Patented Dec. 19, 1939 2,183,924

UNITED STATES PATENT OFFICE

2,183,924

LIGNITE AND PROCESS OF PRODUCING THE SAME

Eugene P. Schoch, Austin, Tex.

No Drawing. Application April 13, 1938, Serial No. 201,850

6 Claims. (Cl. 44—1)

This invention relates to dehydrated lump lignite and a process for producing the same, and has for its object to provide a procedure which will be simpler and less expensive to carry out than any process heretofore proposed.

This invention constitutes an improvement over that disclosed in my U. S. Letters Patent No. 1,871,862, dated August 16, 1932, and also over my inventions disclosed in U. S. Letters Patents No. 1,508,617, dated Sept. 16, 1924, No. 1,556,036, dated Oct. 6, 1925, and No. 1,574,174, dated Feb. 23, 1926, particularly in that, among other things, it enables one to produce a dehydrate lump lignite retaining relatively small amounts of the oil in which it is dehydrated, and accomplishing this with a single operation involving no special fire risk.

In order that the precise invention may be more clearly understood, it is said that fresh lignite, as obtained from North American mines throughout the prairie regions extending from the Gulf of Mexico to Saskatchewan, Canada, contains from 30% to 45% of moisture. When, during storage periods, it is exposed to dry air, lignite loses much of this moisture, but in doing so it disintegrates so extensively as to become mostly dust, fine particles or easily shattered pieces. This same disintegration takes place when it burns in a fire, and hence much of the unburned material drops through the grate. Again, when lignite is heated in dryers or retorts to remove this moisture, it also undergoes such extensive disintegration.

The large moisture content of raw lignite and the fact that it disintegrates whenever the removal of moisture takes place in air, naturally affects its commercial value, and many attempts have been made to change it into an improved form of fuel. However, the effort to do this has not yet led to economically successful processes.

In my U. S. Patent No. 1,508,617, I disclosed my discovery of the fact that when fresh lump lignite was covered with, or completely immersed in, a thin hydrocarbon oil and the mixture was heated, then the lignite gave up its moisture without forming any appreciable amount of powder or small fragments. In fact the original lumps remained intact although some cracks may have formed therein, and some large lumps split into several smaller lumps, but many of the cracks were very fine, and large parts of the pieces remained entirely intact and free of any cracks.

In carrying out this original invention I preferred to use the lumps as they came from the mine, and before they had any opportunity to lose an appreciable amount of moisture, in sizes ranging from 1 to 8 inches in thickness in their various cross sections, and covered them completely with a relatively thin oil such as kerosene or gas oil. I also tried thick oils, but found the resulting product to be undesirable. The time I employed to raise the temperature of the mixture to 200° C. or higher was about two hours, and during this operation the steam bubbled up through the oil and escaped. At the end of the process the oil was drained off, and the mass allowed to cool.

In my first operations carried out as above described, I employed, inadvertently, some especially dense lignite and found that the amount of oil absorbed by the lignite, during the process and retained therein after draining, was only about 10 to 14% of the weight of the final product. But later, when using all kinds of lignite, I found that the percentage of absorbed oil was generally much higher, and in some instances amounted to nearly 20% of the weight of the final product. This high oil content rendered the product undesirable and costly, and hence I tried operations which would yield products retaining little or none of the absorbed oil, and in U. S. Letters Patent Nos. 1,574,174 and 1,871,862 I disclosed processes in which the absorbed oil was removed by operations subsequent to the dehydration process; but none of my prior procedures has solved the problem to the extent of establishing a commercial success.

In the invention now to be disclosed, my primary object is to prevent extensive impregnation of the lignite by the oil, because it is very difficult to remove the oil once it has entered the fine capillaries originally occupied by the water. This object is accomplished by placing the lignite with its cover of light oil in a closed vessel strong enough to stand the total vapor pressure corresponding to the temperature of the mass, and to allow no steam to escape while the mass is being heated to the final temperature.

I have found it desirable to heat to a maximum temperature ranging from 200° to 220° C. in about two hours, and to apply heat by means of steam coils to avoid cracking the oil. The purpose of employing a closed vessel is to compel the moisture to remain in the lignite thus keeping the pores of the lignite filled with moisture and hindering the oil from entering them.

When the mass is at the maximum temperature, then steam is allowed to escape slowly for a period of from 20 to 30 minutes, or until about

two-thirds of the total moisture of the lignite has escaped. By this time the steam pressure may have dropped down to about 150 lbs. Next the oil is promptly and rapidly allowed to drain off through an opening in the bottom of the vessel, and then the steam is allowed to blow off through the same opening. Finally a vacuum is applied for a few minutes to remove the small remaining vaporizable portions of oil and moisture as thoroughly as possible; this operation might be omitted or, in place of a vacuum, a current of an inactive gas might be blown through the charge. This vacuum pressure or gas current treatment constitutes a "scavenging" of the lignite to remove the last removable portions of water and oil therefrom. During all these operations, the steam pressure in the heating coils is maintained at its maximum to prevent the charge from losing heat to its surroundings. Further, the whole operation of "blowing-off" steam and draining the oil, etc. should be done in such a manner as to bring about a continuous drop in steam pressure, because any increase in steam pressure after the blowing-off has begun will serve to inject oil into the lignite, and this injection is to be avoided.

