United States Patent

[11] 3,632,479

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[54] **TREATMENT OF COAL TO PREVENT AGGLOMERATION**
3 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **201/9,** 201/36, 201/32
[51] **Int. Cl.** **C01b 57/06**
[50] **Field of Search** ..... 201/9, 36, 37, 38, 32, 33, 34, 23, 20; 264/80, 29; 23/212 A; 209/5; 302/66, 14; 44/51

[56] **References Cited**

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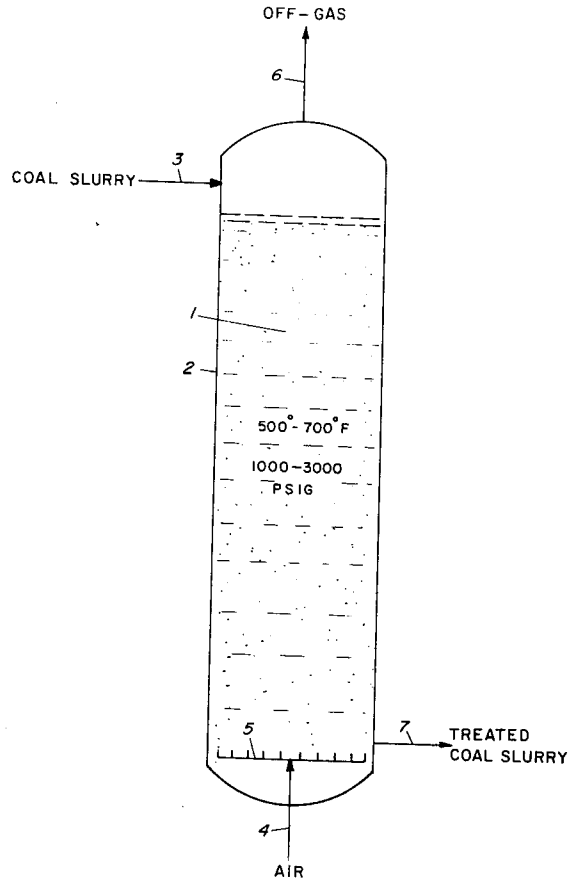
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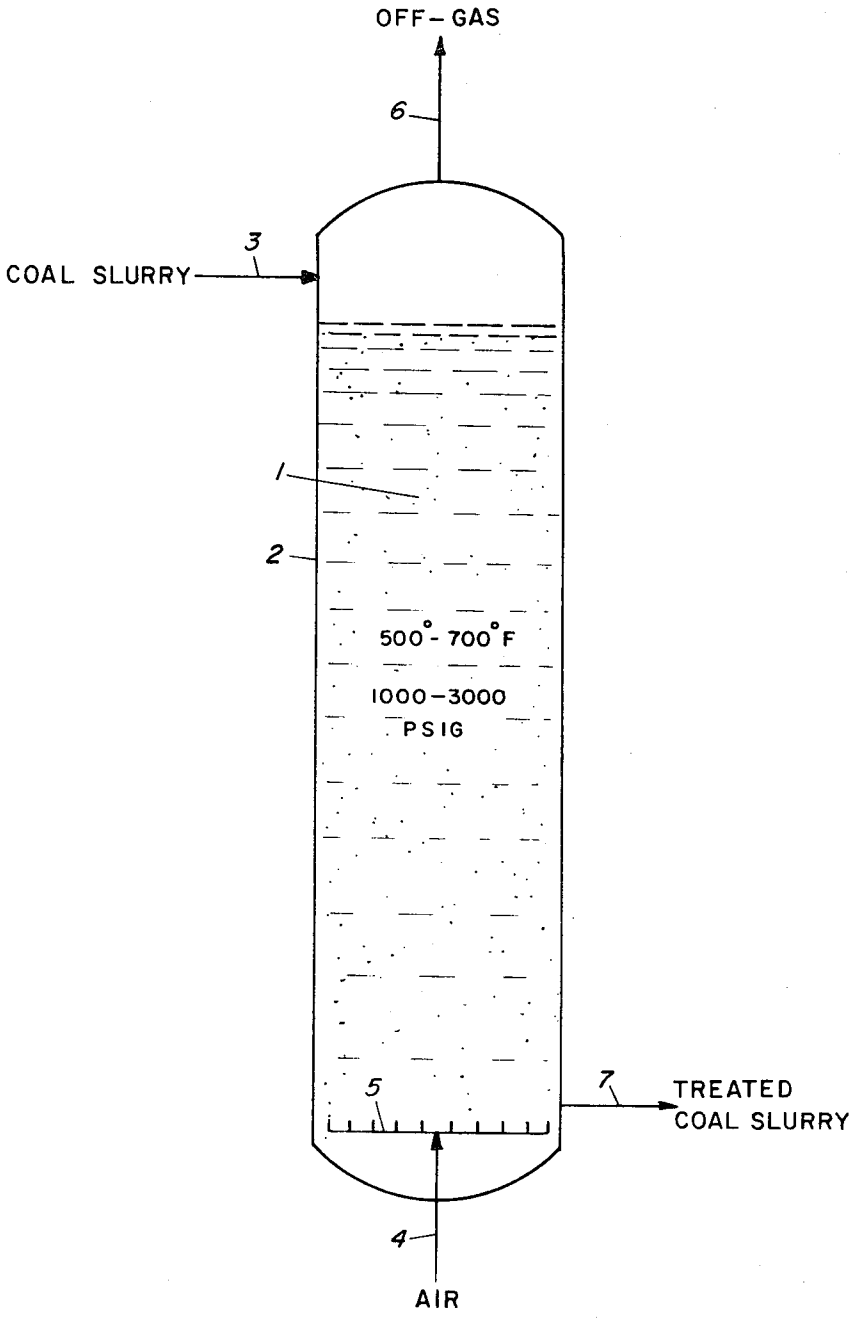
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Primary Examiner—Norman Yudkoff
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ABSTRACT: A liquid slurry of coal is treated with an oxygen-containing gas at elevated temperature and pressure to effect surface oxidation of the coal. The coal is thus rendered nonagglomerating and is suitable for utilization as feed in a high-pressure hydrogasification process.





