



Uniflex Process

Commercially Proven Residue Upgrading Technology

**Maximize Your Return
from Every Barrel**

More Value from the Bottom of the Barrel

Refiners are seeking to add value from their residual fuel oil, also called the “bottom-of-the-barrel”. Given that for many refiners this represents the last fraction of their crude oil that has not already been upgraded, the decision on which technology to utilize to maximize value-add is a very important one, with long-term impacts and economic consequences.

With higher crude oil prices the incentive to opt for carbon-conversion to high value transportation fuels, rather than a carbon-rejection route to coke or heavy fuel oil, is increasingly compelling.

To help refiners address this shifting market, UOP has introduced the UOP Uniflex™ Process. Uniflex is a high conversion, commercially proven technology, that processes low quality residue streams like vacuum residue, to make very high-quality distillate products.

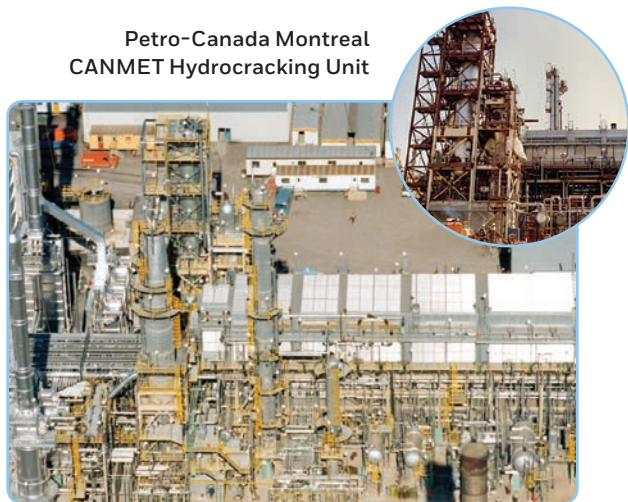
Uniflex offers significant advantages compared to alternative technologies. It is a zero fuel oil solution that maximizes your production of clean distillates. The process has been proven at commercial scale with years of efficient and reliable operation, providing robust economic returns. It can be readily integrated into existing refining facilities.

In the early-2000s, understanding the value that high-conversion upgrading technology could offer to its customers, UOP began evaluating slurry hydrocracking technologies. Its efforts identified that the most efficient approach to date was the Natural Resources Canada’s (NRCan) CANMET Hydrocracking Process, which had been operated successfully in a 5,000 barrel-per-day unit in Montreal for 15 years with up to 95% conversion. UOP acquired the exclusive worldwide rights to license this process in 2007 and through a continued commitment to research and development has developed the UOP Uniflex process to meet the needs of today’s challenging market.

Advanced Technology with 90% Conversion

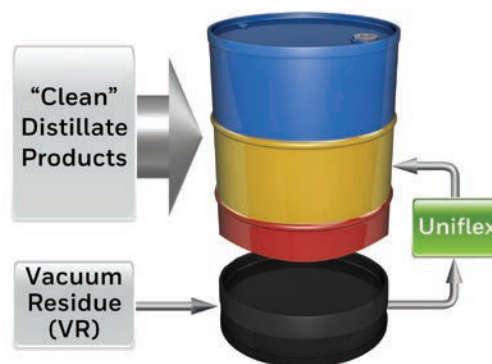
Uniflex technology utilizes thermal cracking to reduce the molecular weight of the residue. It does so in the presence of hydrogen and a proven proprietary, nano-sized catalyst to stabilize the cracked products and inhibit the formation of coke precursors.

Petro-Canada Montreal
CANMET Hydrocracking Unit



Residue feed and hydrogen-rich recycle gas are heated and sent to the upflow reactor. High product vaporization maximizes the residence time of the unconverted liquid phase heavy residue while the backmixing ensures near isothermal conditions within the reactor. Products exit from the top of the reactor and are quenched to terminate the reactions.

The main products from Uniflex are naphtha and diesel with a yield of greater than 80 vol%. These require further hydrotreating to meet finished product quality specifications.

