



## Hydrogenation of Coal

Coal contains only 4.5 % hydrogen whereas 18 % of hydrogen is present in petroleum. So, coal is hydrogen deficient compound.

*The conversion of solid fuel into liquid fuel is known as hydrogenation of coal or synthetic petrol.*

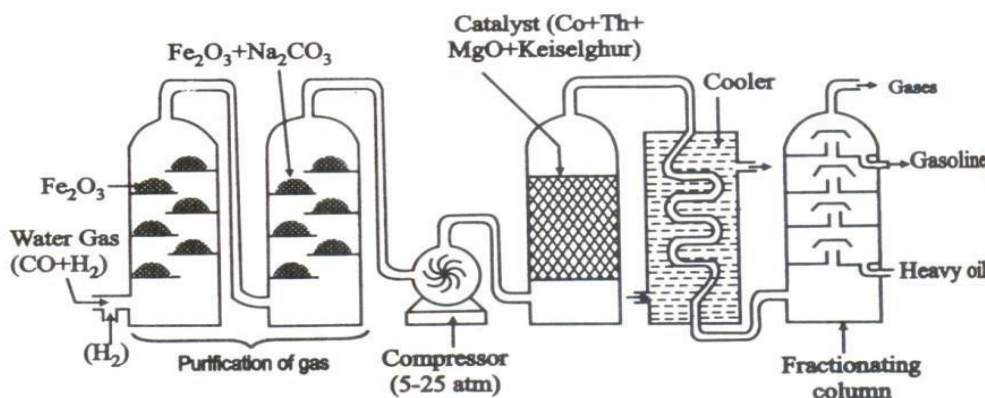
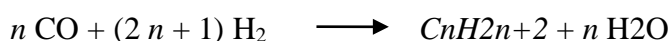
Generally, two methods are available for the manufacturing of liquid fuels from solid coal. They are as follows:

- (a) Fischer – Tropsch process (or indirect method)
- (b) Bergius process (or direct method)

### (a) Fischer-Tropsch method (Indirect method)

In this process (Fig.3), coal is first converted into coke. Then *water gas* ( $\text{CO} + \text{H}_2$ ) is produced by passing steam over red hot coke at  $1200^\circ\text{C}$ . Water gas is mixed with hydrogen and the mixture is compressed to 5-25 atmospheres.

The compressed gases are then led through a converter which is maintained at a temperature of  $200-300^\circ\text{C}$ . The converter is provided with a suitable catalyst consisting of a mixture of 100 parts cobalt, 5 parts thoria, 8 parts magnesia and 200 parts kieselguhr. A mixture of saturated and unsaturated hydrocarbons occurs as a result of polymerization.





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Figure 3:Fischer- Tropsch process

The reactions are strongly exothermic. Hence, the hot out coming gaseous mixture is led to a cooler where a liquid similar to crude oil is obtained. The crude oil thus obtained is then fractionated to yield gasoline and high boiling heavy oil. The heavy oil is used for cracking to get more gasoline

## Bergius process.

This method was developed by Bergius in Germany during the First World War. The low ash coal is finely powdered and made into a paste with heavy oil and then a catalyst (composed of tin or nickel oleate) is included. The whole is heated with hydrogen at  $450^{\circ}\text{C}$  and under a pressure 200-250 atm for about 1.5 hours, during which hydrogen combines with coal to form saturated hydrocarbons, which decompose at high temperature and pressure to yield low-boiling liquid hydrocarbons.

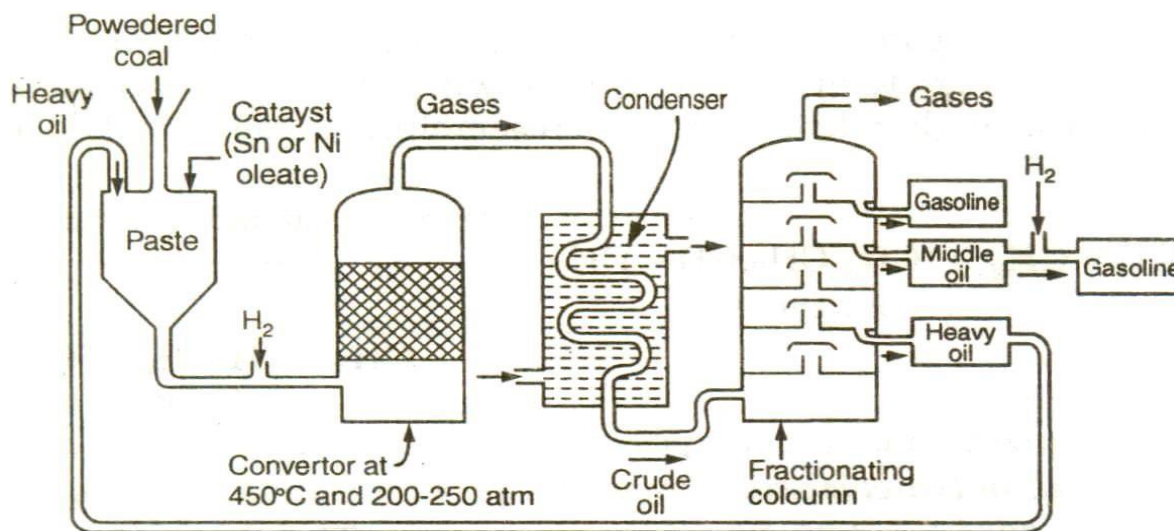


Figure 4: Bergius process of hydrogenation of coal

When this mixture is passed to condenser, the crude oil is obtained. which is then fractionated to get: (i) gasoline, (ii) middle oil, and (iii) heavy oil. The heavy oil produced is used again for making paste with fresh coal dust.. The middle oil is further hydrogenated to yield more gasoline. The yields of gasoline in about 60% of the coal dust used.