Patented Oct. 21, 1947 2,429,416

UNITED STATES PATENT OFFICE

2,429,416

LOW-TEMPERATURE CARBONIZATION PROCESS AND PRODUCT

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No Drawing. Application August 14, 1941, Serial No. 406,807

10 Claims. (Cl. 202—34)

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This invention relates to a low temperature carbonization process and product. It relates more particularly to an improvement in the now well known Wisner process, which is the subject of United States Patents Nos. 1,490,357, 1,748,815, 1,756,896 and 2,080,946 and copending application Serial No. 315,718, and an improved low temperature carbonization product. This application is in part a continuation of my copending application Serial No. 350,069.

In the Wisner process finely divided carbonaceous material, ordinarily coal, is heated to plastic state when it has rather highly developed agglutinating or agglomerating properties and the plastic material is agitated and formed into masses which upon proper treatment and subjection to predetermined temperatures are carbonized and become balls of semi-coke or low temperature coke sometimes referred to as "coal balls." The operation may be carried out in suitable apparatus such as an inclined rotary retort and the details of the process and the apparatus employed which do not constitute the present invention are disclosed in the patents above mentioned.

It is important that the agglutinating property of the coal or other carbonaceous material used be proper for formation of the coal balls. Since coal is the carbonaceous material most frequently used in the Wisner process, the invention will be described in relation to its use as an example material. Different coals have different agglutinating properties when heated to the plastic state. Many coals have too great an agglutinating property when heated to the plastic state and difficulty is encountered in obtaining satisfactory coal balls when such coals are used. It has heretofore been proposed to mix coke breeze with the finely divided coal to reduce the agglutinating property of highly agglutinating coal to render the coal suitable for use in the Wisner process.

I have discovered that other materials may be employed for reducing and controlling the agglutinating property of highly agglutinating or highly coking coal so as to render such coal suitable for use in the Wisner process while at the same time accomplishing advantages not previously obtained. I preferably mix with the finely divided highly coking coal either prior to or during the low temperature carbonization process a relatively non-agglutinating material which will suitably reduce and control the agglutinating property of the coal and which will also greatly enhance the value of the coal balls produced.

I have found that certain relatively non-agglutinating materials may be mixed with highly coking coal to control the agglutinating property of the coal and will also produce coal balls

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containing substances of value which may easily be recovered from the coal balls. I employ inorganic metal and oxygen containing materials which are relatively non-agglutinating in character and will suitably reduce and control the agglutinating property of the coal. I preferably employ such materials which will result in incorporation in the coal balls in intimate association with carbon of metal which may thereafter easily be recovered. This may be illustrated by way of example in connection with the recovery or smelting of zinc.

Zinc occurs in nature as zinc sulphide. The first step in the reduction of zinc sulphide is to roast the zinc sulphide ore in air forming zinc oxide. The zinc oxide is then heated in the presence of carbon and the oxygen combines with the carbon and metallic zinc is produced. It is probable that this reduction of zinc oxide is accomplished by a combined direct reaction in which the carbon combines with the oxygen in the zinc oxide to form carbon monoxide and zinc and an indirect reaction in which the carbon first combines with oxygen to form carbon monoxide and the carbon monoxide then reacts with the zinc oxide to form zinc and carbon dioxide after which the carbon dioxide further reacts with carbon to produce carbon monoxide. Whichever reaction is predominant, it is important that in this reducing or smelting step the particles of zinc oxide and the particles of carbon be in intimate association. This has long been recognized and various efforts to effect intimate admixture of the zinc oxide and carbon have been proposed. However, the recovery of zinc obtained by use of any of the methods heretofore proposed has not been fully satisfactory and the processes have been expensive. For example, a method currently employed in the smelting of zinc is to briquette the zinc oxide and the carbonaceous material with a binder to hold them together, but the results have not been fully satisfactory.

I have found that I can employ, for example, roasted zinc sulphide ore which is predominantly zinc oxide, although containing impurities and often various other oxides, to reduce and control the agglutinating property of highly coking coal used for making coal balls by the Wisner process and that the resultant balls contain zinc, wholly or primarily in the form of zinc oxide, from which by reduction metallic zinc may be recovered. When zinc oxide is finely divided and admixed with finely divided coal in the Wisner process the coal balls produced have the particles of zinc oxide and the particles of carbon in intimate association or admixture and such particles are highly reactive. This is apparently why an unprecedentedly high recovery of zinc can be obtained when the coal balls thus produced are heated in

the final step which corresponds to the final smelting step in the usual zinc smelting process.

