

89-113795/15

H09 (H06)

HYDS 16.10.87

*US 4816-141-A

HRI INC

16.10.87-US-109645 (28.03.89) C10g-01/08

Two = stage catalytic hydrogenation of coal - using ebullated bed catalyst cascaded forward from lower temp. 1st to higher temp. 2nd reaction zone, reducing amt. of fresh catalyst used
C89-050361

Process comprises: (a) feeding a slurring oil and particulate coal at an oil:coal wt. ratio of 1.0 to 4.0 and below about 700 deg.F into a pressurised 1st stage catalytic reaction zone (zone 1) contg. coal-derived liq. and H₂ and an ebullated bed of hydrogenation catalyst; (b) passing the coal and H₂ up through the ebullated bed, maintained at 700-800 deg.F 1000-4000 psig H₂ partial pressure and space velocity 10-90 lb/hr per cu. ft settled catalyst vol., to catalytically hydrogenate the coal, giving a partly hydroconverted material; (c) withdrawing this material contg. gas and liq. fractions from zone 1 and passing it, with extra H₂, to a 2nd stage catalytic reaction zone (zone 2) maintained at 750-860 deg.F and 1000-4000 psig H₂ for further hydrocracking of the liq. fraction with minimal dehydrogenation, to produce gas and lower boiling liq. effluent materials; (d) passing used catalyst particles with average age about 300-3000 lbs. coal processed per lb.

H(9-A1) N(2, 3-C, 3-D, 3-G)

from zone 1 to zone 2, and withdrawing from zone 2 used catalyst with average age at least about 1000lb coal processed per lb; (e) withdrawing the effluent material from zone 2 and phase sepg. it into gas and liq. fractions; (f) passing the liq. fraction to a distn. and a liq-solids sepn., from which a liq. solvent stream of normal b.pt. above 600 deg.F and contg. less than about 30 wt.% particulate solids is recycled as coal slurring oil; and (g) recovering hydrocarbon gas and increased yields of 4C-650 deg.F hydrocarbon liq. prods. from the process.

USE/ADVANTAGE

Compared with the prior art, in which catalyst flows between the reactors in countercurrent to coal and its prods., the fresh catalyst required per ton of coal processed is reduced by about 50%. The pref. recycle of the undesirable 650 deg.F+ hydrocarbon liqs. to the 1st stage reactor eliminates their net prodn.

PREFERRED CATALYST

The particulate catalyst in both reaction zones contains either Ni and Mo or Co and Mo, in each case with an Al₂O₃ support.

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PREFERRED ZONE CONDITIONS

Conditions in the 1st and 2nd stage reaction zones are pref; temp. (1) 720-780, (2) 760-850 deg. F; H₂ partial pressure, (1) and (2) 1500-3500 psig; space velocity, (1) 20-70 lb/cu. ft. of settled catalyst vol.; average age of particulate catalyst removed from the zone, (1) 600-1200, (2) 1000-2500 lb. coal processed/lb. catalyst. (9pp1492RKMII DwgNo0/2).