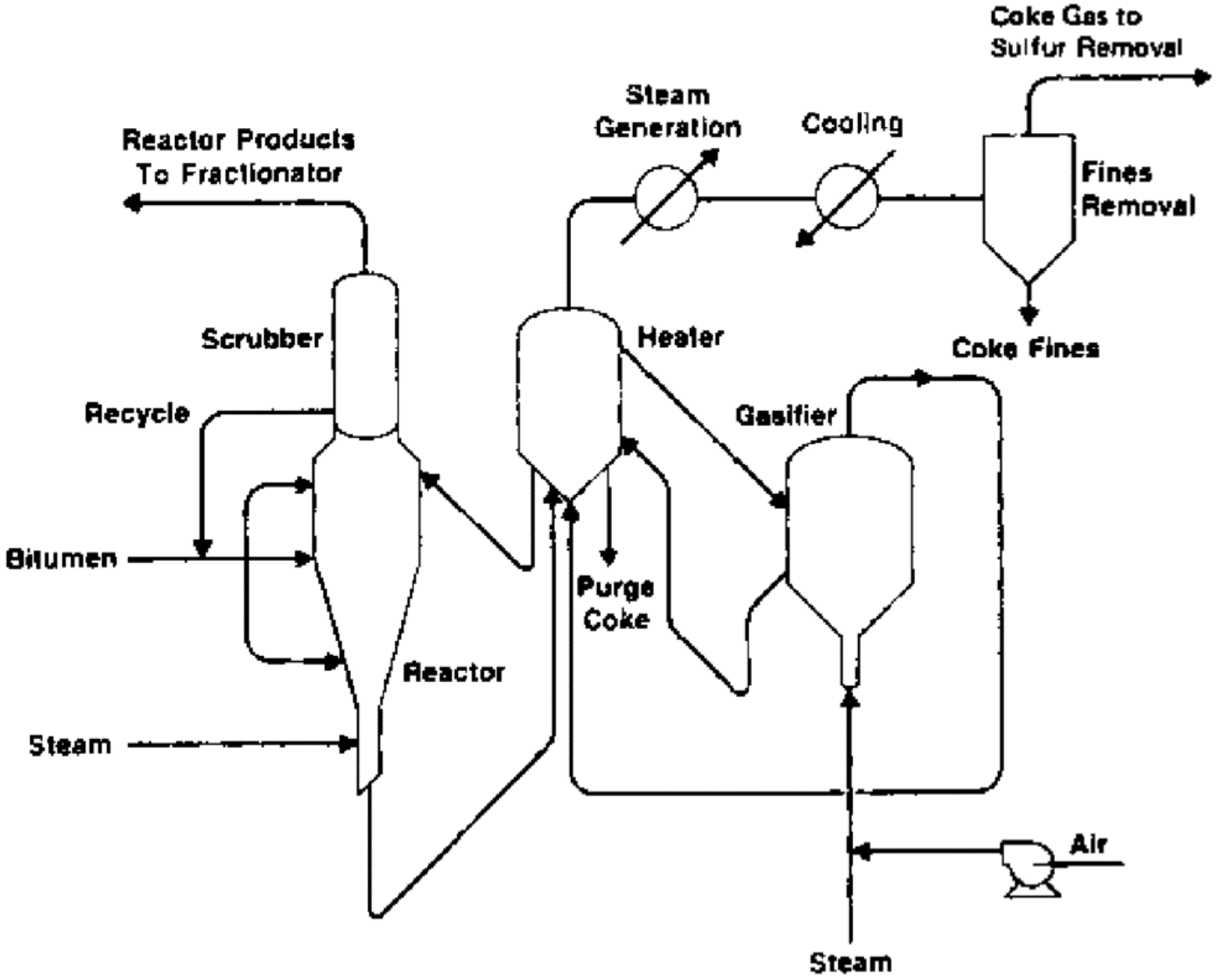
Lecture №12 Flexicoking

Flexicoking is direct descendant of fluid coking and uses the same configuration as the fluid coker but includes a gasification section in which excess coke can be gasified to produce refinery fuel gas.

