



SYDEC™ Delayed Coking Process

Refining

Delayed coking is a total conversion process of residues that produces gas oil conversion unit feedstocks, distillates, naphtha, and petroleum from coke. The normal feedstock to a delayed coker is vacuum residue, although atmospheric residue and other streams (solvent deasphalting pitch) can be coked.

The many chemical reactions of delayed coking are intricately complex, however, three distinct reactions occur:

1. Partial vaporization and mild cracking (visbreaking) of the feed as it passes through the coker's furnace.
2. Cracking of the vapor as it passes through the coke drum.
3. Successive cracking and polymerization of the liquid trapped in the coke drum until it is converted to vapor and coke.

The Selective Yield Delayed Coking (SYDEC) technology, licensed by Foster Wheeler USA Corporation (FWUSA), is a low-pressure, low-recycle design for maximum liquid yields. UOP has exclusive marketing rights for the technology in most parts of the world where multi-unit sales occur.

SYDEC Process

In the coker, preheated fresh feed is mixed with a small liquid recycle stream recovered in the unit fractionator and is charged to the coker heater. Steam is injected into the heater coils to maintain the required minimum velocity and residence time, and to suppress coke formation in the heater tubes.

The vapor-liquid mixture leaves the furnace and enters the coke drum, where it is converted to coke and light hydrocarbon vapors. These vapors travel through the drum and leave overhead.

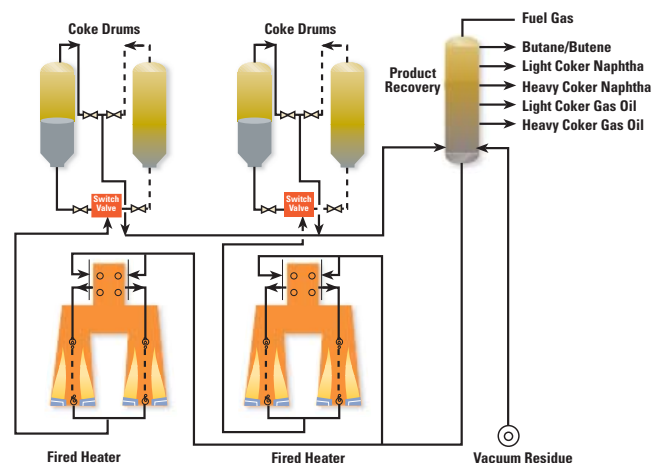
Coke is removed from the coke drums using high-pressure water jets. The water is reused to minimize process effluents.

The coke produced in the delayed coker is almost pure carbon and is utilized as fuel or, depending upon its

quality, in the manufacture of anodes and electrodes. When charging selected feeds, a special type of coke with a needle-type structure may be produced. This coke is commonly known as "needle coke" and is used to manufacture large electrodes for the steel industry. This needle coke has a high strength and low coefficient of thermal expansion.

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The total number of coke drums required for a particular application is dependent on the quality and quantity of the feed and the desired coking cycle. A minimum of two drums is required for operation, with one drum receiving the heater effluent while the other is being decoked.

Types of cokers

Coker types are defined by the types of coke produced.

■ Fuel Grade

The most common type of coker is the fuel grade. Here the objective is to maximize liquid yields as the coke has a relatively low value.

■ Anode Grade

Anode grade coke is produced from low sulfur, and metals type feedstocks. It is used for anodes in the aluminum industry.

■ Needle Coke

Needle type of coke is produced from highly aromatic feedstocks, such as FCC slurry oil or thermal tar. It is used for electrodes in the steel industry and garners a high price. Consequently, coke yield is more important than liquid yield. When producing high-value needle coke, the feedstock must be highly aromatic and have low asphaltene, sulfur, and ash contents.

Operating Variables

<i>Variable</i>	<i>Result</i>
Drum temperature	Increased temperature reduces coke yield and increases coke hardness
Pressure coke	Increased pressure increases and gas yields, decreases C ₅ ⁺ liquid yield, and lowers gas oil end-point
Recycle ratio	Same effect as pressure increase

In a commercial unit it is important to optimize recycle ratio and gas oil end-point.

Investment costs

A typical delayed coker unit will have an ISBL cost in the region of \$3,000 to \$5,000/bbl of feed.

Operating costs

Typical continuous utility requirements based on a low-pressure, low-recycle design are:

Fuel liberated	5,100,000 Btu/h/1000bpd
Power consumed	150 kW/1000bpd
Steam exported	1.7 lb./h/1000bpd
Cooling water	15 gpm/1000bpd

Experience

Foster Wheeler USA Corporation has licensed more than 50 delayed coking plants in 37 countries over the past 50 years. FWUSA has designed and constructed the maximum size coke drums permissible under current hydraulic cutting limitations. Additionally, Foster Wheeler USA has designed the world's tallest delayed coker structure.

For more information

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