UNITED STATES PATENT OFFICE

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DESTRUCTIVE HYDROGENATION OF SOLID CARBONACEOUS MATERIAL

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The destructive hydrogenation of coal or other solid carbonaceous material is often performed in the presence of a catalyst as this leads to a more even course of the reaction, a greater yield of oil and generally a diminished residue of unliquefied coal. It is important to secure an intimate contact between the material to be hydrogenated and the catalyst, and we have found that excellent results are obtained by initially bringing the comminuted coal or other solid carbonaceous material into contact with a limited quantity of an aqueous solution containing one or more catalytic elements or substances. In this way the catalyst is evenly distributed over the surface of the comminuted solid material and opportunity is afforded for adsorption of the catalyst at the surfaces of the particles.

The invention may be carried out, for example, by preparing an aqueous solution of a catalyst for destructive hydrogenation, e.g. nickel nitrate or ammonium molybdate, and wetting the ground or pulverized coal with a limited quantity of the solution, preferably by spraying the solution on to a continually agitated bulk of the material. After draining, the impregnated material may be mixed with a suitable oil and hydrogenated in the standard manner. If desired, the moist raw material may be dried before it is mixed with the oil.

In general, any catalytic material favouring destructive hydrogenation may be employed in the process of the invention if it can be prepared in a water-soluble form. Metals or metal oxides, for example, may be prepared and dissolved in the form of their soluble salts, which are subsequently converted, usually in the course of the hydrogenation, to the active state. Reducible salts are thus particularly suitable.

One method of carrying the invention into effect is shown in the accompanying drawing. Powdered coal falls from hopper 1, past valve 2 into the cylinder 3. It is conveyed along this cylinder by the screw conveyor 4 by which it is continuously agitated while being sprayed with a solution or suspension of catalyst from the line 5. Eventually it passes into the vessel 6 in which it is mixed with oil, supplied through the pipe 8, by means of the mixer 7. The mixture of oil, coal and catalyst leaves the apparatus by pipe 9. The excess of solution may drain away through holes 10.

A saturated solution of the catalyst may be used in quantity sufficient to moisten the coal uniformly. Pressures of about 200 atmospheres and temperatures of about 420°C are preferably employed in the destructive hydrogenation in the known manner and 1000-2000 cubic metres of hydrogen, measured at normal temperature and pressure are employed per ton of coal oil paste which contains 30 per cent of coal and 70 per cent heavy oil.

By a limited amount of solution in the appended claims is to be understood an amount which will just moisten the carbonaceous material.

The solution with which the solid carbonaceous material is sprayed is referred to in the appended claims as being a solution of a substance giving rise to a catalyst. This limitation is necessary since it will be obvious that the actual catalyst will be a decomposition product of the actual substance in the solution.

We declare that what we claim is:

1. Process for the destructive hydrogenation of solid carbonaceous material which consists in spraying the comminuted material in absence of oil with a limited amount of an aqueous solution of a substance giving rise to a hydrogenating catalyst, mixing the coated material with an oil, and thereafter causing it to react with hydrogen under an elevated temperature and pressure.

2. Process for the destructive hydrogenation of solid carbonaceous material which consists in treating the comminuted material in the absence of oil with a limited amount of an aqueous solution of a substance giving rise to a hydrogenating catalyst, mixing the coated material with an oil, and thereafter causing the mixture to react with hydrogen under elevated temperature and pressure.

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3. Process for the destructive hydrogenation of solid carbonaceous material which consists in treating the comminuted material in the absence of oil with an aqueous solution of a substance giving rise to a hydrogenating catalyst, allowing excess solution to drain away, mixing the coated material with an oil, and thereafter causing the mixture to react with hydrogen under elevated temperature and pressure.

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