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(54) Coal gasification process.

(57) Solid surfaces in the quench and heat exchange zone communicating with a reaction zone for the gasification of coal are coated with soot to prevent adhesion of flyslag.

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COAL GASIFICATION PROCESS

The invention relates to a coal gasification process in which the deposition of flyslag deposits in the quench and heat exchange zone of the gasification system is inhibited or prevented.

In processes for the partial combustion or gasification of coal, the coal is reacted at elevated temperatures and elevated pressures with a limited volume of oxygen. The reaction may be carried out in the presence of additional agents such as steam, carbon dioxide, or various other materials. The gasification of coal produces a gas, commonly known as synthesis gas, that contains mostly carbon monoxide and hydrogen. By a combination of factors, such as use of fine particulate dry coal, specially adapted and positioned burners as well as high temperatures and pressures not common in the art, conversion levels of coal are obtainable not previously reported. For example, conversion levels of greater than 98 percent, even 99 percent, basis carbon, may be obtained. Also produced are varying quantities of other gases, such as carbon dioxide and methane, and various liquid and solid materials, such as small particles of ash and carbon commonly known and collectively defined herein as flyslag or flyash. This flyslag, it has been determined, because of the high rate of conversion, does not have the lubricity associated with lower conversion rates, and tends to be different in composition and properties from flyash normally associated with combustion boilers and other processes. In general, the flyslag or flyash entrained with the gas, after solidification, is usually removed from the raw synthesis gas by a combination of cyclones or separators, or a water scrubbing system employing washer coolers, venturi scrubbers, or filters or electrostatic precipitators, or combinations of these systems.

As the flyslag leaves the gasification reactor or zone, it is molten and precaution must be taken to prevent deposition of the sticky particles on the walls of the subsequent stages. For example, there is a variety of quenching techniques, such as the use of a cool recycle gas, designed to solidify the particles and prevent adhesion. The invention also addresses this problem.

Accordingly, the invention relates to a coal gasification process of the type described in which the deposition of flyslag deposits is inhibited or prevented by coating the walls of the quench system or units of the process with soot. The soot can be deposited prior to or during start-up of or during the coal gasification process by combusting a hydrocarbonaceous fuel with insufficient oxygen.

The invention, therefore, provides a method for preventing or inhibiting the deposition of flyslag in a coal gasification process, comprising the steps of

a) partially oxidizing particulate coal in a reaction zone communicating with a quench and heat exchange zone, and producing a hot gaseous stream containing synthesis gas and flyslag;

b) quenching and cooling said hot gaseous stream in said quench and heat exchange zone;

c) separating flyslag from the cooled gaseous stream, and recovering synthesis gas from said gaseous stream, characterized by the step of

d) coating the walls of the said quench and heat exchange zone with soot.

An advantageous embodiment of the invention comprises the steps of

e) combusting a hydrocarbonaceous fuel with an amount of oxygen sufficient to produce a combustion gas containing soot;

f) passing said combustion gas containing soot to the quench and heat exchange zone communicating with the reaction zone for the gasification of coal, and allowing the soot to coat the heat exchange surfaces of the quench and heat exchange zone; and

g) discontinuing the combustion of said hydrocarbonaceous fuel.

In another advantageous embodiment of the invention step (a) can be carried out simultaneously with steps (e), (f) and (g).

Still another advantageous embodiment of the invention comprises the steps of partially oxidizing particulate coal with oxygen in the reaction zone communicating with the quench and heat exchange zone; changing the feed ratio of oxygen to coal to said reaction zone to produce a combustion gas containing soot; passing the combustion gas containing soot to the quench and heat exchange zone, and allowing the soot to coat the heat exchange surfaces of the quench and heat exchange zone, and more advantageously discontinuing the soot production and resuming the partial oxidation of coal.

It will be appreciated that the hydrocarbonaceous fuel can be combusted in the reaction zone for the gasification of coal or in a combustion zone separate from that for the gasification of coal.

Any suitable soot forming hydrocarbonaceous fuel (gas, liquid or solid) may be utilized. For example, natural gas, oils, diesel fuels, coals, and heavy stocks may be used. Viscous materials such as pitch or heavy residue may be used if pumpable and feedable from a burner, or if heated or cut with a diluent to make flowable. Obviously, particulates, such as polymeric material, may be present in the liquid as long as the liquid is flowable. Any suitable coal may be used.

The reactor is advantageously provided with a separate burner or burners for the soot production, since specially designed burners are used for the coal gasification. In practice this burner may be a smaller burner used for ignition of the coal gasification burners. Those skilled in the art may adjust oxygen flow to provide soot generation.

For completeness, details of one developing process for the gasification of coal are described. However, the invention is limited only to those processes which produce flyslag, and details are given of the specified process only insofar as may be necessary to an understanding of the invention.

In general, the gasification is carried out by partially combusting the coal with a limited volume of oxygen at a temperature normally between 1050° C and 2000° C. If a temperature of between 1050° C and 2000° C is employed, the product gas will contain very small amounts of gaseous side products such as tars, phenols and condensable hydrocarbons, as well as molten flyslag particles and salts. Suitable coals include lignite, bituminous coal, sub-bituminous coal, anthracite coal, and brown coal. Lignites and bituminous coals are preferred. In order to achieve a more rapid and complete gasification, initial pulverization of the coal is preferred. Particle size is preferably selected so that 70% of the solid coal feed can pass a 200 mesh sieve. The gasification is advantageously carried out in the presence of oxygen and steam, the purity of the oxygen advantageously being at least 90% by volume, with nitrogen, carbon dioxide and argon being permissible as impurities. If the water content of the coal is too high, the coal should be dried before use. The atmosphere will be maintained reducing by the regulation of the weight ratio of the oxygen to moisture and ash free coal in the range of 0.6 to 1.2, in particular 0.9 to 1.1. The specific details of the equipment and procedures employed form no part of the invention, but those described in U.S. Patent Specification No. 4,350,103 and U.S. Patent Specification No. 4,458,607, may be employed. Steam may or may not be employed. Accordingly, the ratio between oxygen and steam may be selected so that from 0.05 to 1.0 part by volume of steam is present per part by volume of oxygen, although the invention is, as indicated, applicable to processes having none or substantially different ratios of oxygen to steam. The oxygen used is advantageously heated before being contacted with the coal, in particular to a temperature of from about 200° C to 500° C. Alternatively, the soot may be reapplied during operation at normal throughputs by altering temporarily the ratio of feed rates of oxygen and coal.

