

UNITED STATES PATENT OFFICE

2,137,932

PROCESS FOR TREATING COAL

Oliver M. Urbain and William R. Stemen, Columbus, Ohio, assignors to Charles H. Lewis, Harpster, Ohio

No Drawing. Application October 27, 1934,
Serial No. 750,385

8 Claims. (Cl. 252-3)

This invention contemplates a process for treating coal and specifically relates to the provision of a process for the chlorination of coal. Chlorinated coal is highly useful as a filtering medium or purifying agent in water purification processes, especially in the removal of organic compounds therefrom. The present invention is directed to a novel and economic method of producing chlorinated coal suitable for these and other uses.

The coal to be chlorinated may be sub-bituminous, bituminous or anthracite. The coal to be chlorinated is preferably first powdered to pass through a screen of from 5 to 20 mesh. The chlorination of the coal is effected by passing chlorine gas through the coal while the same is maintained at a temperature somewhat below 125° C. or the temperature at which the chlorine compounds decompose. Care is exercised to keep the temperature below this critical point. Of course, the temperature must be at least room temperature or above.

Catalysts are advantageously used in the chlorination process though the coal can be chlorinated in the absence of catalysts. Suitable catalysts are such as iron, iodine, sulfur and lead. During the chlorination period, the coal mass rises somewhat in temperature and hydrochloric acid gas and water vapor are copiously given off. Carbon oxides, hydrocarbons and chlorinated hydrocarbons are also given off in lesser amounts.

The chlorination of the coal is effected in an apparatus possessing the capacity to withstand the action of hydrochloric acid and to also withstand a moderate superatmospheric pressure of say up to 200 pounds per square inch. The process may be advantageously carried out under superatmospheric pressure.

Experience teaches that the finer the coal the higher the temperature up to 125° C. and the higher the pressure that should be employed. A longer time period of contact should be maintained for the finer coal. These factors all tend to produce a finished product having a high percentage of chlorine. In some instances the finished product contains as much as 71% of chlorine by weight.

The percentage of chlorine in the finished product depends upon and can be varied by controlling the following factors:

1. Fineness of the coal.
2. Nature and kind of coal.
3. Temperature of chlorination.
4. Pressure of chlorination.
5. Time subjected to chlorination.

The chlorinated coal, when hard coal is used, has about the same hardness and is no less fragile than the original coal. The chlorinated coal, however, when soft coal is employed, is considerably harder than the original coal.

It is believed that the action of the chlorine on the coal may be expressed by the following factors:

1. The chlorine substitutes for hydrogen in the hydrocarbon part of the so-called coal conglomerate.
2. The chlorine oxidizes certain of the groupings and opens up the ring structures.
3. The chlorine adds to the unsaturated points in the coal.
4. The chlorine renders the inactive inorganic constituents (coal ash) soluble and permits their removal by water washing to open up the coal structure and increase the active surface of the mass.
5. The chlorine activates the surface of the mass by shifting the adsorbed and absorbed gases.

The exact temperature below 125° C., the pressure and the time period of treatment of the coal with chlorine are all variable, depending upon the character of the finished product desired and can be readily selected by trial tests. If the product is to be used as a filter the particle size should be so controlled as to be between 5 mesh and 10 mesh. If the product is to be used as a treating reagent to be mixed with the material treated, it may be reduced to a fineness that will pass through a 40 mesh screen. The product may be water washed if desired.

To increase the activity of the chlorinated coal toward certain groups of organic compounds, for example, alcohols, aldehydes, ketones and organic acids, it is advantageous to effect hydroxylation of the chlorinated coal. This may be effected by treating the chlorinated coal with an alkali such for example as sodium hydroxide or calcium hydroxide, it being understood that the hydroxides of the alkali metals and alkaline earth metals are suitable for this purpose. The hydroxylation may be carried out at temperatures up to 100° C. The reactions, of course, proceed faster at the higher temperatures.

The hydroxylation of the chlorinated coal may also be effected to lesser degree by the action of steam or hot water. In either event, the hydroxylation is believed to be a result of the hydrolysis or saponification, or both, of the chlorinated coal.

What we claim is:

1. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below that at which the chlorine compounds formed decompose, for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by treating with steam thereby improving the sorptive properties of the chlorinated coal.

2. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below that at which the chlorine compounds formed decompose, for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by treating with hot water thereby improving the sorptive properties of the chlorinated coal.

3. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by treating with hot water thereby improving the sorptive properties of the chlorinated coal.

4. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal under super-atmospheric pressures at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by treating with hot water thereby improving the sorptive properties of the chlorinated coal.

5. A process for the preparation of a sorptive carbonaceous material for use in water purification

which comprises passing gaseous chlorine through powdered coal in the presence of a catalyst selected from the group of iron, iodine, sulphur and lead, at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by treating with hot water thereby improving the sorptive properties of the chlorinated coal.

6. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by washing with water containing in solution an alkali metal hydroxide thereby improving the sorptive properties of the chlorinated coal.

7. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently effecting hydroxylation by washing with water containing in solution an alkaline earth metal hydroxide thereby improving the sorptive properties of the chlorinated coal.

8. A process for the preparation of a sorptive carbonaceous material for use in water purification which comprises passing gaseous chlorine through powdered coal at a temperature below 125° C., for a time period adequate to form a product rich in combined chlorine, and subsequently treating with a reagent capable of effecting hydroxylation by introduction of hydroxyl groups thereby improving the sorptive properties of the chlorinated coal.

OLIVER M. URBAIN.
WILLIAM R. STEMEN.