VCC™

Veba Combi-Cracking Technology

Upgrade Low-Value Refinery Residue Streams to High-Quality Products

Maximize refinery profitability or monetize coal assets by using VCC™ technology an engineering process and service, from the BP/KBR alliance. Produce valuable products such as low-sulphur naphtha, ultra-low-sulphur diesel (ULSD) and low-sulphur gas oil from a wide range of coal, residue, and thermally-cracked slurry feeds.

VCC technology opens numerous pathways to monetize distressed feeds and improve refinery margins through increased fuel yields or petrochemical integration

TECHNOLOGY

VCC technology is a slurry-phase hydrogenation process with integrated hydrotreating, converting petroleum residues at very high conversion of heavy or solid hydrocarbons into light distillates by hydrogen addition. Through this, liquid yields up to 115 vol% can be achieved.

The feedstock is mixed with a proprietary additive and injected into the high-pressure section of the process. The feed is mixed with hydrogen and brought to the required conditions. The operating conditions are adjusted to achieve **greater than 95 wt% conversion** of the residue and 90% of coal in a once-through mode of operation without the aid of external diluents. The cracked products are upgraded in the same high-pressure loop to produce low-sulphur products.

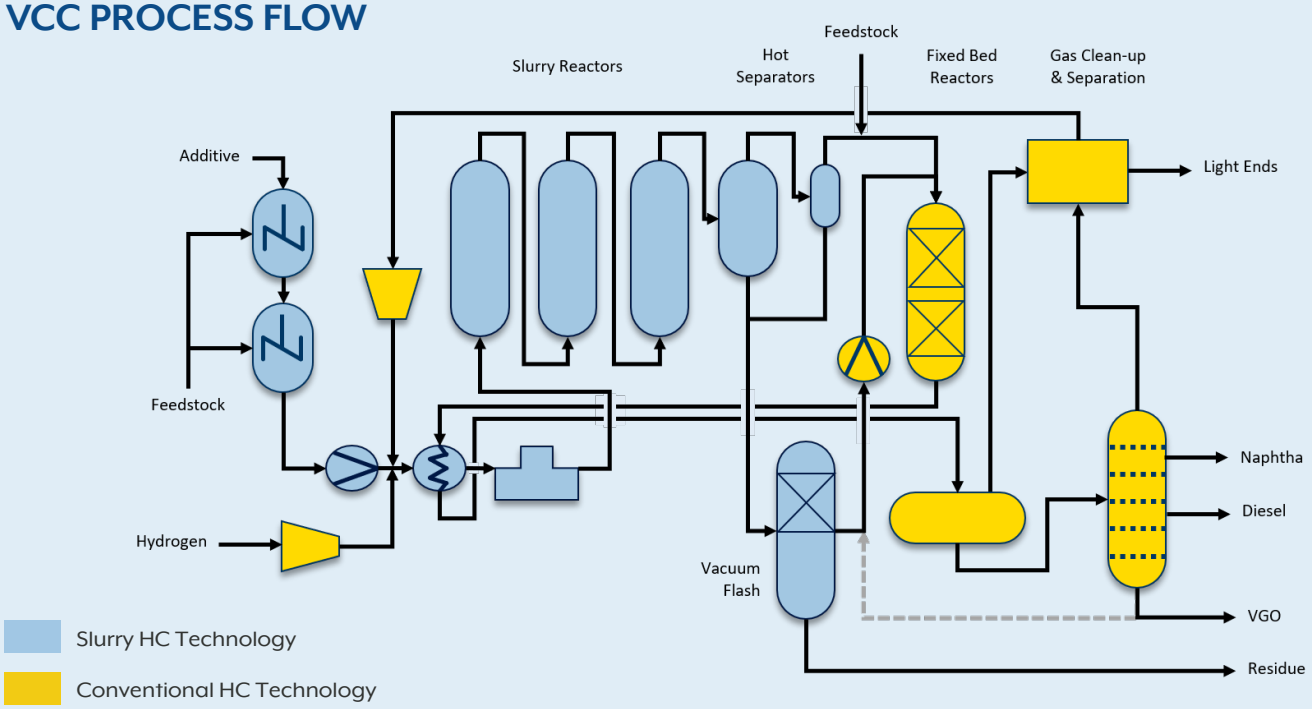
FEATURES

High once-through conversion: Unlike other residue upgrading technologies, VCC operates at 95% once-through conversion without the need for asphaltene removal or recycling, producing high-quality distillate and naphtha products to meet growing fuel and petrochemicals market demand.

Feedstock flexibility: VCC has processed the largest variety of feedstocks of any slurry hydrocracking technology, making it a great option to address the bottom of-the-barrel challenge. With VCC, owners can process coal and liquids, giving them the ability to monetize large coal reserves or other low value heavy streams including high sulphur fuel oil. Pilot facilities are available to test specific feeds.

