PROCES FOR PRODUCING FINELY DIVIDED
COKE FROM BITUMINOUS FUELS
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PROCESS FOR PRODUCING FINELY DIVIDED COKE FROM BITUMINOUS FUELS

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The present invention and application is a continuation in part of my inventions, and applications therefor, Serial No. 43,950, filed August 12, 1948, for Apparatus and Method for Gasification of Powdered Fuel; Serial No. 43,954, filed August 12, 1948, for Method and Apparatus for Preheating Gaseous and Vaporous Reagents in Powdered Fuel Gasification; Serial No. 66,812, for Apparatus for Production of Combustible Gas, filed December 22, 1948, and others now, and hereafter pending with the present application.

The invention relates to the production of a finely-divided, solid, degassed fuel i. e. coke, char, etc., from bituminous solid fuels; and any kind including also such fuels as are bituminous, liquefiable, and solid at normal temperature but which soften under increased temperature, for instance, pitch.

Pitch, especially pitch from bituminous coal has for a long time been converted into a solid coke-like residue by a process of dry distillation. This method generally comprises heating the fuel in the absence of air in a retort or chamber which is itself heated externally, e. g., there may be used a horizontal chamber oven such as is also used for the production of coke from caking coals. Usually the pitch is melted before it is charged into the distillation chamber. The conversion of pitch into pitch-coke in this well-known manner is attended by considerable difficulties and can only be performed in relatively expensive and complicated installations and devices.

The residue remaining from the carbonization or dry distillation is a valuable product because it is almost free from mineralic matter (ash). Therefore the residue can with great advantage be used e. g. for the production of electrodes which are needed for the production of aluminium, and the like, from aluminium by electrolysis. As the demand for carbon for each purpose is considerable this is of great importance. The conversion of pitch into pitch-coke, as it is often called, have been taken for granted and tolerated.

An essential object of the present invention provides for improved process and apparatus for the production of a coke-like pure solid residue from pitch and other bituminous fuels without having to heat the fuels to be treated prior to its carbonization or without having to effect the carbonization in chambers or retorts which are heated externally.

Another important object of the invention relates to the production of a valuable gas containing carbon monoxide and perhaps hydrogen when carbonizing an above mentioned bituminous fuel; such gas can be used for the synthesis of hydrocarbons and for other purposes.

Other essential objects and advantages of the invention are manifest from the following description of a preferred apparatus for practise of the invention and from the appended claims.

Basically, the invention employs the following method for the degassing of solid bituminous fuels: the fuel which is to be treated is first reduced to a very small grain size, in e. g., a mill, and thereafter with the help of an entraining gaseous carrier it is introduced in such manner into a thermal reaction chamber which is kept at such high temperature that each individual particle of the fuel loses its volatile matter and is thereby converted into a coke-like residue before it comes into contact with the walls of the chamber. In the process according to the invention the fuel particles therefore are suspended in a gaseous medium during their carbonization and they move concurrently with it entirely through the reaction chamber, or through a part of it, before the particles separate from suspension in a degasified state, and as each particle in the suspension loses its volatile matter and is converted to coke-like residue, the major portion of the combustibles are converted to carbonaceous residue in the form of finely-divided discrete particles upon withdrawal of the solid residue from the process.

According to one embodiment of the invention, the process can e. g. be practised as follows: the finely-divided fuel is mixed as homogeneously as possible with a limited amount of a gaseous medium which reacts exothermically with carbon, the quantity of this medium advantageously being restricted to that which is necessary to transport the fuel into a carbonization chamber in the form of a jet. At its point of injection into the carbonization chamber, an ignition medium which is preheated to a high temperature, e. g., highly preheated combustion products or air, is added to the mixture of fuel and said transporting gaseous medium. By this addition of the hot ignition medium to said mixture of fuel and exothermically reacting medium, the fuel particles are heated to such temperature that the degasification and removal of part of their volatile matter starts almost simultaneously in all the fuel particles of the mixture entering the chamber. The volatile matter escaping from the fuel particles and which is essentially hydrocarbons and hydrogen then reacts exothermically with the transporting oxygen and the temperature of the remainder of the fuel particles is increased by this highly exothermic reaction to such a degree that their remaining volatile matter escapes from them leaving carbonaceous residue of the major portion of said combustible fuel in the form of coarse particles.

The kind of said gaseous medium which reacts exothermically with carbon and with which the finely-divided fuel is transported and injected into the carbonization chamber depends on the composition of the gas to be produced by the process. If air is used, a gas is produced which contains a considerable amount of oxygen. If the oxygen content of the air is increased and the nitrogen content is correspondingly decreased a gas is produced which contains little or even no nitrogen and which can be used for many purposes and especially for the synthesis of hydrocarbons.

Depending on the height of the temperature attained in the exothermic reaction, the evolved hydrocarbons of the fuel are decomposed into hydrogen and carbon which, to the extent that the latter has not reacted with the added gaseous medium can be separated from the produced gas in elementary form along with the degasified solid fuel.

The process according to the invention may be used for the degasification of pitch, mineral oil residues, asphalts, bituminous coals, or such like.

It is essential that at normal temperatures the fuel is sufficiently solid that it can be reduced by grinding, or other method, and that it also softens or becomes liquid at higher temperatures.

