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Direct liquefaction of coal to middle distillates - comprises solvent treating, hydrotreating, and hydrocracking of vacuum gas oil fraction

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The coal liquefaction process comprises:

(i) conventionally ash-reducing the coal;

(ii) dissolving the coal, using a solvent and pref. H_2, and sepg. the prod. into a light stream (I) comprising atmospheric gas oil and lighter prods., and atmospheric residue (II), including ash;

(iii) recycling part of (II) as solvent to (ii), and hydrotreating the rest to give a prod. which is sepd. in 2 stages into a light stream (III) of AGO and lighter, vacuum gas oil (IV), 2 fractions (V) for recycle as solvent to (ii), and an ash-rich bottom stream (VI) for use in H_2 prodn.; and

(iv) hydrocracking (IV) and sepg. the prod. into a light stream of AGO and lighter, which is mixed with (I) and (III) and finally fractionated, and a heavy stream (VII) including unconverted material, which is recycled to the start of (iv).

USE/ADVANTAGE

A larger yield of middle distillates is obtained.

The advantages of conventional single and multi-stage processes are combined: i.e. solid/liq. sepn. is simply by vacuum flash after (iii); and dissolution and hydrogenation are effected separately under respective optimum conditions.

DISSOLUTION STAGE

The solvent includes part of (II), (V) and opt. parts of (VII) and (VI). The wt. ratio (solvent : deashed coal) is pref. 1-2, temp. 300-500°C, contact time 3-15 min., H_2 pressure not exceeding 350 kg/sq. cm. and H_2 recycle rate 400-4000 cu. m/cu.m.

HYDROTREATING STAGE

The reactor is of the slurry type, at pref. 350-450°C, LHSV 0.2-2.5, pressure 50-350 kg/sq. cm, and H_2 recycle rate 350-3500 cu.m/cu.m. The catalyst comprises sulphided oxides of metals of Gps. VI and VIII on Al_2O_3 or Al_2O_3-SiO_2. At these conditions, recycle solvent components are hydrogenated, and vacuum flash may be used for downstream

sepn.

HYDROCRACKING STAGE

2 fixed bed reactors, (A) and then (B), may be used, the temp. (deg. C) being (A) 300-400, and (B) 350-450; LHSV, (A) 0.2-0.5, and (B) 0.2-1.5; H_2 pressure (kg/sq.cm), (A and B) 50-200; and H_2 recycle rate (cu. m/cu. m), (A) 300-1700, and (B) 300-2500.

The catalyst may comprise oxides of Gp. VI and Gp. VIII metals supported on (A) Al_2O_3, and (B) SiO_2-Al_2O_3. In (A), primarily heteroatoms are removed; and in (B) primarily middle distillates are formed.

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(E) ISR: No Search Report.