I may employ as the material to be added to the coal in the process above described any relatively non-agglutinating inorganic metal and oxygen containing material. I preferably employ such a material from which by reduction the metal can be recovered. Ordinarily I prefer to employ metallic oxides which have the property of desirably reducing and controlling the agglutinating property of the coal and also result in incorporation of metal in the coal balls in such condition that it can be recovered in metallic form by reduction. My results can be obtained by using the oxides of the following named metals either singly or in any combination: tin, zinc, cadmium, lead, iron, chromium, calcium, copper and manganese. My results can also be obtained by using oxides or other oxygen containing materials containing silicon or phosphorus. For example, I may employ quartz or silica, phosphate ores, sodium phosphate or phosphorus pentoxide. While silica and phosphorus are generally classed as metalloids rather than as metals, the word "metal" as used in the claims includes silicon and phosphorus in addition to those elements which are ordinarily classed as metals. Other substances which may be used are metal bearing flue dust, baghouse dust, precipitator dust, smelters' skimmings and drosses and zinc blue powder. My results can also be obtained by using the carbonates of the alkali and alkaline earth metals. I may use the carbonates of calcium, barium, sodium, potassium, magnesium, lithium, strontium, rubidium and caesium individually or in combination.

The coal employed for making the balls by the Wisner process is preferably finely divided before being introduced into the apparatus in which the balls are made and I prefer also to finely divide the added material. The amount of such material used may be more or less than the amount of coal with which the same is mixed. The amount of the added material may be determined by the agglutinating property of the particular coal being used. Ordinarily the amount of coal will be between 25% and 50% of the mixture. The coal and added material may be mixed together before introduction into the retort or they may be introduced into the retort separately and mixed therein. The added material as explained above counteracts to a desired extent the agglutinating tendency of the plastic coal and assists in proper formation of coal balls. The coal balls produced ordinarily consist of semi-coke with at least a portion of the added material combined therewith or embodied therein.

In place of coal other highly agglutinating carbonaceous materials may be employed, as, for example, coal tar pitch, heavy petroleum asphalt or residue, etc.

The semi-coke and the portion of the added material remaining therein are intimately associated or combined in the coal balls and the ball structure may in particular cases be homogeneous throughout, consisting of particles of semi-coke and particles of the additional material, as for example, metallic oxide, interspersed among one another and intimately combined. Coal balls may be in the form of solid or substantially solid generally spherical balls or in lumps or pieces of non-uniform size and shape or in comparatively small pieces or pellet-like particles, depending upon the particular base material used and the particular process employed.

While I have described a present preferred embodiment of the invention and a present preferred method of practicing the same it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. A method of treating strongly coking coal comprising agitating and carbonizing at low temperature coal which has so pronounced an agglutinating property that it cannot be satisfactorily formed into balls of semi-coke by said treatment, not later than during said treatment modifying the agglutinating property of said coal sufficiently to enable the resultant mixture to be formed into balls of semi-coke by said agitating and low temperature carbonization by mixing with said coal a predetermined quantity of relatively no-agglutinating inorganic metal and oxygen containing material such that balls of semi-coke are formed by said treatment out of coal which is so strongly coking that it is otherwise unsuited for formation of balls of semi-coke by said treatment and by said agitating and low temperature carbonization forming balls of semi-coke.

2. A method of treating highly agglutinating coal comprising advancing and tumbling coal while subjecting the coal to low temperature carbonization, not later than during said treatment controlling the agglutinating property of the coal sufficiently to insure that the resultant mixture will be formed into balls of semi-coke by said treatment by mixing with the coal zinc oxide in such amount that balls of semi-coke are formed by said treatment and by said agitating and low temperature carbonization forming balls of semi-coke.

3. A method of combining relatively non-agglutinating inorganic metal and oxygen containing material in intimate association with carbon by treating a mixture of strongly coking coal with such material by agitating and carbonizing the mixture at low temperature, controlling the agglutinating property of the mixture by regulation of the proportions of the coal and such material so as to assure that the resulting mixture will be formed into balls of semi-coke and by said agitating and low temperature carbonization forming balls of semi-coke.