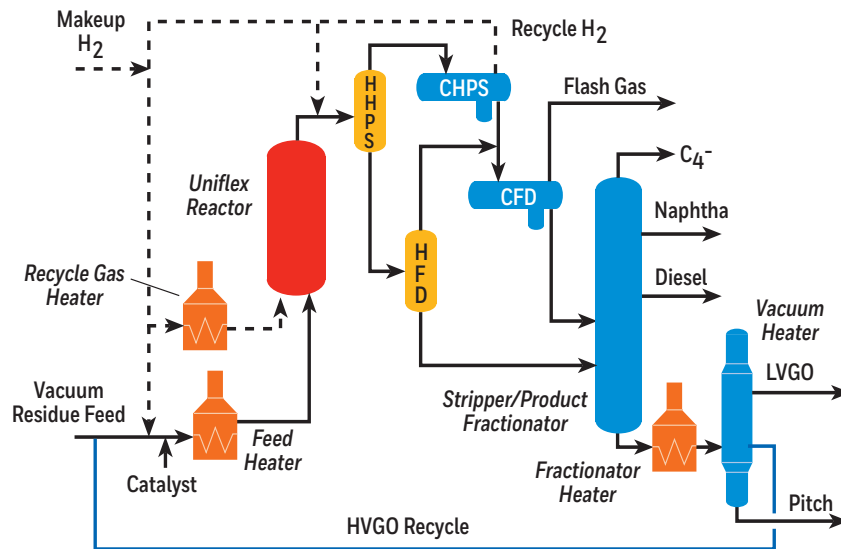


The small amount of VGO produced from the process, typically around 15 vol%, is suitable feedstock for a refinery’s downstream hydrocracker or FCC after hydrotreating.

The process minimizes the production of unconverted residue, or pitch, comprising only 10 Wt% of the overall yield. This stream is suitable for various applications including circulating fluidized bed boilers, cement kilns or power boilers. Pitch solidification can be utilized depending on the location of the end users relative to the refinery.

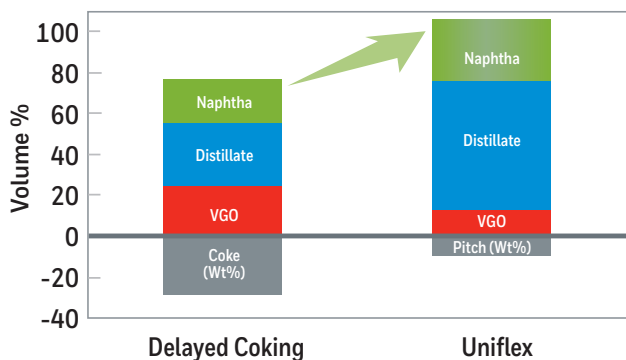
The overall scheme of the Uniflex process is very similar to the widely applied UOP Unicracking™ Process and the reactor pressure is also similar. The reactor has no catalyst bed and limited internal equipment.

UOP Uniflex Bottom of the Barrel Upgrading



Higher Conversion than Delayed Coking

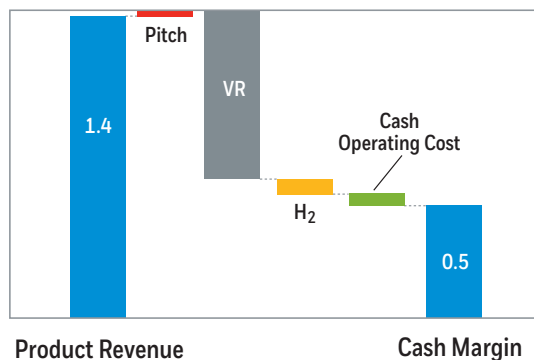
The compelling advantage that Uniflex offers, as compared to delayed coking, is the significantly higher conversion achieved. Uniflex achieves >55 vol% yield of diesel, nearly double that of coking and achieves a low pitch yield - even for poor quality feeds.



