KOPPERS COKE PLANTS

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The great increase in the demand for coke for the metallurgical industries and especially for the iron blast furnace, in the last five years, along with the ever increasing demand for the by-products of the coking process, has caused the production of by-product coke to reach the 40,000,000 ton per year mark as against 15,000,000 tons produced in 1915. By far the greatest portion of this coke is produced in Semet-Solvay, Otto Hoffman, and Koppers types of ovens, and the latter has the record of producing more than any other one type of oven.

In the United States there are Koppers plants operating in seventeen States—Pennsylvania, New York, New Jersey, Maryland, Virginia, West Virginia, South Carolina, Alabama, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Kentucky, Missouri and Colorado. The largest plant is situated at Clairton, Pa., and consists of twelve hundred ovens with a capacity of 5,600,000 tons of coke per year. Pennsylvania leads in quantity production of coke by the Koppers process.

It is the purpose of the writer to outline briefly the Koppers process for the coking of coal and the recovery of some of its by-products.

Not all coals have the properties necessary to make them good coking coals and the choice so far has been governed by experience alone. It is usually conceded that the coking properties of coal are due to the resinous matter present and it has been found that a mixture of Elkhorn, a high volatile coal from Kentucky, and Pocahontas, a low volatile coal, mined in West Virginia, produces the best quantity and quality of coke for blast furnace use and with the greatest yield of by-products. A mixture of the two is necessary because Pocahontas expands greatly on coking and could not be pushed out of the ovens if used alone and because Elkhorn gives a low yield of coke. The mixture in most cases is about 65% Pocahontas and 35% Elkhorn, and other coals are also included in the mixture at some plants.

When the coal is received from the mines it is stored in a stock pile from which the supply for the ovens is taken. On the way to the ovens the coal is conveyed to Bradford breakers and hammer-mills where it is crushed and pulverized to about one-eighth inch size, and where all sticks, pieces of stone, and steel are removed. If more than one coal is used the mixture is effected by means of continuous belt conveyors, the percentage of each coal being governed by the speed of the belt or by adjustable gates. The pulverized coal then ready for coking, travels by means of other conveyor belts to the hoppers or bins over the ovens.

The ovens are built in batteries with from 40 to 120 ovens to one battery and each oven is about 37′x11′x17-21″ (inside), one side being wider than the other to make the pushing of the coke easier. The ovens are practically air tight and are heated on each side by a gas combustion chamber which gives heat to the silica walls of the ovens. These combustion chambers and ovens alternate in the direction of the battery and beneath each oven there is a brick checker work or regenerator for reheating the air that goes in to aid in the combustion of the fuel gas in the chambers.

The coal is dropped from the storage bins into a four-compartment larry car and charged thru the four holes in the top of each oven. The charge runs about 24,000 pounds of coal to the oven.

The volatile matter or gas from the coal is driven off by the heat thru a stand-pipe or riser and into a collector main, under a slight back pressure to prevent leakage of air into the ovens. The temperature of coking varies with the coking period and the quality of coke desired. It usually averages about 1800° F. with a coking period of 17 or 18 hours.

The coke is pushed out of the ovens into a transfer car by means of an electrically operated pusher ram, after the door on each end has been removed, the standpipe closed and the charging holes opened. The car takes the hot coke to the quenching station where it is quenched with water and then screened. The ovens are numbered and the pushing is done in an order such as first No. 1, then No. 5 and 9, 7, 2, 4, 10, 6, 8, 3, so that they will not cool off too much. The large size coke goes to the blast furnace, the pea-coke to domestic consumers and the coke breeze, or fine coke, to the power plant to be fired in the boilers.

The next step is the recovery of the by-products from the gas. In some plants the gas from the ovens is separated into rich and lean gas, the rich coming aff during the first part of the carbonization and the lean during the latter part. In that case there are two collector mains, but as each goes thru practically the same processes for the recovery of by-products that practice will be omitted here.

From the collector main the gas passes thru a cross-over main which contains a butterfly valve, operated by means of a Northwestern governor, and from this point is drawn, usually by Connersville exhausters, thru the "down-comers" where some tar drops out, and thru the primary coolers. In this last apparatus the tar and ammonia liquor, condensed from the gas on cooling, are removed and pumped to a separating tank and then to tar and liquor storage tanks. The tar is marketed in that form and the liquor is charged into continuous ammonia stills. The ammonia vapor from these stills is either used in the saturators to make ammonium sulphate or is condensed and sold as a concentrated product of refrigeration plants and manufacturers of chemicals.

After the primary coolers the gas goes thru the exhausters and P. & A. tar extractors, where nearly all of the remaining tar is removed, next thru the reheaters and then to the saturators. The saturator is a lead-lined cast iron cylinder with a conical bottom, containing a bath of 5%

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sulphuric acid. The gas bubbles thru the acid and the remainder of the ammonia is absorbed, forming sulphate salt. The salt is ejected, by means of compressed air, out of the saturator, thru a vertical pipe, on to a draining table. The bath drains off and runs back into the saturator and the salt is shoved or paddled down into two centrifugal driers where the free acid is washed out with water or ammonia liquor and the salt dried. From the driers the salt is weighed and conveyed to the stock pile. In some instances the sulphate is further dried in rotary driers and the ammonia content increased by the application of ammonia vapor in this apparatus. The salt is shipped to fertilizer manufacturers. Sometimes the pyridine is recovered by distillation from the saturator baths, not so much because of its value but because, if left in, under some conditions, it colors the salt. The reheater is inserted between the tar extractor and saturator to increase the temperature of the gas, thus increasing its water carrying ability, increasing the speed of the reaction and the formation of salt and producing a salt made up of finer crystals.

After leaving the saturators the gas goes thru the final coolers, where it comes in contact with water and the napthalene is washed out, after which it is sent up thru the scrubbers. In this apparatus wash-oil is sprayed down from the top of the towers and absorbs the light oil from the gas as it passes countercurrent. The residual gas then runs into the gas holder and from there about 50% goes to the combustion chambers between the ovens and the same amount to the municipal lighting companies or to other markets.

The wash-oil from the scrubbers is pumped to storage tanks at the benzol plant and then charged into wash-oil stills, distilling out the light oil. The residual wash-oil circulates back to the scrubbing towers and is used over again.

The light oil is further distilled and benzol, toluol and solvent naphtha fractioned out. These products are purified by washing with acid and caustic and by re-distillation.

The fractioning in the benzol plant is governed largely by the market demand for the products which it can furnish. During the war there was a great demand for toluol for the manufacture of T. N. T. and for benzol for motor fuel, and at present most of the plants are producing pure benzol, about 88%, to mix with a low grade of gasoline to make a high test product, and refined motor benzol, a mixture of benzol and solvent naphtha, for consumption in automobile engines.

An increase in quantity production of ammonia, tar and light oil could be brought about by changing the temperatures and coking periods on the ovens, but such a practice would be at the expense of the main product, coke.

Born to Mr. and Mrs. Alfred Halterman a son on December 5th. Mr. Halterman is a member of the class of 1921.