The details of the gasification reactor system form no part of the present invention, and suitable reactors are described in U.S. Patent Specification No. 4,202,672 and U.S. Patent Specification No. 4,022,591. The high temperature at which the gasification is carried out is obtained by reacting the coal with oxygen and steam in a reactor at high velocity. An advantageous linear velocity of injection is from 20 to 200 meters per second, although higher or lower velocities may be employed. The pressure at which the gasification can be effected may vary between wide limits, for example from 1 to 200 bar. Residence times may vary widely; common residence times are from 0.2 to 20 seconds, more in particular from 0.5 to 15 seconds.

After the starting materials have been converted, the reaction product, which comprises hydrogen, carbon monoxide, carbon dioxide, and water, as well as the aforementioned impurities, is removed from the reactor. This gas, which normally has a temperature between 1050° C and 1800° C, contains the impurities mentioned and flyslag, including carbon-containing solids. In order to permit removal of these materials and impurities from the gas, the reaction product stream should be first quenched and cooled. A variety of elaborate techniques have been developed for quenching and cooling the gaseous stream, the techniques in general being characterized by use of a quench gas and a boiler in which steam is generated with the aid of the waste heat. The walls of the quench zone, i.e., the wall surfaces not in contact with the synthesis gas, and those of the primary heat exchange zone, are cooled with steam or boiling water, and, as indicated, the wall surfaces in contact with the impure synthesis gas may collect deposits of flyslag. The soot on these walls is weakly bonded, and in accordance with the invention, the flyslag depositing tends to break off, particularly if rapping is employed. While the soot coating may eventually be exhausted, there is particular value on start-up, and other factors then may become dominant in preventing or inhibiting flyslag deposition. Again, if desired, the gasification may be interrupted and soot reapplied, or the soot can be applied during a turndown, i.e., a time when gasification in the reactor is conducted at a reduced throughput. Alternatively, the soot may be reapplied during operation at normal throughputs by altering temporarily the ratio of feed rates of oxygen and coal.

While the invention has been illustrated with particular apparatus, those skilled in the art will appreciate that, except where specified, other equivalent or analogous units may be employed. The term "zone," as employed in the specification and claims, includes, where suitable, the use of segmented equipment operated in series, or the division of one unit into multiple units to improve efficiency or overcome size constraints, etc. Parallel operation of units, is, of course, well within the

scope of the invention.

Claims

1. A method for preventing or inhibiting the deposition of flyslag in a coal gasification process, comprising the steps of

a) partially oxidizing particulate coal in a reaction zone communicating with a quench and heat exchange zone, and producing a hot gaseous stream containing synthesis gas and flyslag;

b) quenching and cooling said hot gaseous stream in said quench and heat exchange zone;

c) separating flyslag from the cooled gaseous stream, and recovering synthesis gas from said gaseous stream, characterized by the step of

d) coating the walls of the said quench and heat exchange zone with soot.

2. The method as claimed in claim 1 characterized by the steps of

e) combusting a hydrocarbonaceous fuel with an amount of oxygen sufficient to produce a combustion gas containing soot;

f) passing said combustion gas containing soot to the quench and heat exchange zone communicating with the reaction zone for the gasification of coal, and allowing the soot to coat the heat exchange surfaces of the quench and heat exchange zone; and

g) discontinuing the combustion of said hydrocarbonaceous fuel.

3. The process as claimed in claim 2 characterized in that the step of partially oxidizing particulate coal in the reaction zone communicating with said quench and heat exchange zone, is carried out simultaneously with steps (e), (f), and (g).

4. The method as claimed in claim 1 characterized by the steps of partially oxidizing particulate coal with oxygen in the reaction zone communicating with the quench and heat exchange zone; changing the feed ratio of oxygen to coal to said reaction zone to produce a combustion gas containing soot; passing the combustion gas containing soot to the quench and heat exchange zone, and allowing the soot to coat the heat exchange surfaces of the quench and heat exchange zone.

5. The method as claimed in claim 4 characterized in that the production of soot is discontinued, and the partial oxidation of coal is resumed.

6. The process as claimed in any one of claims 2-5 characterized in that the hydrocarbonaceous fuel is combusted in the reaction zone for the gasification of coal.

7. The process as claimed in any one of claims 2-5 characterized in that hydrocarbonaceous fuel is combusted in a combustion zone separate from that for the gasification of coal.

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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 1722

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-3 607 157 (SCHLINGER) * Column 1, line 66 - column 2, line 50 *	1,4	C 10 J 3/46
A	US-A-4 466 810 (DILLE) * Column 4, lines 9-30 *	1	
A	DE-B-1 170 379 (TEXACO) * Column 3, line 27 - column 8, line 17 *	1	
A	EP-A-0 063 682 (CHEMISCHE WERKE HÜLS)		
A	NL-A-7 602 388 (SHELL)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C 10 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-09-1989	WENDLING J.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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