In the process, excess coke is converted to a low heating value gas in fluidized bed gasifier with steam and air. The air is supplied to the gasifier to maintain temperatures of 830-1000 °C but is insufficient to burn all of coke. Under these reducing conditions, the sulfur in the coke is converted to hydrogen sulfide, which can be scrubbed from the gas prior to combustion. A typical gas product, after removal of hydrogen sulfide, contains CO, 18%, CO_2, 10%, H_2, 15%, N_2, 51 %, H_2O, 5%, CH_4, 1%.

The equipment for the flexicoking process



The heater is located between the reactor and gasifier, and it serves to transfer heat between the two vessels.

Yields of liquid products from flexicoking are the same as from fluid coking, because the coking reactor is unaltered. The main drawback of gasification is the requirement for a large additional reactor, especially if high conversion of the coke is required. Units are designed to gasify 60-97 % of the coke from the reactor. Even with the gasifier, the product coke will contain more sulfur than the feed, which limits the attractiveness of even the most advanced coking processes.

The flexicoking process produces a clean fuel gas with a heating value of about 90 Btu/ft^3 (800 kcal/m^3; 3351 kJ/m^3) or higher. The coke gasification can be controlled to burn about 95% of the coke to maximize production of coke gas or at a reduced level to produce both gas and a coke that has been desulfurized by about 65%. This flexibility permits adjustment for coke market conditions over a considerable range of feedstock properties. Fluid coke is currently being used in power plant boilers.

The liquid products from the coker can, after cleanup via commercially available gas oil hydrodesulfurization technology, provide large quantities of low sulfur fuel (< 0.2 wt% sulfur). The incentive for fluid coking or flexicoking increases relative to alternative types of processing, such as direct hydroprocessing, as feedstock quality (Conradson carbon, metals, sulfur, nitrogen, etc.) decreases. Changes in yields and product quality result from a change from a low cut point, high reactor temperature operation to a high cut point operation with a lower reactor temperature

Fluid coke is used in electrodes for aluminum manufacture, in silicon carbide manufacture, in ore sintering operations, and as fuel. The coke from a feedstock containing a large amount of contaminants may not be suitable for these uses, from the standpoint of either product contamination or environmental considerations. The flexicoking process overcomes this problem by converting part of the gross coke to a gas that can be burned in process furnaces and boilers. The coke fines from a flexicoker contain most of the metals in the feedstock and may be suitable for metals recovery.

The fluid coking processes can be used to produce a high yield of low sulfur fuel oil as well as to completely eliminate residual fuel and asphalt from the refinery product slate

The different distributions are obtained by varying the fluid coker/flexicoker

operating conditions and changing the downstream processing of the coker reactor products. In fact, there are many process variations that can be used to adapt the process to particular refining situations. Once-through or partial recycle coking can be used where there is a small market for heavy fuel oil or where a quantity of high sulfur material can be blended into the fuel oil pool.

In reference to the process parameters, the *reactor temperature* is normally set at 510–540°C (950–1000°F). Low temperature favors high liquid yields and reduces the unsaturation of the gas but increases the reactor holdup requirements. The burner temperature is normally 55–110°C (100–200°F) above the reactor temperature. Regulating the amount of coke sent to the reactor from the burner controls the reactor temperature. Burner temperature is controlled by the air rate to the burner.

Low pressure provides a maximum gas oil recycle cut point, minimizes steam requirements, and reduces air blower horsepower. Reactor pressure normally adjusts to the gas compressor suction pressure but is made higher by the pressure drop through the piping, the condenser, the fractionation tower, and the reactor cyclone. The unit pressure balance required for coke circulation and is normally controlled at a fixed differential pressure relative to the reactor.

The *reactor coke level* is controlled by the cold coke slide valve on the transfer line from the reactor to the burner, and the *burner coke level* is controlled by the coke withdrawal rate.

In the flexicoking process, the heater temperature is controlled by the rate of coke circulation between the heater and the gasifier. Adjusting the air rate to the gasifier controls the unit inventory of coke, and the gasifier temperature is controlled by steam injection to the gasifier.