

UNITED STATES PATENT OFFICE

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PROCESS OF COKING COAL

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My invention relates to new and useful im-
provements in processes for the coking of coal
in order to produce coke as used for ordinary
fuel, and also for use in metallurgical opera-
5 tions. The invention particularly contemplates
a process which will efficiently and economically
produce coke having a comparatively small sul-
phur content, and to this end an object of the
invention is to provide a method of treating
10 the coal preparatory to being coked so that
sulphur existing in the coal, either free, or in
combination, will be eliminated substantially
from the coke, or reduced to so great an extent
as not to be objectionable in the use of the
15 coke.

A further object is to provide a method of
treatment which may be applied to the sulphur-
bearing coal previous to the coking thereof and
before charging into the oven or other coking
20 apparatus, and thus obviating the disadvan-
tages of treating the coal, or hot, partially
coked coal, or the finished hot coke, while in
the oven or other coking apparatus.

I will describe my new method as applied
25 to the elimination of sulphur from coal in which
at least a portion of the sulphur content exists
in the form of a sulphide, for example, pyrite
(FeS₂), although the coal may contain free
sulphur and sulphur in other combinations, such
30 as organic sulphur compounds, sulphates of iron,
calcium, copper, and magnesium, and various
other forms in which sulphur may occur as
compounded in coal deposits.

According to the present invention, a sulphur
35 eliminating agent capable of reacting with the
sulphur compounds in the coal to form gaseous
sulphur compounds which can be eliminated, is
mixed with finely divided coal to be coked and
previous to charging in the coking apparatus, so
40 that when the treated coal is charged into the
coking apparatus the heat incident to the cok-
ing operation will accelerate the reaction be-
tween said agent and the sulphur compounds
to thereby form gaseous sulphur compounds
45 which will pass off or be driven off with other
fumes generated during the coking operation.
For the purpose stated, I prefer to employ a
fluid agent, preferably hydrochloric acid, which
will react with the sulphur content of the py-
rite to form ferrous chloride and hydrogen sul-
phide (H₂S), the latter being gaseous and pass-
ing off with other fumes attending the coking
operation. The hydrochloric acid of proper
50 strength as hereinafter described, may be ap-
plied to the finely divided coal by any suitable

means which will thoroughly disseminate the
acid throughout the coal mass, this step being
performed previous to the introduction of the
coal into the coking apparatus, as by so doing
thorough mixture of the agent with the coal 5
will be accomplished. I prefer to apply the acid
of proper strength to the coal, by causing the
finely divided coal to drop or gravitate in a
more or less separated or disseminated condition
or stream through a suitable chute or duct and 10
spraying the agent by means of an atomizing
steam jet into the coal while falling. By the
procedure just described, the hot acid vapor is
caused to be brought into thorough contact with
substantially all the coal particles and be dis- 15
seminated throughout the coal mass, and thus
insure complete and efficient reaction between
the acid and the sulphur compounds in the coal.
It will be understood that the proportion of acid
by weight to the amount of coal treated will 20
depend upon the amount of sulphur compounds
present in the coal. I have found by actual
operation that one pound of commercial 20°
Baumé hydrochloric acid (HCl) will serve to
remove an approximately .05% content of sul- 25
phur from one ton of coal of the character
usually employed for the production of coke,
and on this basis the quantity of acid necessary
to remove a given amount or percentage of
sulphur from a ton of coal can be determined 30
readily, it being premised that the sulphur con-
tent of the particular coal to be coked is deter-
minable readily by well known methods of anal-
ysis. In practice, in treatment of coal of a given
pyritic sulphur content—say, about .15%—about 35
three (3) pounds of commercial 20° Baumé hy-
drochloric acid may be used to one (1) ton of
coal in order to reduce the sulphur content in
combination, such as pyrite, to the desired ex- 40
tent. It will be noted that the acid is in a
highly concentrated form, and it will be under-
stood that the steam employed for the atomiz-
ing effect is preferably in such quantity as to
reduce the acid concentration as little as possi- 45
ble, as the reaction takes place more effectually
with concentrated or strong acid than with more
dilute acid; at the same time the steam should
be of sufficient pressure to carry the acid into
the stream or column of descending coal.

After treatment as above described, the coal 50
may, if desired, be stored in bins or other re-
ceptacles until it is desired to coke the same,
or may be charged directly into the coking ap-
paratus. It is sometimes advantageous to re-
tain the treated coal for a period previous to 55

coking, as by so doing thorough saturation of the acid with the coal mass is enhanced, and the desired reaction between the acid and the pyrite is initiated and partially accomplished before coking. After treatment, either immediately after the application of the desulphurizing agent, or after the coal treated therewith has been permitted to stand for a desired period, the coal is charged into a suitable coking apparatus—for example, any of the well known forms of beehive ovens—wherein the coking is accomplished by heat in the usual manner. When the treated coal is subjected to the heat of the coking oven, the pyrites are broken down by the heat to iron sulphide (Fe_2S_3) and free sulphur, the latter combining with the hydrogen gas generated by the coking to form hydrogen sulphide which passes off with the coking fumes. The iron sulphide (Fe_2S_3) resulting as above described, combines with the hydrochloric acid gas to form iron chloride (FeCl_2) and hydrogen sulphide (H_2S) which is liberated and passes off with the fumes. It will be understood that the reaction begins when the hot acid vapor is added to the finely divided coal and is continued and accelerated by the heat generated during the coking of the coal. The treatment does not require the use of any critical temperature attending the application of the acid, but it will be found that the colder the coal and the hotter the acid vapor stream when applied, the more promptly the reaction will be initiated.

When referring herein to the coal as being finely divided, I merely mean that the coal is in the divided condition commonly used in well known coking operations.

Among the advantages of the method of procedure above described, are the following:

The preliminary treatment of the coal previous to being charged into the oven assures that the acid can be thoroughly disseminated throughout the mass, and therefore result in a more complete reaction with the sulphur compounds than the case would be if the acid were

applied to the coal while the latter were in a more or less compact and dense mass in the oven. The light acid gas formed by the atomization displaces the cold and heavy coal gases and air in the voids of the coal and assures prompt starting of the reaction before the application of heat in the coking oven. The preliminary treatment of the coal also facilitates the handling and application of the acid without extensive or complicated apparatus. The treatment produces a coke of higher quality than would result from the same coal not so treated, the coke being not only free of a large portion, if not all, of its sulphur content, but is of a finer and denser texture, is harder, and of greater weight per given volume or bulk.

What I claim and desire to secure by Letters Patent of the United States is:

1. The method of coking coal containing sulphur in solid form capable of reacting with hydrochloric acid comprising, forming a stream of finely divided coal, spraying the stream with hydrochloric acid of approximately 20° Baumé, at the rate of approximately one pound of acid for each .05% of sulphur per ton of coal, and then coking the treated coal whereby hydrogen sulphide formed by the reaction of the acid and sulphur will pass off with the fumes resulting from the coking operation.

2. The method of coking coal containing a solid sulphur compound, which comprises producing a stream of raw, finely divided coal with the particles separated, spraying the particles with hydrochloric acid disseminated throughout the stream to cause immediate reaction with the solid sulphur compound to form a gaseous sulphur compound, and thereafter coking the coal in loose, finely divided form with its acid reagent so that the gaseous sulphur compound of reaction will pass off with the fumes resulting from the coking operation, said hydrochloric acid being of high concentration and applied at the rate of approximately one pound for each .05% of sulphur per ton of coal.

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