

Time to take stock

Andrew Brennan, ExxonMobil, USA, considers the effects of the COVID-19 pandemic on refining footprint.

A key component to ensuring customers receive consistent, high quality base stocks is having a robust and efficient manufacturing process. While most recognise that base stocks are produced in the same refineries that produce fuel products, few realise just how important refinery economics are to the production of base stocks. This connection has become even more evident as the world continues to grapple with the challenges presented by COVID-19.

There are three key elements that impact the economic viability of a base stock production unit: cost of feedstock, operating expenses, and value generated from products produced. The cost of feedstock is one of the most important elements when it comes to impacting refinery economics (Figure 1). Specific to base stocks, there are two key elements that come into play. The first is feedstock quality, which can require a producer to pay more for a higher quality lube crude or feedstock in order to meet a finished product specification. The second is yield. It takes many barrels of feed to produce one barrel of base stock, so any increase in feed costs can have an amplified effect on the cost to produce base stock (Figure 2). Some refineries' feedstock choices start with crude purchases, while others begin with intermediate streams such as vacuum gas oil (VGO) or hydrocracker bottoms (HCB). Whichever feedstock is used, the cost and quality need to be considered in conjunction with the site's production capabilities and end product specifications.

Other considerations in the economics of lubricant refining are the operating expenses (OPEX), which are the refinery costs incurred to convert the feedstock to an end product. These costs include categories such as salaries and wages for workers, utilities, maintenance expenses, and storage and handling.

Some expenses increase as more product is made (variable expense) while others are fixed (salaries for workers). One benefit that large producers enjoy is economies of scale, as they can produce more products at approximately the same level of total fixed OPEX. This enables a lower unit cost.

When it comes to revenues, refineries have two value generating streams: the base stocks and the by-products. By-products are different depending on the type of manufacturing at the refinery. Paraffin waxes and extracts are generally the primary by-products for Group I base stock production and fuels products for Group II or III base stock production. Obviously, a higher value that the refinery can receive for each of those streams improves the overall economics for the site.

As with any business, a refinery needs to generate positive net margin to remain viable. This principle is also applicable to the base stock production unit specifically. If the base stock production is not structurally profitable then the refinery operator may need to make changes to improve margins.

The current state of refineries

There are around 700 refineries around the world today, with only about 120 making lubricant base stocks. Refineries primarily exist to produce fuel. In fact, the global demand for base stocks is less than 1% of global hydrocarbon demand. There are only a handful of lubricant specific or specialty refineries that exist today. These are relatively smaller refineries that are less complex and more niche, with lower volumes and higher costs. Base stocks are a larger percentage of their output, and they are heavily dependent on the health of the lubricants industry. If base stock prices were to drop significantly relative to feedstock for an extended period of time then the viability of that site could be called into question.

For larger, integrated refineries, there can be more flexibility to respond to changing market conditions. With these refineries, production can be optimised to help better match supply with demand, and to improve production economics. These refineries have the ability to shift their intermediate feedstocks to other refinery units in order to maximise overall refinery margins. For example, a refinery may be producing a light neutral Group I or II base stock, which is realising declining margins due to industry oversupply. The refiner can optimise their site by sending that light neutral stream to another refinery or chemical plant unit to manufacture a higher value product instead. Smaller, less complex refineries, on the other hand, may be dependent on a certain type of crude or feedstock to produce the quality base stocks they want. This limitation can be quite costly during times of crude and fuel price swings. The larger integrated sites typically have more flexibility to optimise feed selection and subsequent operations.



