BIC MAGAZINE
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Optimizing pumps and compressors for renewable diesel refining

October 2023

During the pandemic, almost a dozen US refineries shuttered due to declining demand for transportation fuels. Today, 4 of these refineries are being converted to renewable diesel plants. As they come back online, the pumps & compressors that have been used for decades to refine traditional fuels are being updated to handle different feedstocks. This shift provides an opportunity to upgrade rotating equipment in a way that not only addresses the new requirements, but also optimizes efficiency.

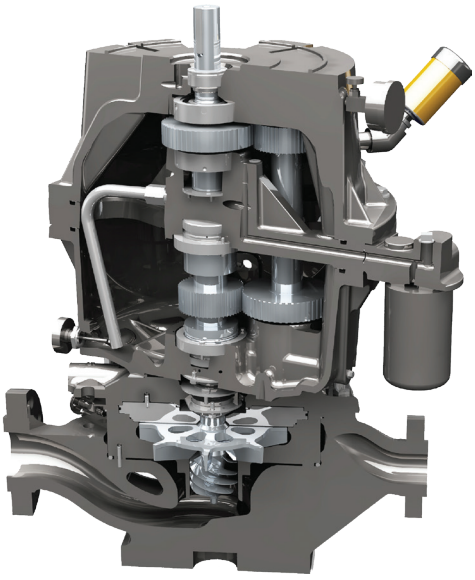
A closer Look at Renewable Diesel:

Approximately 50% of crude oil used around the globe is refined into transportation fuels, which create greenhouse gas emissions. Biomass is a cleaner energy source that can be mixed with crude oil and converted into liquid transportation fuels. Like Ethanol that's mixed with crude to make unleaded gasoline, a range of renewable materials can be used as feedstocks for diesel. These include plant-derived oils such as soybean and palm oil, or other green feedstocks like jatropha and algal oils.

Renewable diesel refining is expected to grow in the future, because the feedstocks are less harmful to the environment, and also because these renewable inputs can be less expensive than crude oil, thus improving a refinery's operating margins.

The refining process for renewable diesel is in many ways similar to traditional refining. Renewable feedstocks are mixed with traditional crude oil and hydrogen, and they are pumped at high pressures into multi-stage catalytic reactors. Throughout the process, byproducts (such as propane and naphtha) are separated, and a series of cold-flow properties are adjusted to meet required specifications.

The viscosities of the feedstocks used in renewable diesel refining differ from traditional



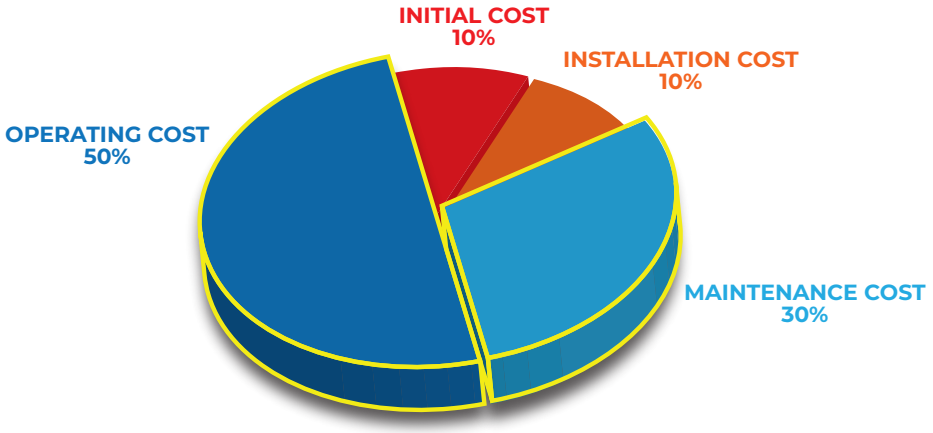
refining feedstocks – so the equipment used to move these materials must operate at different flows & pressures. The pumps most commonly used in refining include API single stage integrally-geared pumps and multistage pumps.

How can operators ensure that pumps are optimized to run at peak efficiency?

It starts with sizing the pump properly for the required task. This is accomplished by advanced analytics and computer-tailored hydraulics, which place the B.E.P. (Best Efficiency Point) at or slightly below the rated point, which results in optimum efficiency. This enables smaller drive sizes to be utilized, which can still deliver the required output while saving energy.