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TREATMENT OF COAL TO PREVENT AGGLOMERATION

As natural gas reserves in the United States continue to dwindle, the most likely substitute is synthetic high-B.t.u. gas produced from coal. Many coal gasification processes, such as the IGT Hygas process, involve high-pressure operations wherein hydrogen-rich gases react with coal directly to form methane. However, in these processes strongly caking coals are difficult to use as feed because of their tendency to agglomerate in the initial stages of reaction. Vast deposits of coal in the East and Midwest of the United States, for example, are highly caking bituminous coals.

In addition, in high-pressure processing, the mechanical means for introducing coal from atmospheric pressure into a high-pressure reactor represents costly equipment that requires extensive maintenance. Lock hoppers, for example, are commonly used for introducing solids into low or medium-pressure systems. However, to feed a high-pressure system a number of lock hoppers in series is needed whose operating sequence must be closely timed, and gases released in the several stages of lock hoppers require extensive recompression.

Prior art discloses the treatment of caking coals with acids at temperatures above ambient to reduce the swelling and caking properties of the coals (U.S. Pat. No. 2,336,154, Wolf). However, such processing is costly because of the acid consumption. Williams, in U.S. Pat. No. 2,805,189, discloses a fluidized bed process for treating caking coals with oxygen-containing gas to reduce agglomeration. This process, however, operates at essentially ambient pressure as a precursor to an atmospheric-pressure carbonizer. For a high-pressure gasification process, such pretreated coal can only be fed to high-pressure gasifier by additional mechanical means. The present invention operates at high pressure, and the treated coal can enter the gasifier directly. Kruppa, U.S. Pat. No. 2,336,151, discloses a batch process for treating coal at 45–150 p.s.i. pressure, at temperatures below 200° C. (393° F.). The low temperature and pressure require a long treating time which, as a batch system, require in turn large reactor volume for treatment. The present invention operates at higher temperature and pressure, and in continuous process.

It has now been found, according to the process of the invention, that destruction of the agglomerating properties of coals may be effectively and economically accomplished by treatment of a liquid slurry of the coal with an oxygen-containing gas at elevated temperature and pressure. At the same time, the coal slurry can be continuously pumped to high pressure in compact and commercially available equipment, thus avoiding the complicated dry-feeding system such as lock hoppers.