Proven technology: VCC is the result of decades of research and operating history making it a highly dependable upgrading technology unmatched by competitors. VCC units are designed to operate reliably from 60-110% of nameplate capacity, maintaining expected yields tailored to the client's objectives. Based on historical operating data, a typical VCC unit can be expected to meet or exceed an on-stream factor of 92% per year, and a run length of two years or more based on hydroprocessing catalyst life.

VCC PROCESS FLOW



HIGH-QUALITY PRODUCTS

Due to the features of our proprietary VCC additive to prevent fouling, the unit can operate at a high conversion rate. All VCC products are derived from the conversion of residue, producing high-quality products.
Technology features allow reaction severity to be controlled while providing flexibility to meet changing diesel/naphtha demands.

The low-sulphur naphtha product has a relatively high naphthene plus aromatics content, which makes it a suitable feedstock for petrochemicals production or a reformer. The diesel product has a high Cetane Index and can be directly blended into the ultra-low-sulphur diesel (ULSD) pool. Vacuum gas oil (VGO) from the unit is suitable for further processing in conventional fixed-bed hydrocrackers or fluid catalytic crackers. It can also be recycled to extinction within the VCC unit, so the only products are diesel and lighter materials.

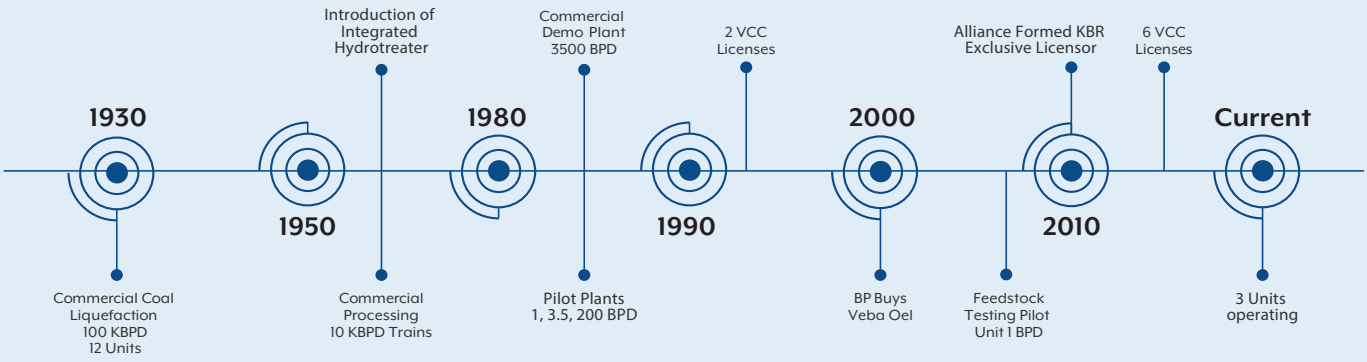
With VCC, operators can produce high-quality products like naptha, diesel and UCO (low-sulphur gas oil) from bottom-of-the-barrel residuum like FCC slurry oil or coal

COMMERCIALIZATION

Since acquiring the initial German heritage technology from VEBA Oel in 2002, BP has continued to enhance and develop its proprietary Veba Combi Cracking (VCC) technology for upgrading hydrogen-deficient feeds. The 3,500 bpd Bottrop demonstration unit was commissioned in 1981 and operated for 20 years on coal, petroleum residues and waste plastics. In 2010, BP and KBR entered into a collaboration agreement to promote, market and execute VCC licensing and engineering services. To date, KBR has sold six licenses for VCC units processing various types of feedstock, including coal, with three currently operating.

The combination of KBR's know-how and BP's operating experience results in VCC, an innovative, reliable, cost-effective bottom-of-the-barrel technology

Licensee	Yanchang Petroleum Company	Yanchang Petroleum Company	TAIF-NK	Cambodia Petrochem. Corporation	Jordan Petroleum	Riverview Energy Corporation
Location	Yulin, China	Shenmu, China	Nizhnekamsk, Russia	Cambodia	Zarqa, Jordan	Indiana, USA
Feedstock	FCC Slurry Oil / VR + Coal	Coal Tar	Vac. Residue + VGO	Vacuum Residue	Vacuum Residue	Coal
Capacity	450 KTA	500 KTA	2.7 MMTA + 1.0 MMTA	1.2 MMTA	1 MMTA	1.6 MMTA
Products	Naphtha 17wt% Diesel 59wt%	Naphtha 23wt% Diesel 64wt%	Naphtha 14wt% Diesel 60wt% VGO 12wt%	Naphtha 21wt% Diesel 62wt%	Naphtha 11wt% Diesel 45wt% VGO 27wt%	Naphtha 21wt% Diesel 42wt%
Status	Operating	Operating	Operating	Delayed	Engineering	Environmental permitting complete
Start-up	2015	2016	2017	TBD	2025	2025



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