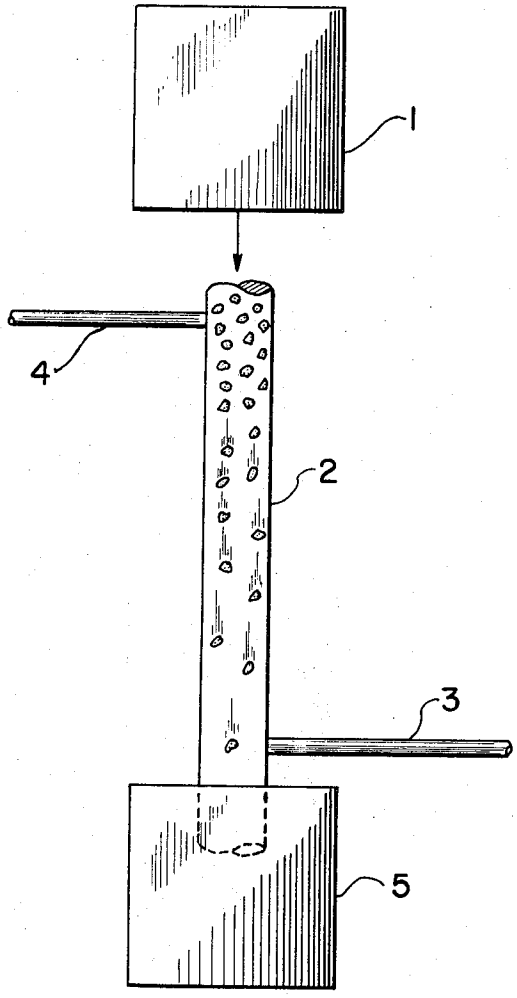
Dec. 12, 1967 S. J. GASIOR ETAL 3,357,896

DECAKING OF CAKING COALS

Filed Jan. 25, 1966



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United States Patent Office 3,357,896 Patented Dec. 12, 1967

3,357,896

DECAKING OF CAKING COALS

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Filed Jan. 25, 1966, Ser. No. 522,992
1 Claim. (Cl. 201—34)

ABSTRACT OF THE DISCLOSURE

Heating large particles of caking coal through their plastic range in a free fall system to produce non-caking coal char.

This invention relates to the production of noncaking coal-chars from highly caking coals.

Existing processes for making noncaking coal-chars from highly caking coals are complex and involve expensive mechanical devices such as a rotating kiln, chain grates, jiggling grates, and rotating screws to prevent the strongly caking coals from fusing into one solid mass while being taken through the plastic temperature range. such equipment makes these conversion processes expensive ones.

The object of this invention is to provide a simple and inexpensive process for converting caking coals to noncaking coal-chars.

The invention is based on the discovery that particles of caking coal can be taken through their plastic temperature range in a substantially free fall system without caking, fusing or agglomerating. After such treatment, a coal-char particle is produced that does not cake, fuse or agglomerate when exposed to hydrogen-rich atmospheres at elevated temperatures and pressures.

For a more detailed understanding of the invention and for further objects and advantages thereof, reference is to be had to the accompanying drawing, in which the figure is a schematic flow diagram showing the system of the present invention.

Particulate caking coal is preheated rapidly to its softening point with an inert gas such as steam, flue gas, nitrogen, carbon dioxide or a combination of all four, in a chamber 1. Preheating can be accomplished in several ways including fixed-bed, fluidized- and free-fall systems.

A gaseous oxygen content of about 1 to 10% (by volume) of the heating gas is desirable for most operations. If the oxygen content is insufficient, agglomeration will occur. If too much oxygen is employed, uncontrolled rises in coal temperatures may occur.

The length of the path through which the coal particles fall and the gas-coal contact time during heating through the plastic range depend upon many factors including the particle size of the coal being treated and the composition, temperature, pressure and amount of heating gas employed. So as not to measuredly hinder the flow of the freely-falling coal, gas is supplied to the conduit at low velocities ranging from about 2.0 to 10.0 feet per second. Therefore the gas pressure should be high enough to maintain enough of the gas in contact with the coal to effect an efficient and economic decaking. Likewise, the gas temperatures are selected with a view to economics and efficiency. With most conventional inert gases, under gas temperatures ranging from about 560 to 670° C. and pressures ranging from about 250 to 350 p.s.i.g., with a gaseous oxygen content of from about 1.0 to 10% by volume, freely falling 4–8 Tyler mesh and ¼–⅜ inch size particulate caking coal can be heated through its plastic range without caking in only a few seconds.