Increase Margins by 60 to 100%

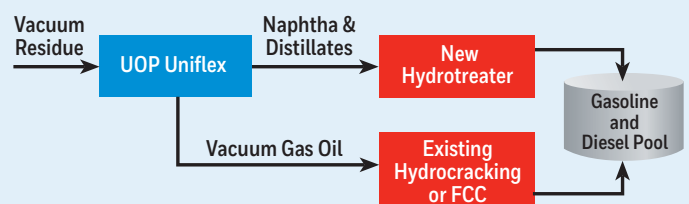
Uniflex typically increases the refinery margin by 60-100%, or ~\$300-500 million/year for a 2 million t/yr unit. This combination of high margin uplift and minimized CAPEX result in very attractive economics for applications in both existing and new refineries.

Indicative Annual Cash Revenues/Costs (\$ Billion)



Simple Integration into Existing Refineries

One of the key Uniflex advantages is simple integration into most existing refineries, which enables use of existing plant and facilities and minimizes the level of new investment CAPEX required. Typically a new hydrotreater will be required for Uniflex naphtha and distillates. In most cases the small amount of VGO produced can be processed in an existing hydrocracker or FCC.



The key global market drivers for refiners are now aligned in support of residue upgrading – falling fuel oil demand, rising clean distillates demand and high prevailing crude oil prices.

The UOP Uniflex process is a highly compelling technology, maximizing the use of existing facilities to minimize capital cost, while offering a new commercially proven industry benchmark in zero fuel oil refining.

Uniflex offers a proven technology solution that closely aligns with current and future market needs, and is available for license from a company that has almost 100 years of technology innovation, design and commercial application. The integration of Uniflex with proven and state-of-the-art hydroprocessing technologies ensures that the highest quality clean fuels are produced.

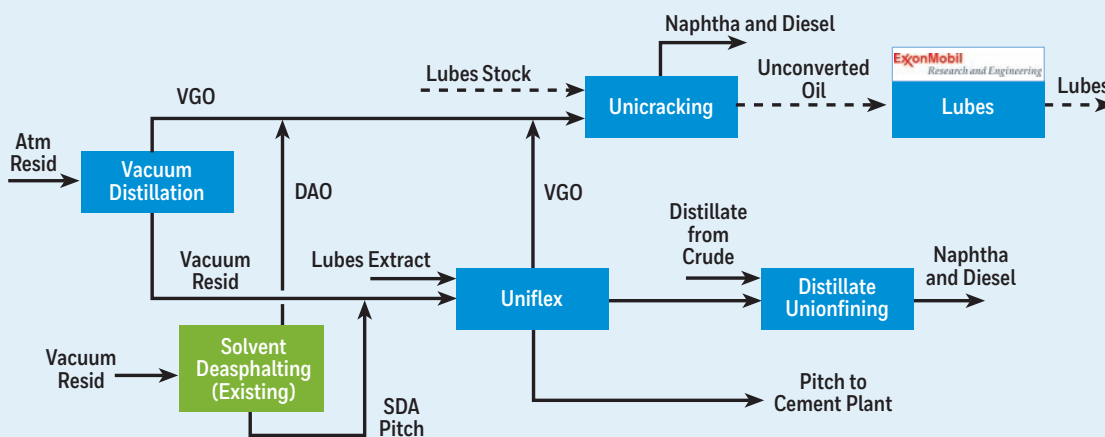
National Refinery Limited (NRL) Selects UOP Uniflex for Bottom of the Barrel Upgrading

In late 2011, NRL selected Uniflex to provide valuable residue upgrading capabilities at its facility in Pakistan. With stagnant demand for low-value fuel oil and growing diesel demand, Uniflex will help the refiner to address the market shift and increase their profitability.

NRL will use Uniflex to upgrade its many heavy residue streams into distillate products. Of particular value to NRL is the high yield of diesel possible from the technology, which is nearly double that of competing residue conversion technologies. In the integrated facility, Uniflex will work in conjunction with UOP Unionfining™ hydroprocessing technology to produce high-quality diesel fuel and naphtha for gasoline production.

Vacuum gas oil from the facility will also be converted to diesel and lube base oils using UOP's Unicracking™ technology and lube oil dewaxing technology provided by an alliance between UOP and ExxonMobil Research and Engineering Company (EMRE).

The NRL facility, scheduled for start-up in 2016, will produce 40,000 barrels per day of diesel fuel and 4,500 barrels per day of lube base oils.



For more information

For more information, please contact your UOP representative or visit us online at www.uop.com

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