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PRODUCTION OF COKE

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The invention relates to the production of hard and blocky coke, particularly for metallurgical processes, from caking coal and more especially to the production of coke from such caking coal that coked alone will solely yield a very porous, soft or easily breakable coking product that cannot be used as a so-called metallurgical coke.

The object of the invention is to develop improvements making it possible to treat caking coal before the carbonisation in such a way that the coal when being coked will yield a hard and blocky coke for metallurgical purposes.

A further object of the invention is to pre-treat the coal to be coked in such a way that it yields a hard metallurgical coke without any addition of all or without a substantial addition of other carbon-containing matter.

Further objects of the invention result from the following description:

There are certain coals which when being coked alone in a conventional horizontal chamber oven also certain types of cooking equipment in general use for the production of coke that yield a comparatively bad and brittle coke which cannot be used for metallurgical purposes. To produce a good coke from this coal it is a common use to blend the coal with another grade of coal before coking it. Depending on the properties of the initial coal sub-bituminous or bituminous coal will be added. This treatment of the coal to produce coke alone does not yield a good metallurgical coke. Consequently, in order that another suitable grade of coal may be available in sufficient quantities, the treatment should take place not far from the production field to avoid high transportation costs. This assumption does not come true anywhere.

Moreover, it has been proposed to add crushed coke, especially coke breeze or low-temperature coke, to the caking coal that carbonised alone will not yield a good metallurgical coke. It is also known to use as additional matter to the caking coal a product obtained by partial oxidation of bituminous coal at normal or slightly elevated temperature. All these well-known admixtures are characterized in their having any or practically no longer caking properties, i. e. when a great deal of these admixtures are heated alone without any access of air as this occurs in a conventional coke oven the different particles do not agglutinate.

The conventional addition of finely divided coke, coke breeze, or oxidized coal to the bituminous coal results in a good metallurgical coke only in the case of the inert, i. e. practically not caking admixture being uniformly added to the bituminous coal. Mostly, this cannot be achieved in large-scale operation. The risk of a posterior segregation of the mixture of bituminous and inert admixture is great. It has to be taken into account that the quantity of the inert admixture that can be added to the bituminous coal, as a rule, is comparatively small, thus rendering also the uniform dispersion of the inert admixture to the bituminous coal more difficult, particularly in the case of the inert admixture being finely dispersed,

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Eventually, it has also been proposed to condense the bituminous coal, if necessary, by adding a certain quantity of another good coking coal (bituminous coal), before coking it, e. g. by stamping with a view to producing a hard and blocky metallurgical coke.

In short, the invention consists in subjecting the bituminous coal to be coked which alone does not yield a good metallurgical coke before the carbonisation, to a controlled partial oxidation that indeed reduces the coking capacity of the initial coal to a certain predetermined extent, however, without the formation of inert material, i. e. material having practically no caking or coking properties.

The inventor found out that when partially oxidising caking bituminous coal the baking bitumen by which I understand in this case the constituents of the bituminous coal which effect the agglutination of the individual particles when being heated without any access of air is changed in the coal particles starting from the surface of the particles, the matter provoking the caking capacity being destroyed, while this baking bitumen remains unchanged in the centre of the individual coal particles. When coking bituminous coal oxidized in such a way that the single coal particles contain in their inner the mentioned baking bitumen in a still unchanged state the coal particles agglutinate and yield a dense and strong coke that can be used for metallurgical purposes. It can be supposed that when heating the oxidized bituminous coal to coking temperature the baking bitumen first melts and then solidifies under formation of gas. When the coal has been partially oxidized before then the baking bitumen, when the coal is heated, first fills the oxidized surface layers of the single coal particles from which only separates a reduced quantity of the liquefied bitumen with the effect of joining the adjacent coal particles. This smaller quantity of baking bitumen develops substantially less gas than the original quantity of baking bitumen and, consequently, the coke produced is less porous. On the other hand, all or practically all of the particles of the bituminous coal remain active, i. e. they keep their coking properties to a certain extent and, therefore, participate in the formation of coke in contrast to the inert admixtures that have been used so far and that no longer possessed coking properties.

The essential measure as per invention to achieve the mentioned controlled partial oxidation of the bituminous initial coal consists in subjecting the bituminous coal supplied in a grain size as homogeneous as possible to the partial oxidation. As an important rule, it can be said that the grain size of the bituminous coal to be oxidized should be between about 0.5 mm. and 3 mm. as maxima, i. e. the coal should have a minimum of grain sizes over 3 mm. and below 0.5 mm. The coarser or smaller sizes can be removed by screening or in another suitable way. Highly important is the removal of the smaller sizes below 0.3 to 0.5 mm. as these during the oxidation at a high speed will be transformed into a completely inert material which should be avoided according to the invention as already said.