Heating freely falling particulate caking coal through its plastic range with a countercurrent flowing gas containing an inert gas mixed with a minor amount of gaseous oxygen is the most important criteria of this invention.

The following example indicates the effectiveness of the process:

Strongly caking bituminous coal, with a 4 to 8 Tyler mesh particle size, was rapidly preheated to its softening point (350° C.) with steam. It was then dropped through a 20 foot long, 2-inch pipe in countercurrent direct contact for about 2 seconds, with steam containing 4–10% by volume gaseous oxygen, the heating gas being supplied at 560–670° C. and 300 p.s.i.g., whereby the coal was heated through its plastic range (360° to 430° C.). 1.9 pounds of steam per pound of coal and 3.0 cubic feet of oxygen per pound of coal were required for decaking. Treated coal did not cake when exposed to hydrogen at 600° C. and 300 p.s.i.g. for 5 minutes. This is an arbitrary test to determine whether the treated coal would cake at conditions found in a coal gasifier. A weight percent analysis of the raw coal and treated coal is shown in the following table:

	Moisture	Volatile matter	Fixed carbon	Ash	H	C	N	O	S	Free-swelling index
Raw bituminous coal	2.0	35.6	54.4	8.0	5.6	84.3	.7	7.0	1.4	8.0
Treated coal	0.0	25.4	65.0	9.6	4.5	85.0	1.8	7.2	1.5	1.0

Preheated coal is then delivered to conduit 2 and falls substantially freely therethrough countercurrently to a heated gas containing an inert gas (such as the gas used in the preheating step) mixed with a small amount of gaseous oxygen. Conduits 3 and 4 supply and exhaust the heating gas, respectively. Treated coal falls as a particulate noncaking coal-char into collection chamber 5.

During its substantially free-fall through conduit 2, the coal is contact with the heated gas just long enough to heat the coal through its plastic range whereby it loses about 40% of its volatile matter. This in turn contributes to the noncaking quality of the treated coal.

Gaseous oxygen in the heating gas apparently reacts slightly with the coal, preventing it from caking while it is heated through its plastic range. Oxygen treatment also contributes to the noncaking quality of the treated coal. The low free-swelling index of the treated coal is indicative of a noncaking coal.

Other manufacturing methods for producing noncaking fuels from highly caking coals are expensive because of the requirement of high capital investments. This invention requires a minimum of investment because a strongly caking coal can be converted to a noncaking coal-char in a matter of seconds by simply dropping the raw coal through a countercurrent flow of a heated gas containing an inert gas mixed with a minor amount of gaseous oxygen.

Decaked coal produced by the process of this invention is highly suitable for processing or conversion to synthetic fuels and chemicals. For example, since natural gas reserves in the United States appear to be dwindling, the most likely substitute would be a synthetic high-B.t.u. gas

produced from coal. Presently, fixed-bed pressure gasification appears to be most attractive for making a high-B.t.u. gas. Unfortunately strongly caking coals cannot be gasified in this manner. Caking coals agglomerate when heated through a temperature range at which they become plastic rendering the gasifier inoperable. Coals found in parts of the country where the largest markets for a high-B.t.u. gas exist are highly caking. The inexpensive decaking process of the present invention permits the use of these vast caking coal deposits for the production of high-B.t.u. pipeline gas via fixed-bed pressure gasification.

While the particular process herein described is well adapted to carry out the objects of the present invention, it is to be understood that various modifications and changes may be made all coming within the scope of the following claim.

What is claimed is:

A process for decaking particulate caking coal having a particle size of from about 8 mesh to about ⅜ inch consisting of

(a) preheating said caking coal to its softening point;

(b) allowing said preheated coal to fall substantially freely;

(c) rapidly heating said freely falling coal through its plastic range with a hot gas composed of from about 1.0 to 10% by volume oxygen and a gas inert with

respect to said coal, said oxygen being present in an amount sufficient to prevent agglomeration of said coal while it is being heated by said hot gas but in an amount insufficient to cause uncontrolled rises in the temperature of said coal while it is being heated by said hot gas, said hot gas being at a temperature of from about 560° C. to 670° C. and a pressure of from about 250 to about 350 p.s.i.g.; and

(d) removing said coal from said hot gas just after it has been heated through its plastic range, and collecting said removed coal as a particulate noncaking coal char.

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