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A coal Extraction Procedure

Processes for extracting coal with various solvents are known for a long time. Initially the operation took place under gentle conditions; its main purpose was the obtaining of an optimum understanding of the chemical structure of this fossil fuel. The yields of dissolved substances were initially slight. In order to increase them harsher working conditions with respect to temperature and pressure have been used, putting up with extensive changes in the coal, due to depolymerization. At present, we are in the position to dissolve the major part of the organic-coal substance by operating at pressures of more than 100 atm., temperatures of more than 400°C, and with suitable solvents, such as tetraline, tetraline cresol and middle oils obtained by hydrogenating either coal or pitch. The product obtained, after being filtered, is a substance (extract) practically free of ashes, which is interesting for industry. Such extracts, which are free from ashes may be used in high pressure hydrogenation for the production of liquid motor fuels, or for coal dust motor of PAWLIKOWSKI; the cooled material is furthermore most suitable for manufacturing electrodes which are practially free of ashes for manufacturing aluminum steel or electro steel. For this reason it has been for many years produced on a technical scale at the Welheim plant.

When operation first was started at Welheim, a tetraline and cresol mixture was used as a solvent. Later on, the process has been simplified and rendered less expensive by substituting middle oil from the pitch hydrogenation for it. The middle oil, prior to being used for extraction processes, had been passed directly to the gaseous phase and had been worked up to benzine; later on, it was passed through the extraction unit, being used for dissolving the coal, then it was separated from the filtered extraction solution and was available for the gaseous stage only after going through the preliminary stages. Due to this coupling of extraction and the dimensions of the extraction unit were thereby determined since the activity of the middle oil is gradually exhausted in the extraction recirculation and must be replaced by fresh oil.

The Welheim plant has operated with the gas coal mined at (illegible). It must be said, however, that gas coals as well as gas-flame coals of different provenience would yield the same results. Ruhr-coal specimens, as well as those coming from the Saar or from Upper Silesia, has been investigated regarding their suitability as extraction coals. Along with tetralin-cresol mixtures, the middle oils from the 700 atm. pitch hydrogenation are the most favorable solvents. However, the corresponding oils from the coal hydrogenation may be used, too. At the Welheim plant, we have successfully used oils produced by the hydrogenation of pitch, without the adding of any hydrogen. But if coal-hydrogenation oils are used, the addition of slight amounts of hydrogen is indispensable.

This is the Welheim extraction method:

Fine coal (water content about 10%) is dried and finely ground in the coal-drying and grinding unit (dust with 65% to 70% of grains of less than 0.06mm). The coal dust is mixed into a paste with the solvent taken from the tank farm or with

flushing filtrate, the ratio being 1:2. The paste is heated to about 90°C. This mixture of coal dust and solvent is then passed to the high-pressure pulp presses by means of reciprocating pumps; there the decomposition and dissolution processes take place, (temperature: 415-435°C; pressure, 100-150 atm) residence, about 1 hour). The decomposition chamber consists of a system of tube bundles and resembles the preheater of a hydrogenation chamber. The reaction product, the "crude solution," is gradually cooled and its pressure is released; along with a few percent of reaction gas and a slight amount of light benzine, which has evolved, it passes on to the filters (Bldg. 13) at a temperature of 150°C, this temperature being maintained during filtration.

In Building 13, at first, reaction gas and light benzine are separated off. The gas is mixed with other gases (from the hydrogenation) and serves as heating gas. The light benzine is worked up in the gaseous phase along with other products. By filtration, the "crude solution" is separated into a nondecomposed coal residue which contains the entire content of ashes and into the pure filtrate which is practically free from residue "pure filtrate" and which is pumped to the distillation chamber to be worked up. Candle pressure filters, each aggregate of which contains 32 candles provided with granulated quartz chamotte filter stones, serve as filters (total surface: ca. 21m^2). The optimum filter pressure is 3-4 atm, the optimum temperature, ca 150°. When the filtration is terminated, the filter channels are flushed with solvent - likewise at 3-4 atm. and 150°C - -. The first fractions of the flushing filtrate are added to the extract and the main fraction to the coal hydrogenation. The flushed coal residue is removed from the filters and transported to Bldg. 11a, where the solvent is reclaimed. The oil is here recovered from the residual coal in rotating drums, the temperature of the products being 360°C. The residual coal is practically free of solvent, its content of ashes being 25% to 35% and of solvent less than 0.5%. It can be burnt in the boiler house.

The extract solution which is free of ashes (pure Filtrate) is separated in Building 15 into solvent and extract by means of a 2-step vacuum distillation process. The ash-free extract is drawn off in a molten (liquid) state, quenched and transported to the shipping bunker by means of conveyor belts. The melting point of the extract is 230-240°C, ash content, less than 0.5%, water content less than 1%. The solvents recovered in the two distillation steps are partly recycled into the extraction circulation and partly passed on to the gas phase.

The rate of decomposition is 80 to 92% (based as/or on to the pure coal); large scale yields are 66-99% (based on the crude-coal charged).

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cc: All Divisions
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