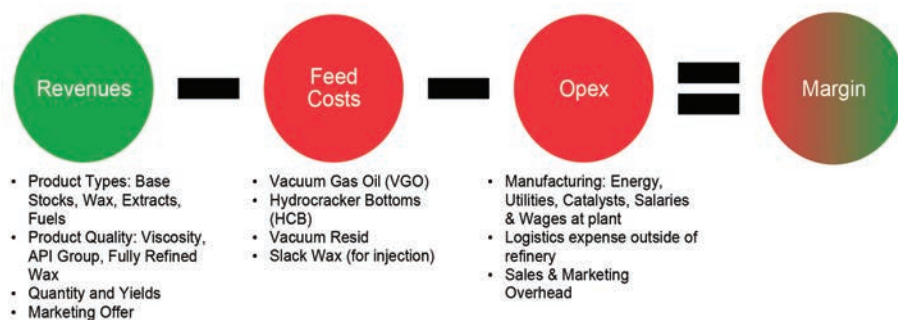
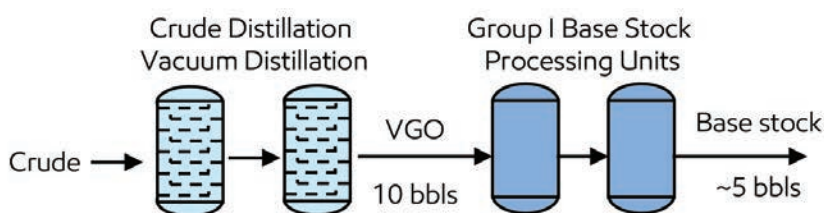


Figure 1. Economics of lubricant refining.



Based on general industry Group I processing yields, a \$1/B increase in Vacuum Gas Oil (VGO) costs results in a \$2/B cost increase in Group I base stock produced

Figure 2. Impact of feed cost increase on base stock produced.

The global pandemic impacts fuels demand and base stock supply

The COVID-19 pandemic has impacted every industry around the world, and the global refining industry is no different. As countries began lockdowns, there was an unprecedented decline in the demand for transportation fuels. This rapid reduction in fuels demand caused inventories to peak and refinery margins to fall. Despite the news headlines of ‘negative crude prices’ for the US WTI benchmark for some contracts in late spring 2020, international crude prices remained firm relative to fuels prices. The resulting poor demand and negative unit margins caused multiple refineries around the world to completely shut down during that first lockdown period while other refineries significantly reduced their utilisation.

As refineries adjusted their crude intake due to the decline in fuels demand, this impacted the availability of feedstock (VGO and HCB) used to produce base stocks. Coincidentally, this lower base stocks supply was initially balanced with lower demand for finished lubricants due to falling industrial activity, engine oil changes, etc. As demand for finished lubricants started to recover in late summer 2020, base stock production struggled to match customer demand.

Potential impacts of COVID-19 on refiners

The stronger the economic position of the refinery prior to the pandemic, the better the chances are for continued profitable operation throughout and after the pandemic.

That said, this pandemic has really challenged the refining industry. As of November 2020, multiple refineries have already announced a permanent shutdown or conversion to a terminal or biofuels production. As for the base stock industry, supply from any refineries with base stock units that shut down due to the pandemic will be impacted. However, since the base stock markets were oversupplied prior to the pandemic, it is not clear how long it may take the markets to come back into balance, given how dramatic the impacts of COVID-19 have been over the past year.

For refineries struggling with margins, there are steps they can take to potentially help the situation by adjusting some of the elements that drive refining profitability: feed cost, OPEX, and product revenues. In the case of base stocks, as operators optimise and make adjustments to their refineries, customers need to be prepared for any potential changes to product

specifications, service offering, and product availability. As has been seen in the past in over-supplied markets, if the refiner has a higher alternative value for the feedstock of the lubricants unit then the lubricants unit will risk being shuttered.

Key factors a refinery may consider before switching production to another finished good

Before making any decisions to optimise the site, a refiner would typically consider how these steps affect one of the three elements of refining economics: cost of feedstock, operating expenses, and revenue streams. The operator needs to understand what assets they already have and what the capability is of those assets. Reasonable questions the operator may ask might be: does this optimisation require additional capital investment? Will it enable a lower cost feedstock? What is the value of the other finished product and will it generate more revenue? Switching production in the refinery usually comes with credits and debits, so it is important to consider all aspects and the end results.

Larger, more complex integrated manufacturing sites with access to competitive feedstocks and global markets will tend to be more resilient to market fluctuations, as they have the capability to switch production between products with less cost or investment. Smaller refineries that are not in advantageous locations and do not manufacture a wide product mix may continue to face margin pressure long after the pandemic is over. 