Needle/Synthetic Graphite Coking

Chevron Lummus Global

Overview

Chevron Lummus Global's (CLG) innovative Needle Coking Technology is one of the best technologies for the conversion of a wide variety of feedstocks for producing synthetic graphite for anodes for lithium-ion batteries (LIB) and high-quality needle coke for the manufacture of large-diameter High Power (HP) and Ultra High-Power (UHP) Electrodes for the production of steel in electric arc furnaces (EAF) from scrap metal.

The technology is based on several decades of extensive research and development work combined with experience gained from numerous commercial unit designs currently in operation. It includes the application of both CLG's conventional delayed coking and two-step technology.

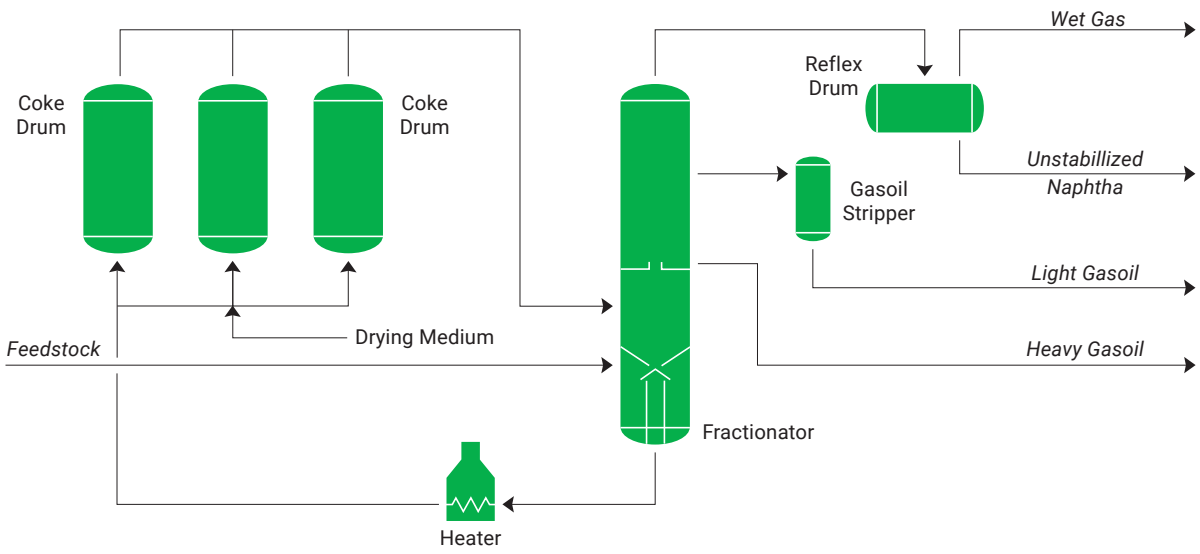
A variety of feedstocks can be processed, including FCCU decant oil, coal tar pitch, thermal tar, and ethylene pyrolysis tar. The two-step technology minimizes the coefficient of thermal expansion (CTE), an important performance criterion for graphite electrodes in electric arc furnaces.

Every design is supported through CLG's wholly owned coker pilot plant by subjecting the feedstocks to extensive screening tests followed by the manufacture of test samples that allow evaluation of all the required performance specifications for high-quality electrodes and/or testing for suitability of coke for energy storage.

Technical Advantages

Process Features	Process Benefits
Extensive Commercial and Pilot Plant Database; Predictive Tools	Optimizes key operating conditions to meet stringent electrode performance specifications for variety of feedstock properties
Two-Step Coking Technology	Allows gradual mesophase development and coalescence to produce highly crystalline structure minimizing the CTE
Various Feedstock Pretreatment	Eliminate contaminants such as quinoline insoluble (QI), sulfur, and nitrogen
Special Coking Heater Design	Maximizes run length • High efficiency
Online Heater Decoking	Higher on-stream factor
Fully Enclosed Automated Flange Unheading System	Enhanced operational safety • Shorter cycle time
Insulated Transition Spool Piece	Reduces deformation for longer coke drum life
Coke Drum Mechanical Design/ Vertical Plate Coke Drum (VPCD)	Maximizes drum life for all drum sizes
Helical Baffle Exchangers	Improved unit on-stream time
Environmentally Advanced Design	Reduces fugitive emissions and waste effluents

Process Flow Diagram



Process Description

Conventional and two-step coking is a semi-continuous process using alternating drums that are switched off-line after filling and drying modes of operations. Support facilities include closed blowdown, coke cutting and handling, and water recovery systems.

The Feedstock is fed to the bottom of the fractionator, where it mixes with condensed recycle. The combined stream is heated in the coking heater to initiate free radical formation in the first step for the mesophase development and coalescence inside the coke drums. Then, a drying medium is used in the second step to move the reaction towards completion and formation of ordered solid needle coke.

Coke drum overhead vapor flows to the fractionator, where it is separated into wet gas and coker liquid products such as unstabilized naphtha, light gasoil, and heavy gasoil.

During the coke drum steam out and cooling period, all steam and hydrocarbon vapors are directed to the closed blowdown system, where they are recovered and recycled. After the coke drum cooling cycle is complete, the coke is hydraulically cut from the drum with the aid of the specially designed coke cutting head and dropped into a pit or pad, where water is separated from the coke and recycled.

Predictive Tools

From extensive pilot plant and operating experience, CLG has developed a correlation package and computer software to predict coking yields and operating conditions for various feedstocks and product requirements. CLG's pilot plant facility is used to produce needle coke and manufacture test electrodes to determine the required graphite electrode performance.

Additionally, synthetic graphite suitability as an energy storage precursor for LIB application is conducted to evaluate capacitance, irreversible capacity, fast charging, and discharging capability at different rates.

CLG, through Lummus Technology, provides operator training simulators (OTS) that exactly duplicate the actual unit control room environment. OTS uses an in-house developed dynamic simulation of the delaying coking unit using a confidential kinetic model of CLG's proprietary delayed coking technology.

CLG provides plant support through its highly experienced technical services group. Additionally, remote monitoring and artificial intelligence optimization are available via Lummus Digital throughout the unit's life cycle.

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