

Description of Plant Gelsenberg Benzin I-III. Gelsenkirchen-Horst,
October 10, 1941

The plant consists of six coal stalls and six gasoline stalls. The stalls are 44.4 feet long, 28.6 feet wide and about 72.2 feet high and are arranged in such a way that two stalls form one double stall. The walls of the stall are of reinforced concrete and have a thickness of about 13.8 inches. The layout of the stalls is shown in the attached drawing. The coal stalls are designated 24 to 28 and 124 to 126; the gasoline stalls are 21 to 23 and 121 to 123.

The stalls 24, 124 and 25 comprise one heat exchanger of 1.97 feet inner diameter and 59 feet length, two coal converters of 3.28 feet inner diameter and 59 feet length, one coal converter of 3.28 feet inner diameter and 49.2 feet length, one hot separator of 3.94 feet inner diameter and 32.8 feet or 39 feet length, one gas preheater, one gas cooler, two air coolers (for gas and sludge) and one product separator.

The coal stalls 125, 26 and 126 are different from the other stalls in that they have three instead of two of the 59 feet converters so that each stall has a total of four converters. The units operate at a pressure of 10,300 psi.

From the paste presses the coal paste is passed into a system of tubes called "preheater". In the preheater the addition of hydrogen which has been preheated in the heat exchanger takes place. The preheater serves the purpose of bringing the coal paste gas mixture to the reaction temperature desired. The heating medium is flue gas which is recycled in the apparatus.

The tube system of the gas preheater consists of seamless tubes (drilled) of 6.74 inch outer diameter and 1.58 inch wall thickness which are welded together at a length of about 49.3 feet. Fins are welded to the outside of the tube in order to improve heat transfer. Every two lengths of tube are connected with each other by means of a welded return bend, thus forming a "hairpin" and the individual hairpins are connected with double bends which are screwed on. The material of these tubes is a chromium-tungsten-molybdenum-vanadium steel of high resistance to hydrogen and heat. Design of these preheaters, as well as the choice of materials and manufacturing methods follow the experience of the I. G. Plant, Ludwigshafen.

In order to avoid unduly high wall temperatures, care is taken that fuel gases do not touch the tubes immediately. The combustion gases enter first a mixture chamber where the combustion temperature is reduced from about 2,732°F. to about 1,112°F. by contact with cool recycled flue gas. Recycling is carried out by two blowers, each of which has a capacity of 2,645,000 cubic feet per hour. Each preheater is equipped with safety valves.

After the coal paste-hydrogen mixture has been heated in the preheater to about 842°F., it passes into three or four coal converters. The mixture flows through the converters in the presence of a catalyst and here the conversion to gasoline and middle oil takes place by the addition of hydrogen.

The pressure shells for the heat exchangers and the coal regenerators consists of seamless steel tubes which are fabricated from a hydrogen-resistant special chromium-nickel-molybdenum steel of the following properties: Ultimate tensile strength at 68°F. 92,400 to 106,500 psi., yield point 64,000 psi. at 68°F. 122

The shells are calculated on the basis of experience of the I. G. Ludwigshafen with similar materials for a wall temperature of maximum 572°F. All shells are insulated at the inside. The wall temperatures are continuously controlled during operations by means of thermocouples.

From the converters the product passes into the hot separators which have a length of 32.8 to 39.4 feet and here the remaining heavy oil and the ash is separated from the gaseous products. The latter flow into the above-mentioned heat exchangers in order to heat the fresh hydrogen. In the air condensers arranged outside the coal stalls (high-pressure tubes of alloyed material with cooling fins), cooling to about 392°F. takes place. The product is further cooled in water-cooled tubes (gas coolers or water coolers) where a temperature of about 140°F. is reached and where the middle oil and gasoline are condensed. Hydrogen is separated from these products in the product separator. In the depressuring vessels the pressure on the product is released and the product is transferred to the distillation unit via intermediate storage. The residue separated in the hot separators is passed through another air cooler of the same design as previously described and flows then through depressuring vessels into the centrifuging plant.

The gasoline stalls can be differentiated into three kinds:

1. Stalls for 5058 catalyst, structures 121 and 22. Each of the two 5058 stalls consists of two heat exchangers of 1.97 feet diameter and 59 feet length, three gasoline converters of 3.28 feet diameter and 59 feet length, one electric preheater, one gas cooler and one product separator.
2. Stalls for 6434 catalyst, structures 21 and 122. The chamber 122 consists of two heat exchangers of 1.97 feet inner diameter and 59 feet length, three gasoline converters of 3.28 feet diameter and 59 feet length, one gas preheater, one gas cooler and one product separator. The stall 21 is distinguished from the preceding stalls only in that it contains only two instead of three gasoline converters.
3. Stalls for 1719 catalyst, structures 23 and 123. Each of the two 1719 stalls consists of three heat exchangers, 1.97 feet diameter and 59 feet length, three gasoline converters of 3.28 feet diameter and 59 feet length, one refining reactor of 3.28 feet diameter and 59 feet length, one gas preheater, one gas cooler and one product separator.

The units work at a pressure of 4,400 psi. Flow of product in the gasoline unit is exactly the same as in the coal unit, with the exception that in this case middle oil instead of coal paste is being used.

The electric preheater consists of eight tubes of chromium-molybdenum-tungsten-vanadium steel of a length of 39.4 feet, an outer diameter of 5 inches and a wall thickness of 0.7 inches. One to two regulating transformers of 600 Kw. each are used for controlling the power and current is usually only required during heating up of the unit.

The gas preheater consists of seamless tubes of an outer diameter of 5 inches, a wall thickness of 0.73 inches and a length of 49.3 feet. The preheater tubes are provided with cooling fins. The arrangement of the gas preheaters for the gasoline stalls is the same as those for the coal stalls, with the exception that the two blowers only have a capacity of 1,235,000 cubic feet per hour each.

The units are operated from the central control room which contains instruments for the measurement of pressure, temperature and flow and which also house the necessary control valves.

For the installation of the converters, hot separators, heat exchangers, etc., a crane is on hand with a capacity of 220 tons.

