

COAL PRODUCTS AND BY-PRODUCTS*

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Methods of Producing Coke, Gas, Ammonia and Tar, from Bituminous Coal.

The employment of coal for commercial purposes may be roughly classified under three main divisions as follows: (1) the combustible matter in the coal is completely burned with an excess of air; (2) the combustible matter in the coal is completely gasified by partial combustion with a limited amount of air, or of air and steam; and (3) the volatile matter of the coal is vaporized by the application of external heat, in the absence of air.

In class 1, the coal is burned under steam boilers and in furnaces, etc. The coal is fed in and burned, heat is generated, and ashes are left. In this class, heat is the main product; the only by-products being the valueless ashes and furnace gases.

In class 2, the coal is gasified in the producer by blowing air and steam through it; but, by limiting the quantity of air supplied and having a deep layer of fuel, the coal is not completely oxidized, hence the gas produced is combustible. In this class the combustible gas is the main product, although ashes and heat are necessarily produced. The heat, which is generally kept as low as practicable by means of the steam, can be partially utilized, but is often a total loss. The gas is sometimes burned simply as a source of heat, while in other cases it is utilized as a source of power in internal combustion engines. As the gas leaves the producer it almost invariably contains more or less ammonia and coal tar, the quantities varying with the type of producer, with the amount of steam employed, and with the character of the coal gasified. By means of a suitable purifying plant, the ammonia and tar may be recovered from the gas before it is used. These residuals are, therefore, by-products from the utilization of coal in gas producers.

In class 3, the coal is carbonized in gas retorts for the production of coal gas, and in coke ovens for the production of coke. In both cases the coal is heated, gas and other volatile products pass off, and coke remains in the retort or oven; but in the coal gas plant the gas is the main product, the coke being only a by-product; whereas in the coke-oven plant the conditions are reversed, the gas being the by-product. In both cases, however, the gas, as it leaves the coal, contains ammonia and coal tar vapors, and these are recoverable by-products.

The by-products obtained from gas works and from coke-oven plants are of very great importance. Before discussing these in detail, a brief description of the plants themselves will be given.

The coking of coal for the manufacture of coke is carried out in what are known as coke ovens. There are two types of these in common use, known respectively as beehive and retort ovens.

As already stated, coal during coking loses gas and volatile matter. In some cases these are immediately burned in or adjacent to the ovens, and produce the heat required; in other cases the volatile matter is collected, its more valuable constituents saved, and only the residual gases burned. Coke ovens, therefore, whether beehive or retort, can be classified as non-recovery ovens and by-product recovery ovens.

Three types of ovens will be considered as illustrating three of the above classes. The fourth class—the by-product beehive oven—is not very important, and is not employed in Canada.

Non-recovery Beehive Oven.—This is the simplest type of oven in common use. It has a circular floor and domed roof, and is usually built of brick or stone lined with firebrick. The ovens are built back to back, in long rows, with the object of economizing heat and space. In operation, a suitable charge of coal is fed into the oven through a hole in the roof, the brickwork of the oven having been left hot enough by the preceding charge to start the coking of the coal and ultimately to ignite the volatile matter driven off. Air is cautiously admitted through loose brickwork in the door in front, and in such a way that the volatile matter escaping from the coal is burned in the oven over the charge, and the coal and the coke preserved, as far as possible, from oxidation. The heat generated by the combustion of the volatile matter is radiated down from the roof, and completes the coking commenced by the heat from the brickwork, and the whole oven is raised to a red heat. When the coking is completed—usually after about 72 hours—the coke is drawn out and quenched with water, and a fresh charge of coal is introduced into the oven. In most beehive-oven plants the coke is drawn out by manual labor, as the shape of the oven is not suitable for the utilization of mechanical extractors. Occasionally, the hot waste gases leaving the oven are carried under boilers, and used to generate steam, but otherwise coke is the one and only product of this type of oven.

Some beehive ovens have been so constructed as to allow of the recovery of by-products; but in these, the simplicity of the ordinary beehive oven is lost, without gaining the advantages obtained from the retort oven.

Non-recovery Retort Ovens.—In non-recovery retort ovens, the coal is coked in long, narrow retorts built of firebrick. The retorts may be arranged either horizontally or vertically, in batteries. They are made slightly wider at one end than the other, to allow of the ready discharge of the coke from the oven by means of a ram or by gravity. Coal is charged into a hot oven, as in the case of the beehive oven, but no air is admitted into the oven itself. The volatile products from the coal leave the oven through special ports, are then mixed with air, and burned in flues surrounding the oven. The heat of their combustion is conducted back into the oven through the walls, and the coking of the coal is thus completed. The hot gases from the flues are often used to generate steam, but otherwise coke is again the one and only product of this type of oven.

By-product Retort Ovens.—The construction and operation of these ovens is in many ways similar to that of the non-recovery retort ovens, indeed so much so that some retort ovens can be operated either with or without by-product recovery. The difference consists in the fact that, with the recovery ovens, the gases and other volatile products from the coal are led away through pipes to a hydraulic main, and thence to a recovery plant where they are passed through con-

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