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 AIR PRODUCTS & CHEM INC \*DE 3414-788-A  
 25.04.83-US-488553 (25.10.84) B01j-23/88 C10g-01/06  
 Coal liquefaction by hydrogenation using iron catalyst - and co-catalyst, pref. molybdenum, gives higher coal conversion and oil selectivity

C84-114687

**CLAIMED PROCESS**

A coal liquefaction process is operated in a H-donor solvent at a temp. above 399°C, and uses a catalyst combination of iron and another metal from Gps. VI or VIII, pref. W, Co or Ni or esp. Mo. The catalyst is unsupported, and may be added e.g. by impregnating the coal.

**ADVANTAGES**

The selectivity to fuel-range liq. prods. is increased. Selectivity to hydrocarbon gases, and H<sub>2</sub> consumption are maintained or reduced. Coal conversion is increased. Conversion of coal to oil is e.g. 25% using 1% Fe as catalyst (added as FeSO<sub>4</sub>), but is 36.3% using 1% Fe and 0.02% Mo (added as ammonium molybdate).

**PREFERRED CATALYST**

The coal may be impregnated with oil-sol. cpds. of the 2

H(9-A) N(2-A1, 2-B1, 2-C1, 3-C, 3-D)

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catalyst metals, e.g. as in US4111787, or with water-sol. cpds.; or the oil-sol. cpds. may be added to the recycled solvent; or the metals or their cpds. may be added as fine-ground particles (dia. below 0.074 mm).

Pref. concns. (relative to coal) are: 0.5-5 wt. % Fe (esp. 1% added as FeSO<sub>4</sub>), and 0.005-0.05 wt. % of the co-catalyst (pref. Mo added as ammonium molybdate).

**PREFERRED PROCESS CONDITIONS**

The coal (e.g. hard or brown coal) should be ground to 0.25mm particles or smaller, and dried. The pref. H-donor reaction solvent is a recycled prod. fraction of b.pt. about 232-538°C.

Reaction is effected at 399-455°C, and 70-141 bar H<sub>2</sub>, and with 566 cu.m H<sub>2</sub>/t coal, and for a reaction time of 40 min. The reactor is e.g. tubular with upflow, or a well-stirred tank.

**EXAMPLE**

A suspension of 30% of coal and 70% recycled solvent (b.pt. 270-489°C) was hydrogenated in a 1 l. stirred tank at 440°C and total pressure 142 bar for about 36 min.

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The catalyst concns. in separate experiments were:  
(a) none, (b) 1% Fe, (c) 1% Fe + 0.02% Mo. Compared with case (a), the increase in oil formation was (b) 105%, (c) 197.5%; the increase in selectivity ratio (oil/gas prods.) was (b) 209%, (c) 409%; and the increase in (selectivity to oil/H<sub>2</sub> consumption) was (b) 227%, (c) 222%. (35pp1492MHDwgNo0/0).