The grain size of the fuel introduced into the carbonization chamber depends on the requirements which the degasified residue is to meet. Generally, that size of grid is preferred having the largest proportion of particles that pass a sieve the meshes of which have a width of about 2 mm. If coarser grained fuels are used it is possible these coarser particles will not be completely degasified, a fact which may in many cases be without sig-
3. Significance, as for example in the production of coal char. The attached drawing shows apparatus suitable for practice of the process according to the invention.

The fuel which is to be treated and which has been reduced to the chosen size of grain is transported into the storage bin 1. From here it slides continuously into a mixing device 2 into which a gaseous medium, that is under suitable pressure and which can react exothermically with solid carbon, is added at 3. In mixing device 2 a homogeneous mixture is formed of the finely-divided fuel and the gaseous medium and which, by means of pipeline 4, is blown into the lower part 5 of the degasification chamber in the form of a jet.

The inlet line 6 for the mixture of fuel and transporting gas is suitably provided with water cooling. The discharge opening of line 6 is situated about centrally in a niche 7 which tapers conically and which is surrounded by an annulus-like nozzle 8 through which a hot gaseous medium enters from duct 9 into the degasification chamber 5. This hot gaseous medium can, for instance, be produced in burners 10 by the combustion of a gas with air or oxygen or air with an increased content of oxygen, the burners communicating with the ducts 9.

The temperature of the hot gaseous mixture is thus added to the inlet of the nozzle 8, be about 1200° - 1500° C. But, depending on the characteristics of the fuel, this temperature may also be lower.

In the niche 7 the nozzle opening of line 6 and the nozzle 8 are so arranged relative to each other that an injector effect is produced which draws in, in a manner resembling the action of a water-jet pump, the hot gas into the jet of the mixture of the medium, that reacts exothermically with carbon of the finely-divided solid fuel. In this way, quick mixing is obtained and the degasification of all parts of the fuel is initiated simultaneously and the fuel jet is evenly degasified.

The zone of the degasification space may be in the form of a vertical cylinder having a row of niches 7 each provided with an inlet for the fuel and with the other features described above. During operation, a temperature of, for instance, 1200° C may be kept in these niches. It is therefore advantageous to build the walls 11 of chamber 5 out of refractory material. This zone 5 opens at its upper part into an enlarged space 36 having at its top 12 a gas off-take 13.

The bottom of chamber 5 is formed of a conical, water-cooled portion 14 in which the outlet for the wanted degasified fuel residue is arranged. The opening 15 is governed by a valve 16 and leads to an extracising arrangement 17, e.g., a bucket wheel, which transports the degasified residue continuously or discontinuously into a pipe 18 through which the finely-divided residue is transported to further use by means of a carrier gas blown in under pressure at 19.

The gas produced in chamber 5 flows through the off-take 13 into a pipe-line 20 lined with refractory material and which leads to a heat exchanger 21 which is designed like a boiler. The temperature of the gas is advantageously decreased to about 300° C at this stage.

Part of the solid fuel is carried along by the gases flowing from chamber 5 and also from the enlargement 36 and can settle in a dust catcher 22 located underneath the boiler 21 whence it can be drawn off into receiver 23 and thence into a pneumatic transporting pipe 24 similar to said pipe 18.

The gas from the dust catcher 22 flows through the pipe-line 25 into an electrical precipitator 26, which it enters at a temperature of about 200° C. This temperature may, if necessary, be secured by the addition of cold gas, e.g., into the pipe-line 25. The electrical precipitator 26 is constructed in the usual way and there is no need to those skilled in the art for a description of this well-known plant. In precipitator 26, the last traces of combustible dust and any finely-divided ash, which may have been produced, are separated from the gas and collected in the receiver 27 from which they are removed by the pneumatic pipe-line 28.

The gas produced which is practically free of solid matter is finally drawn off through pipe-line 29 and is either blown into the open air or transported to another disposition for further utilization.

The invention as hereinbefore set forth is embodied in particular form and manner but may be variously embodied within the scope of the claims hereinafter made.

I claim:

1. A process for the production of finely-divided coke from a bituminous combustible material, which is solid at normal temperature but which softens at high temperature, selected from the group consisting of bituminous coal, pitch, asphalt, and mineral oil residue, said process comprising forming a suspension of said bituminous combustible material, in finely-divided state, in an amount of free oxygen-containing gas containing inefficient free oxygen to react with all of the suspended bituminous combustible material, introducing the suspension into a reaction chamber maintained at at least the carbonization temperature of said fuel but not greater than about 1300° C, thereby liberating volatile material from at least a portion of said fuel to carbonize same, maintaining said suspension in dilute phase in the carbonizing zone, supplying a portion of the heat necessary to maintain the reaction chamber at said carbonization temperature by simultaneously introducing a highly preheated gaseous medium into the reaction chamber as an annular stream surrounding the said suspension, maintaining in the reaction chamber a separating zone above said carbonizing zone and a collecting zone below said carbonizing zone, said separating and collecting zones being relatively quiescent with respect to said carbonizing zone, allowing the so-produced finely divided coke to settle from the separating zone and removing the settled coke from the collecting zone of the reaction chamber.

2. The process of claim 1 in which the highly preheated gaseous medium is the product of a combustion reaction.

3. The process of claim 1 in which the free oxygen-containing gas is substantially pure oxygen.

4. The process of claim 1 in which the free oxygen-containing gas is oxygen-enriched air.

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