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Hydrocracking of heavy residues from coal hydrogenation - to provide hydrogen for process and increased yields of liq. fractions

A process is claimed for hydrogenating coal at 426-481 °C and 690-2070 n/cm^2 H_2 partial pressure, with a flow rate of 240-2400 kg/hr. per m^3 reactor volume, to convert at least 80% of the coal into gas, light liquids and a heavy residue. The technique involves (a) reacting the residue with H_2 in a multi-zone hydrocracking reactor contg. a fluidised inert carrier to form a H_2/CO gas mixt., light liquid hydrocarbons and ash, (b) separating at least one liquid stream having a boiling range of C4-371 °C, (c) reforming the gas mixt. with steam in a zone heated by light hydrocarbon gas from the cracking reactor to produce the H_2 required for the hydrogenation step, (d) combining the light hydrocarbon liq. streams from the hydrogenation and hydrocracking processes.

ADVANTAGES

Yield of liquid hydrocarbons is increased, and the difficult process of separating the solids from the heavy residue is avoided, the ash being readily separated from the synthesis gas stream obtained from step (a). Unreacted coal particles in the residue are converted to synthesis gas in step (a).

H(9-A1).

PREFERRED PROCESS

Hydrogenation is carried out in a fluidised catalyst bed at 438-472 °C and 1033-1724 N/cm^2 H_2 pressure, with a catalyst exchange rate of 0.23-0.91 kg per tonne coal. The heavy residue may be vacuum distilled before hydrocracking.

Carbon deposited on the carrier in the cracking zone is burnt off with O_2 and steam in an adjacent zone at a temp. below the m.pt. of the ash.

In step (b), two liquid streams are separated, with boiling ranges of C4-204 °C and 204-524 °C respectively, and combined with similar streams from the hydrogenation.

Step (c) is carried out at 816-925 °C and 207-345 N/cm^2.

EXAMPLE

Coal was catalytically hydrogenated at 455 °C and 1240 N/cm^2 H_2 pressure with a flow rate of 496 kg/h per m^3, and an H_2 consumption of 0.047 kg/kg. Yields per kg coal were

0.123 kg 1-3C gas, 0.162 kg C4-204°C, 0.159 kg 204-343°C and 0.063 kg 343-524°C liquid fractions with 0.329 kg residue.

The residue was (A) gasified conventionally by partial oxidn. to provide H_2, or (B) hydrocracked (as claimed), with the following results.

	(A)	(B)
1-3C gas (product)	0.083	0
" " (plant fuel)	0.040	0.040
" " (reformer fuel)	-	0.048
O_2 consumption (kg)	0.200	0.107
Steam consumption (kg)	0.164	0.151
Hydrocracking products		
Gas (to reformer) (kg)	-	0.143
C_4-204°C product (kg)	-	0.033
204-343°C product (kg)	-	0.033
342-524°C product (kg)	-	0.017
Total gas feed to reformer (kg)	-	0.178
Liquid products C_4-204°C (kg)	0.162	0.195
204-343°C (kg)	0.159	0.192
343-524°C (kg)	0.063	0.080
Ash and coke (kg)	0.103	0.103

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