THE RECOVERY OF BY-PRODUCTS

For a comparison of the economical aspects of the various methods of gasification, the valuation of by-products is very important. Until now, such by-products may be of little value as no market can be found. This situation will change immediately when production of gasoline from coal has been started, because then the by-products of gasification after refining can be mixed with products

TECHNICAL PERFORMANCE AND POSSIBLE IMPROVEMENT OF THE DIFFERENT METHODS.

Fixed Bed, Mechanical Grate, Atmospheric Pressure.

This method of gasification is very suitable for the production of hydrogen-rich gases for hydrogenation and synthesis from coke, semi-coke, or anthracite. Such a gas is highly concentrated, and can be easily purified. For the gasification of raw bituminous coal, the content of CH_4 is a drawback, except in case the gas should be used as a heating gas, possibly after passing a synthesis plant.

Therefore, this gasification method should be considered primarily for the utilization of highly bituminous, non-caking coals, in connection with a carbonization plant. The auschwitz works, built in 1942, were based on this method.

Mechanical units with a capacity of 60 to 80 tons of coke or 120,000 to 150,000 normal cubic meters of carbon dioxide-free gas per day and a relatively low consumption of oxygen account for low investment and low operation costs of such a plant.

Carbonization and gasification can be combined in a modified Lurgi carbonizer. Such a combination obviously improves the heat and the material balance and saves investment and labor costs compared with separate carbonization and gasification plants. Units of a capacity of 300 tons of bituminous coal per day, corresponding to 300,000 to 350,000 normal cubic meters of carbon dioxide-free gas from gasification of coke are the usual dimensions of a Lurgi carbonizer. The gas production can be increased to 400,000 normal cubic meters per day and unit by a splitting of the distillation gas with oxygen.

Downwards operating with part of the used oxygen saves part of the steam, and allows production of a gas with a high carbon monoxide content. Even the ratio 2:1 for CO to H_2 can be produced if part of the carbon dioxide is recycled from the water wash.

Gasification with Fixed Fuel Bed Under 20 Atmospheres Pressure.

This method is suitable for the gasification of all non-caking fuels in sizes above 1/8 inch. A primary gas with 20 percent CH_4 is produced with only 50 percent of the oxygen consumption of other methods and even 35 percent based on thermal units. No compression of the gas is required, and the hydrogen sulfide can be removed with the water wash.

For the production of hydrogen or synthesis gas, the primary gas must be split with oxygen, and the total quantity of oxygen is equal to the amount needed in straight gasification under atmospheric pressure. Organic sulfur and gum-forming compounds are removed completely. The splitting stage allows a regulation of the $CO:H_2$ ratio in a wide range between 1.5:1 and 1:2.

By-products are recovered in very good quality. City gas with 500 to 800 B.t.u. can be easily and cheaply produced by converting part of the carbon monoxide and hydrogen in a 1-stage synthesis into gasoline.

The capacity of a 2.6 cubic meter unit, when operated with coal of medium or high fusion point of the ash, is 100 to 120 tons of water-free coal per day. Construction of a mechanized unit of 3.5 cubic meters and a capacity of 180 to 200 tons of coal or 220,000 to 250,000 normal cubic meters of carbon dioxide-free gas per day cannot offer serious difficulties according to the experience available.

This method has some important advantages for the gasification of all non-caking coals, for the production of city gas and the gasification of small-sized, non-caking coal with a tar content above 5 percent, for the production of gas for synthesis and hydrogenation. These are by-product recovery and low power consumption.

Gasification in a Fixed Bed in a Slagging Producer.

Only a solid coke above 1-inch size can be gasified with this method. The $CO:H_2$ ratio of the primary gas is above 2, the carbon dioxide content low enough for a direct use in a synthesis process. 300,000 to 350,000 Normal cubic meters of synthesis gas can be produced per unit per day. This method is favorable when high-grade coke and anthracite is available at a low price and a high $CO:H_2$ ratio is needed for the synthesis process that follows. An additional shift conversion of carbon monoxide is normally required, and an elimination of the carbon dioxide formed in the shift reaction.

Gasification of Pulverized Coal.

This method may be considered the most universal with regard to the fuels. Even caking coals, not suitable for any other method of direct gasification, can be gasified. Consumption of oxygen and steam are relatively low, the oxygen consumption slightly higher than in stationary fuel bed operation. The additional costs of pulverization may be important with hard fuels, such as anthracite, splint coal, woody lignite, and some carbonization residues. By-products can be recovered only by a separate carbonization.

The method has been developed technically only in an experimental unit, but no exceptional difficulties should be expected in developing an industrial unit of 300 to 500 tons capacity per day for atmospheric pressure operation. The gas production of such a unit may safely be estimated as 500 to 600,000 normal cubic meters per day.

For the eastern coal fields of the United States, where caking coals probably are primarily available for the production of liquid fuels, gasification of pulverized coal seems to be so important that the development of an industrial unit should be considered urgent, even if the method is less favorable for other coal fields.

The production costs of the gas could be reduced considerably in case gasification of pulverized coal would be operated under 10 atmospheres pressure.