For refiners making the shift to renewable diesel, pumps and compressors handling renewable diesel feedstocks should be re–rated to keep them operating within the API limits (ideally between 80 and 100% of B.E.P). Rotating equipment operating above or below rated flow can result in cavitation, seal failures, high vibration and motor overloads.

Pump or compressor failures of any kind result in poor mean time between repair (MTBR), plant down time and increased maintenance costs. Preventing this domino effect is critical – because maintenance & operational costs can make up as much as 80-percent of the total lifecycle costs.



BREAKDOWN OF LIFE CYCLE COSTS

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The Shift to Renewable Diesel Presents an Opportunity for Plant Operators to Upgrade their Pumps & Compressors

Enhancements in manufacturing, combined with customer feedback from operators in refineries have identified the following 10 areas for optimizing pump and compressor performance, extending maintenance intervals, and reducing Total Costs of Ownership:

1. **Pump & Compressor Upgrades:** Outdated compressors/pumps in the field can be upgraded with the latest technology without changing out the major components (such as the casing, housings and foundation).
2. **Re-Rates:** when process conditions change, pumps & compressors should be re-rated to tailor flow and head to the new process requirements. Efficiency improvements are achievable without requiring a new motor, footprint or piping. Some re-rates have been able to provide 30% additional head with 10% power savings.
3. **Seal replacements:** new materials have improved seal performance and extended seal life. Modifications to seal housings improve fluid flow-through and remove high-point vapor pockets, which improves seal life.
4. **Cartridge Seal Upgrades:** facilitate error-free replacements for pump shaft seals. Self-contained cartridge seals include a shaft sleeve, seal and gland plate, and they're fitted onto the pump shaft as a single assembly.
5. **Inboard & Outboard Bearings:** the latest generation of bearings offers better rotor stability over a wider operating range. They also dampen & reduce vibration and extend seal longevity.
6. **Bearing Frame Upgrades:** Power-end replacements enhance reliability and ensure compliance with current API 610 bearing life requirements.
7. **Gearbox Conversion Kits:** deliver up to 10 design improvements via an interchangeable, bolt-on package that delivers an estimated minimum 5-year MTBM. Gearbox exchanges provide better bearing life, and they include stronger gear sets that facilitate higher load levels.
8. **Compressor Inlet Guide Vanes (IGVs):** are a series of blades arranged at the inlet of a compressor that "pre-swirl" gas flow entering the impeller. IGVs increase a compressor's turndown while reducing the amount of work needed from the main driver.
9. **High Efficiency Compressor Impellers:** recent impeller design improvements enable compressors to produce the same amount of flow utilizing up to 20% less power than previous designs.
10. **Instrumentation:** updated instrumentation for monitoring vibration and temperature gives operators peace of mind that rotating equipment is operating at Best Efficiency Points.

The R.O.I. of Upgrades Versus Purchasing New Equipment:

These upgrades cover almost 90% of the maintenance requirements for rotating equipment. Upgrading the key components can add decades of service life. They also eliminate the cost of installing a new pump or compressor, which in refineries involves a highly customized process that can require unique foundations, complex piping runs and teams of welders, concrete workers and crane operators.

Each of these updates can be accomplished in a matter of days, at a fraction of the cost of buying new equipment, providing the following benefits:

Lower Operating costs: ensuring that pumps and compressors are operating at their B.E.P. minimizes vibration and reduces energy costs.

Lower Maintenance costs: upgrading the key components with new parts that are warrantied extends maintenance intervals and reduces overall maintenance costs.

Increased Plant Uptime: In the months ahead, refining capacity around the globe will increase significantly. Many refineries run operations around the clock, and plant uptime is the true measure of all optimization efforts.

In Summary:

Today, oil prices are rising, and demand for diesel fuel is increasing. As a result, many refineries are contemplating ways to meet demand with new market opportunities such as renewable diesel. Any plant that is considering increasing its output – or varying its processes to accept renewable feedstocks – should consider re-rating and upgrading their rotating equipment. To learn more, please visit: www.sundyne.com/aftermarket-services/conversions-rerates.