this context, it is very important to consider that Allweiler® is one of only a few manufacturers of PC pumps that produces its own stators. Engineers choose from approximately 20 different materials to achieve the longest possible service life with the specific pumped liquid. Both the stators and joint collars used by PURALUBE are made of Viton. Additionally, pump speed is adapted to the amount of solids in the material. At 178 rpm,



Centrifugal pump providing column circulation (liquid: base oil)

pump speed is actually much slower than is possible. Higher speeds and smaller pumps would have been possible. But in order to maximize service life, larger pump units running at reduced speeds were chosen. As a result, average service life of the synthetic stator is at least 6 to 9 months, despite the difficult liquid. The special surface structure of the stator and rotor is another advantage of these pumps. The stator surface exhibits a honeycomb structure. Combined with the patented "shark-skin" rotors, the results are low starting and operating forces for greater efficiency and constant performance curves during operation.

Frequency control with a start-up ramp ensures efficient and safe pumping across great distances. Starting up slowly is essential in order to bring the liquid slowly into motion and avoid cavitation.

Once the feedstock has passed through the reactors, it moves to distillation in the main column. A variety of base oils in viscosity classes P75, P160, and P300 are produced here in addition to diesel fuel and naphtha. The resulting off gas is thermally processed in the refinery's heaters.

High temperatures

Centrifugal pumps are used both for the return in the column as well as for final pumping of base oils. At this point, all solids have been separated out and are no longer a factor in selecting pump technology. But now the process involves volatile compounds in addition to temperatures that can exceed 300 °C.

During distillation in the column, oil temperature is between 200 °C and 330 °C, placing high demands on the pumps. Special heat-carrier pumps of the Allheat CTWH series have shown to be ideal for these purposes. Manufacturer Allweiler® of Germany has designed these centrifugal pumps so that



Magnetically-coupled centrifugal pump of the CNH-ML series providing column circulation (liquid: naphtha)

the temperature at the shaft seal remains low enough to use commercially available mechanical seals without external cooling. Since the mechanical seal is the most temperature-sensitive part of the pump, this characteristic is critical for maintaining continuous, disturbance-free pumping at plants that stay in operation continuously. In addition, investment and maintenance costs are kept low by foregoing external cooling. Pumps used for column returns and pumping the products to outgoing storage tanks are designed as redundant units.

Specially designed pumps

Low boilers in the pumped liquid place additional strains on the heat carrier pumps, so special design solutions must compensate. A large seal chamber and the ability to collect and remove gases from the pump are critical for extending the pump's service life and increasing its reliability. Pumps used at Zeitz move between 6 m³/h and 19 m³/h at a pressure of up to 6 bar.

While the thermal conditions of distillation require use of special high-temperature pumps, other factors come into play when pumping the final products. The products are partially volatile and temperatures max out at about 100 °C. The stipulations of the TA Luft air-pollution regulations must be observed as well. In view of the lower liquid temperatures, PURALUBE has selected magnetically-coupled centrifugal pumps of the CNH-ML and CNH-M series from Allweiler®. These pumps are hermetically sealed and move benzene, naphtha, and diesel to the final storage tanks virtually without emissions. With silicon carbide bearings directly behind the impeller, these pumps are quiet in operation and may even run dry for short periods without damage. Pump capacity is between 1 m³/h and 5 m³/h, with pressure at 6 bar(g). The pumps are monitored by thermal sensors.



Centrifugal pump of the CTWH series providing column circulation (liquid: base oil)

One supplier

In total, 77 Allweiler® pumps of several different design types are used at the plant. All pumps are designed with explosion protection. Besides design benefits and optimization for a variety of pumping tasks and liquids, having a single supplier for all pumps has additional advantages: Common parts simplify spare parts management, less capital is tied up, and maintenance is easier because technicians require knowledge of only one manufacturer. Additionally, authorized manufacturer workshop Pumpenfabrik Leipzig GmbH provides competent on-site support and delivery of spare parts.



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