4. A method of treating highly agglutinating carbonaceous material comprising agitating and carbonizing carbonaceous material at low temperature, not later than during said treatment controlling the agglutinating property of said carbonaceous material sufficiently to insure that the resultant mixture will be formed into balls of semi-coke by said agitating and low temperature carbonization by mixing with said carbonaceous material a predetermined quantity of relatively non-agglutinating inorganic metal and oxygen containing material such that balls of semi-coke are formed by said treatment, by said agitating and low temperature carbonization forming balls of semi-coke and continuing said agitating until said balls are formed.

5. A method of treating highly agglutinating carbonaceous material comprising agitating and carbonizing carbonaceous material at low temperature, not later than during said treatment controlling the agglutinating property of said carbonaceous material sufficiently to insure that the resultant mixture will be formed into balls of semi-coke by said agitating and low tempera-

ture carbonization by mixing with said carbonaceous material a quantity of relatively non-agglutinating inorganic metal and oxygen containing material such that the original carbonaceous material forms between about 25% and about 50% of the resultant mixture whereby balls of semi-coke are formed by said treatment, by said agitating and low temperature carbonization forming balls of semi-coke and continuing said agitating until said balls are formed.

6. A method of treating highly agglutinating carbonaceous material comprising agitating and carbonizing carbonaceous material at low temperature, not later than during said treatment controlling the agglutinating property of said carbonaceous material sufficiently to insure that the resultant mixture will be formed into balls of semi-coke by said agitating and low temperature carbonization by mixing with said carbonaceous material a predetermined quantity of metallic oxide such that balls of semi-coke are formed by said treatment, by said agitating and low temperature carbonization forming balls of semi-coke and continuing said agitating until said balls are formed.

7. A method of treating highly agglutinating carbonaceous material comprising agitating and carbonizing carbonaceous material at low temperature, not later than during said treatment controlling the agglutinating property of said carbonaceous material sufficiently to insure that the resultant mixture will be formed into balls of semi-coke by said agitating and low temperature carbonization by mixing with said carbonaceous material a quantity of alkali or alkaline earth metal carbonate such that balls of semi-coke are formed by said treatment, by said agitating and low temperature carbonization forming balls of semi-coke and continuing said agitating until said balls are formed.

8. As a manufacture, balls of semi-coke comprising partly coked carbonaceous material which has so pronounced an agglutinating property that it cannot be satisfactorily formed into balls of semi-coke by low temperature carbonization having admixed therewith a quantity of relatively non-agglutinating inorganic metal and oxygen containing material such as to render the mixture satisfactorily formable into balls of semi-coke by low temperature carbonization.

9. As a manufacture, balls of semi-coke comprising partly coked carbonaceous material which has so pronounced an agglutinating property that it cannot be satisfactorily formed into balls of semi-coke by low temperature carbonization having admixed therewith a quantity of metallic oxide such as to render the mixture satisfactorily formable into balls of semi-coke by low temperature carbonization.

10. As a manufacture, balls of semi-coke comprising partly coked carbonaceous material which has so pronounced an agglutinating property that it cannot be satisfactorily formed into balls of semi-coke by low temperature carbonization having admixed therewith a quantity of zinc oxide such as to render the mixture satisfactorily formable into balls of semi-coke by low temperature carbonization.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,838,882	Trent	Dec. 29, 1931
1,852,709	Kern	Apr. 5, 1932
1,899,809	Kern et al.	Feb. 28, 1933
1,940,352	Jacobson	Dec. 19, 1933
2,156,591	Jacobson	May 2, 1939
1,756,896	Wisner	Apr. 29, 1930
2,080,946	Lesher	May 18, 1937
2,219,407	Baptist	Oct. 29, 1940
2,000,305	Thomsen	May 7, 1935
332,497	Cary	Dec. 15, 1885
394,486	Haas	Dec. 11, 1888
617,700	Brubaker	Jan. 10, 1889
945,331	Kaffers	Jan. 4, 1910
1,236,447	Kendall	Aug. 14, 1917
1,576,179	Edwards	Mar. 9, 1926
1,810,070	Palmerton	June 16, 1931
2,364,828	Swartzman	Dec. 12, 1944

FOREIGN PATENTS

Number	Country	Date
249,170	Great Britain	1936
11,044	Great Britain	1900