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PROCESS FOR PRODUCTION OF SYNTHETIC CRUDE OIL FROM LOW TEMPERATURE COAL TARS

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ABSTRACT OF THE DISCLOSURE

A process for the production of synthetic crude oil from low temperature coal tars which have been obtained by careful temperature control during the carbonization of various cool materials, such as coal.

SUMMARY OF THE INVENTION

This invention relates to an improved process for the economical production of synthetic crude oil. The synthetic crude oil is obtained from low temperature coal tars which have been obtained by carefully controlling the temperature during the carbonization of various cool materials such as coal.

Generally speaking the synthetic crude oil and accompanying gaseous products are obtained by introducing heated low temperature tars with hydrogen into an insulated drum containing a suitable catalyst comprising one or more of the following elements: cobalt, molybdenum or nickel. The residence time of the combined heated low temperature tars and hydrogen in the presence of the catalyst is sufficient to produce a petroleum-like synthetic crude oil. A batch or continuous type process may be used to accomplish the formation of an expanded "high-type" synthetic crude oil. This expanded high grade synthetic crude oil from which most of the fixed or organic sulphur has been removed during the process contains a large percentage of naphtha and is ready for further processing. Following removal of the naphtha fractions by methods well known in the art, the bottoms product or remainder of the synthetic crude can be introduced as a recycle into the low temperature tars entering the system.

The synthetic crude oil formed by the process of the present invention can be refined by any of the processes well known in the petroleum industry. End products after refining, deepnding on the variation of heat, pressure and time that the low temperature tars and hydrogen are in contact with the catalyst will contain high percentages of aromatic hydrocarbons, amines, phenols, paraffins, olefins and various other light end materials. Gaseous products formed will contain hydrogen, light end gases, nitrogen compounds, and hydrogen sulfide, all of which can be processed into marketable products.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the practice of the present invention carbonaceous material, such as bituminous coal and the like, is introduced into a suitable roaster, such as multi-hearth vertical roaster, under controlled temperature with the gases removed at each level to avoid overheating. The solid material is retained in the roaster from two to four hours at a temperature of from between 400° to 600° centigrade. The rotation speed of the roaster arms and the feed is regulated to assure the desired retention time. The roaster arms preferably move the material along with a plow-type action. The roaster preferably has a heat exchange and induction center at the bottom thereof for the introduction of the super heated steam. The exhaust resulting

from the introduction of the superheated steam contains hydrogen, carbon dioxide, steam and other trace gases. This exhaust is treated to separate the hydrogen and carbon materials and the hydrogen is retained for subsequent use.

After the hot gases have been removed the remaining soild material, high volatile char, are removed mechanically from the roaster, cooled, and marketed or further processed into producer gas which in turn is marketed for heating or refined into light end products.

The hot distillation gases emitted at the various levels of the roaster are cleaned and condensed into low temperature tars with the remaining gases sent to the light end plant. At this point approximately 1200 to 1500 cubic feet of hydrogen is added to each barrel of low temperature tar and salvaged bottoms and the mixture is brought into contact with a fixed bed catalyst under controlled pressure, heat and time. A single antoclave-type batch unit having a void to catalyst ratio of from 1:1 to 4:1 can be advantageously used, or a continuous flow through unit with a liquid hourly space velocity (oil-to-catalyst volume ratio) of from 1.5 to 4.0 can be used. The pressure in the units is maintained from between 700 to 2000 p.s.i., and the temperature is maintained between 350° to 500° C. Generally, the tars are passed through a primary reactor at a temperature between 350°–370° C., and are then passed through a second reactor at a temperature of from 450° to 490° C. The resulting effiuent is then cooled into synthetic crude oil and gases. After cooling, the gases containing hydrogen sulfide, hydrogen, various light end hydrocarbons and nitrogen compounds are removed and further processed.

The hydrogen gas can be recycled and introduced into the low temperature tar stream entering the reaction chamber or burned as a flare gas. The hydrogen sulphides can be processed to produce a commercial sulphur or processed with hydrogen to produce commercial acids. The light hydrocarbons can further be refined in light end units where yielded off-gases are erturned for production heat. The nitrogen compounds can be converted into commercial fertilizer, acids and other products.

The low temperature tar which has been converted into a synthetic crude stock is then processed in a conventional petroleum distillation unit to yield a naphtha product boiling below 250° C. and a series of gases which are utilized in light ends plant or burned as excess. The synthetic crude after removal of the naphtha and light end gases becomes residual and can be recycled with low temperature tars or further treated to form various grades of asphaltic material, fuel oils and lubricating stock.

The material removed from the distillation unit as a naphtha cut can be further procesed into regular petroleum products or petrochemicals utilizing any number of refining processes known to the art. The light ends plant consist of polymerization, alkylation and/or isomerization units. The phenols can also be processed into commercial units.

The invention claimed is:

1. A process for preparing an esentially sulfur free synthetic crude oil which comprises the steps of:

(a) Roasting bituminous coal at a temperature of about 400 to 600° C. for about 2 to 4 hours,

(b) Continuously collecting and condensing the distillation gases,

(c) Separating the low temperature tars from the condensed gaseous products.

(d) Contacting the low temperature tars with a cobalt-molybdenum catalyst in a fixed bed system heated to a temperature of 350 to 500° C. and a pressure of 700 to 200 p.s.i. in the presence of hydrogen added

in an amount equal to 1200 to 1500 cubic feet of hydrogen per barrel of low temperature tars,

(e) Cooling the effluent from the reactor and separating the gaseous products containing hydrogen, hydrogen sulfide and nitrogen compounds therefrom and

(f) Recovering the essentially sulfur free synthetic crude oil product.

2. A process according to claim 1 wherein the low temperature tars are fed into a primary reactor maintained at a temperature of 350 to 370° C. and then passed thru a second reactor heated to a temperature of 450 to 490° C.

3. The process according to claim 1 wherein the low temperature tars are contacted in an autoclave unit with a void space to catalyst ratio of 1:1 to 4:1.

4. The process according to claim 1 wherein the low temperature tars are contacted in a continuous flow thru unit at a weight hourly space velocity of 1.5 to 4.0.

5. The process according to claim 1 wherein the bituminous coal is roasted at about 400 to 600° C. in the presence of steam.

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