In the process as specified by the invention the bituminous coal to be coked that possesses a content of volatile matter of more than 30%, preferably about 35–40%, referred to coal with 7% of ash and has a coking power (measured according to the Kattwinkel method) of more than 150, preferably of 200 and more, first is crushed and then screened in such a way that the coal has a grain size of about 0.3 to about 6 mm., preferably 0.5 to 3 mm. When screening the coal the greatest value should be set on removing the smallest grain of below about 0.3 to 0.5 mm. and the coarser grain of over about 3 to 6 mm. though a certain portion of oversizes, according to the

invention, will not be so detrimental as an increase of the smallest sizes below about 0.5 mm.

The coal so screened is now brought into contact at rest or in motion and during heating with an oxidizing medium; preferably air, a treating temperature below the softening point of the bituminous coal and below its ignition point but over about 75° C. (degrees centigrades), preferably over 80° C. being selected. Under these conditions the screened bituminous coal is treated with oxidizing media as long as the coking power of the coal has been reduced to about 50 to 60% of the coking power of the untreated initial coal or to a still smaller value. It will be advisable to immediately coke the coal after the treatment so that no further alteration of the coking power of the coal can take place before the coal is coked.

In a preferred form of achievement of the invention the oxidizing treatment of the coal is finished under the conditions described before as soon as the coal particles have been oxidized to such an extent that the diameter of the core not oxidized is not smaller than the thickness of the oxidized surface layer of the particle, i. e., for instance, with a diameter of the coal grain of 3 mm. in the case of the oxidized layer being 1 mm. and the core not oxidized equally being 1 mm.

The alteration of the properties of the coal due to oxidation becomes obvious when investigating the softening behavior of the coal in heating. The softening of the coal can be measured in any way, for instance, by using a plastometer as employed in bread factories.

When the softening values in Mkp. are investigated at temperatures of e. g. 340 to 500 degrees centigrades, for instance, with a Pitts-Consol-Coal not oxidized it becomes obvious that in the range between 340 and 350° C. the softening curve steeply ascends, up to 1.4 Mkp, steeply descends at about 355° C. to about 0, lying near the vacuum-line at about 425° C., then ascends again at about 450° C. to the inferior value of 0.35 Mkp and, eventually, descends to 0 at 455° C.

If the same coal is oxidized according to the invention it shows a completely different softening behavior. The softening figures then steeply ascend at about 385° C. up to about 0.7 Mkp descending to 0.05 Mkp at 400° C.; then they ascend up to 1 Mkp at 440° C. and shortly after that they descend to 0.

The softening range of the coal not oxidized thus comprises a temperature space of about 100° C., viz between 345 and 455° C. The softening range of the oxidized coal according to the invention, however, comprises only about 65° C., viz the temperature space between 375 and 440° C.

Such a restriction of the softening range of the coal is of greatest importance for the subsequent coking. It is characterized in that the pre-degasification is relatively stronger but the middle de-gasification is smaller. The reduction of the middle de-gasification implies that the

coke becomes less porous. The term Mkp is used to identify "Meterkilopond." The term is quite frequently used in connection with the so-called "plastometer" process used in the softening of bituminous coal. In the present instance, the term Mkp defines the torque of the stirrer which moves in the melting coal.

The oxidation of the bituminous coal according to the invention can be achieved, e. g., in a rotary tubular kiln that is continuously fed with the coal of the desired grain size.

I claim:

1. In a process of producing coke from a bituminous caking coal so as to reduce the quantity of small and large particles and which does not yield metallurgical coke without pre-treatment with an oxidizing agent, the improvement which comprises separating from the coal the particles having a grain size below about 0.3 mm. and above about 6 mm., treating the caking coal to be coked with an oxidizing medium, at increased temperature of the coal before coking and in a continuous flow, and then treating the coal to a temperature above about 70° C.

2. In a process of producing coke from a bituminous caking coal which does not yield metallurgical coke without pre-treatment with an oxidizing agent, the improvement which comprises separating from the coal the particles having a grain size below about 0.3 mm. and above about 6 mm., treating the caking coal to be coked to partial oxidation, at increased temperature of the coal before coking and in a continuous flow, and at the same time reducing the quantity of the small and large particles having a grain size below about 0.3 mm. and above about 6 mm., and then treating the coal to a temperature above 70° C. but below the softening point of the coal, so as to produce a hard and dense metallurgical coke without a substantial addition of other carbon containing matter.

3. In a process of producing coke from a bituminous caking coal which does not yield metallurgical coke without pre-treatment with an oxidizing agent, the improvement which comprises reducing the quantity of the small and large particles of the coal having a grain size below about 0.3 mm. and above about 6 mm., and then treating the coal in a continuous flow in the presence of a gaseous oxidizing agent to a temperature above 70° C. but below the softening point of the coal, so as to produce a hard and dense metallurgical coke without a substantial addition of other carbon containing matter.

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