The process of the invention is illustrated by the flow diagram of the figure, in which the oxygen-containing gas is air. Coal slurry 1 is introduced to treatment vessel 2 via line 3, and the temperature and pressure are adjusted to suitable values, as shown in the figure. Air is then introduced to the treatment vessel via line 4 and sparger 5. Off-gas from the treatment vessel exits via line 6 and the treated, nonagglomerating coal is removed in the form of a slurry via line 7.

The process of the invention is applicable to any of a variety of caking coals. Severity of treatment, i.e., the extent of the oxidation, necessary for substantial destruction of agglomerating properties will, however, vary considerably with the different types of coal and is best determined experimentally.

A slurry of the coal is initially prepared by grinding the coal to a suitable particle size, e.g., about 10 to 100 mesh, and subsequently suspending the ground coal in a suitable liquid, such as water. Liquids other than water may also be used in forming

the suspension, provided they do not react with the coal or with the oxygen-containing gas. The liquid should be present in an amount sufficient to allow the slurry to be pumped. Coal concentration in the slurry could vary from near 0 to about 70 percent by weight, most commonly in the range of 30 to 65 percent by weight.

Air is usually most conveniently and economically employed as the oxygen-containing gas. However, oxygen itself may also be used. In addition, oxygen or air diluted with an inert gas such as nitrogen may also be used. Efficient contact between the gas and the coal, as well as uniform dispersion of the coal in the liquid, is achieved by stirring or otherwise agitating the mixture. This agitation may, of course, also be facilitated by the flow of the oxygen-containing gas through the slurry.

The oxygen-containing gas is introduced into the slurry by conventional means such as bubbling, sparging, etc. Rate of flow of the gas, time of treatment and total amount of gas employed will, of course, be interrelated and will vary with the amount of pretreatment required, which in turn depends on the intended subsequent treatment or utilization of the coal. These variables are also a function of the type of coal and the temperature and pressure employed and the optimum combination of the variables is best determined experimentally.

Optimum temperatures used in the process of the invention will also depend on the above-discussed variables, as well as on the pressure employed. Generally, however, suitable temperatures will range from about 400° to 900° F., with about 500° to 700° F. being the preferred range.

In order to maintain the slurry medium in the liquid form, the pressure must be maintained higher than the vapor pressure of the liquid at the operating temperature. Subject to this requirement, if water is used as the slurry medium in a temperature range of 500° to 700° F., suitable pressures are from about 1,000 to 3,000 p.s.i.g. Again, optimum values of these variables are best determined experimentally. Treating the coal at pressure suppresses the release of volatile matter from the coal and results in a minimum destruction of volatile matter. Thus, more of the volatile matter in the coal can be carried into the subsequent gasification operation. Furthermore, any tarlike material normally released in pretreatment would be carried in the slurry into the subsequent gasification step.

The following example will serve to more particularly illustrate the process of the invention.

EXAMPLE

In this example a caking high-volatile Pittsburgh seam bituminous coal, having a volatile matter content of 35 percent, was ground to a particle size of 20 to 100 mesh, and mixed with water to form a slurry of about 30 percent by weight of coal. This slurry was then treated with oxygen in a rocking bomb calorimeter, at 600° F. and 1,000 p.s.i.g. and with stirring. The oxygen was bubbled through the slurry for a period of 2 hours. The resulting coal, having a volatile content of 27 percent, was heated to 1,400° F. with no sign of agglomeration.

What is claimed is:

1. A process for pretreatment of coal to prevent agglomeration consisting essentially of treating an aqueous slurry of the coal with an elemental oxygen-containing gas at a temperature of about 500° to 700° F. and a pressure of about 1,000 to 3,000 p.s.i.g.

2. The process of claim 1 in which the oxygen-containing gas is oxygen.

3. The process of claim 1 in which the oxygen-containing gas is air.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,632,479 Dated January 4, 1972

Inventor(s) Bernard S. Lee, et. al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet, the following should be inserted: -- [73] Assignee The United States of America as Represented By The Secretary of The Interior -- .

Signed and sealed this 12th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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