The following table shows the essential observations made in connection with five such trials, and gives the results obtained. The raw lignite used contained about 7% ash and 36% moisture removable by "distillation in kerosene". 5000 grams of raw lignite were immersed in about 4 gals. of liquid.

No. Exp.	Oil used	Steam jacket pressure	Inner vessel		Water removed by blow-off	Pressure drop during blow-off	Composition of product	
			Temperature	Pressure			Oil retained	Water retained
			° C.		*Grams*	° C.	*Per cent*	*Per cent*
23	Kerosene	330	222	230		To 150	5.32	5.9
26	Gasoline	315	217	275		To 150	2.79	2.75
27	3 parts gasoline to 1 part gas oil	330	221	275		To 150	4.11	3.83
29	do	320	220	275		To 150	6.53	2.64
30	do	330	221	275	1,000	To 150	4.86	3.40

Later observations indicated that the internal temperatures were probably about 10° lower than the thermometer readings in column 4 of the preceding table.

These examples show that under these conditions the lignite is almost completely dehydrated, and yet it retains only relatively small amounts of the oil under which it is submerged during the process. They also show that the percentages of oil retained decrease with the volatility of the oil employed, being least for pure gasoline, and higher for the others.

The amount of water retained is adjusted by the amount of blow-off which is allowed to take place, and by conducting the latter through a condenser, the observer can tell the amount he has removed.

Thus by proper selection of the volatility of the oil employed, of the maximum temperature to which the charge is heated, and of the extent of the blow-off, the operator can produce a product with any desired final content of oil and moisture.

It should be noted that the product thus produced is as nearly free of oil as it is possible to make it, and that whatever oil is present serves merely to film the surfaces rather than to fill or impregnate the pores. In this respect the product is fundamentally different from that produced according to my U. S. Letters Patent No. 1,556,036.

It is obvious that those skilled in the art may vary the steps of the process without departing from the spirit of this invention and therefore it is desired not to be limited to the exact foregoing disclosure except as may be demanded by the claims.

What is claimed is:

1. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil of which a substantial fraction has distillation temperatures higher than water, within a closed vessel capable of standing the resulting high vapor pressure; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing any desired portion of the moisture from the lignite to be blown off while the charge is at such a high temperature and while it is still submerged under and is being heated by the oil; and draining off the remaining liquid oil from the lignite.

2. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil of which a substantial fraction is less volatile than the steam produced by this process, within a closed vessel capable of standing the resulting high vapor pressure; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing any desired portion of the moisture from the lignite to be blown off while the charge is at such a high temperature and while it is still submerged under and is being heated by the oil; draining the hydrocarbon oil from the vessel; and scavenging the lignite to remove the last removable portions of water and oil therefrom.

3. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil, within a closed vessel capable of standing the resulting high vapor pressure the oil being such that a substantial fraction thereof shall exert lesser vapor pressures than the steam produced in the vessel; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing the moisture from the lignite to escape slowly until substantially two-thirds of the total moisture of the lignite has escaped, such escape being conducted while

the charge is at such a high temperature and while it is still submerged under and is being heated by the oil; rapidly draining the hydrocarbon oil from the vessel; blowing-off the remaining steam; and scavenging the lignite while in the vessel to remove the last removable portions of water and oil from the lignite.

4. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil composed partly or wholly of compounds distilling normally within the range of 100° to 300° C., within a closed vessel capable of standing the resulting high pressure; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing any desired portion of the moisture from the lignite to be blown off while the charge is at such a high temperature and while it is still submerged under and being heated by the oil; and draining off the remaining liquid oil from the lignite.

5. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil composed partly or wholly of compounds distilling normally within the range of 100° to 300° C., within a closed vessel capable of standing the resulting high pressure; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing any desired portion of the moisture from the lignite to be blown off while the charge is at such a high temperature and while it is still submerged under and being heated by the oil; removing the hydrocarbon oil from the vessel; and scavenging the lignite to remove the last removable portions of water and oil therefrom.

6. The process of dehydrating lignite which comprises submerging raw lignite as obtained from a mine under a hydrocarbon oil composed partly or wholly of compounds distilling normally within the range of 100° to 300° C., within a closed vessel capable of standing the resulting high pressure; heating this closed vessel and its contents to a temperature above the vaporization point of the water in the lignite, while allowing no substantial amount of water vapor to escape but retaining it until a desired maximum temperature is attained; then allowing the moisture from the lignite to escape slowly until substantially two-thirds of the total moisture of the lignite has escaped, such escape being conducted while the charge is at such a high temperature and while it is still submerged under and being heated by the oil; removing the hydrocarbon oil from the vessel; blowing-off the remaining steam; and scavenging the lignite while in the vessel to remove the last removable portions of water and oil from the lignite.

EUGENE P. SCHOCH.