Extraction of Hydrocarbon

Why in news?

Over millions of years, organic materials from deceased organisms undergo geological processes such as heat and pressure within the Earth's crust that transforms these into hydrocarbons.

Where hydrocarbons are located?

- **Rock formation**- The most common forms in which these hydrocarbons exist in subterranean rock formations are natural gas, coal, crude oil, and petroleum.
- **Reservoirs-** Hydrocarbons are typically found in underground reservoirs, they are created when a more resistant rock type overlays a less resistant one, effectively creating a "lid" that traps the hydrocarbons below it.

  Rock formation are crucial as they prevent hydrocarbons from floating to the surface and dissipating

- **Kerogen-**The primary source of hydrocarbons in these underground formations is kerogen, which consists of lumps of organic matter.

Sources of kerogen	About	Benefits
Lacustrine	Remains of a lake ecosystem	It yields waxy oils.
Marine	Remains of a larger marine ecosystem	It produces oil and gas.
Terrestrial	Remains of a terrestrial ecosystem	It results in light oils, gas and coal.

- **Source rock**- The rock that contains kerogen is known as the source rock.
- **Petroleum geologists**- They have several responsibilities like locating source rock, analysing characteristics and estimating hydrocarbon potential, through this they take drilling decision.

How are hydrocarbons accessed?

- **Production well**- The first step is to create a production well, which serves as the primary hole through which hydrocarbons are extracted from the reservoir, the well's location is chosen to maximize drainage from reservoir.
- **Drilling process**-Engineers use a drilling machine to create the well.

Components of drilling	About

Drill pipe	The main pipe used for drilling.
Drill collars	It is located toward the bottom of the drill string
Drill bit	It is positioned at the very bottom, it breaks through the rock to create the hole

- **Steel casings**- They are slightly narrower than the hole created by drill bit, they are lowered into the tunnel.
- **Cement slurry**- It is pumped into the gap between the tunnel's outer edge and the casings, it protects the upper parts of the tunnel from collapsing and prevents soil **fluids from entering the well.**
- **Drilling fluid-** The tunnel is filled with drilling fluid (also known as mud), they serve two primary purposes.
    - It prevents the drill bit from overheating.
    - It carries away pieces of rock cut by the bit when pumped to the surface.
- **Controlled pressure**- The pressure of the drilling fluid must be carefully controlled, if not it could force hydrocarbons in the source rock to rush into the gap between the casing and the drill string, causing an eruption like an oil volcano.
- **Blowout preventers**- Modern drilling setups include mechanical valves called blowout preventers, they prevent uncontrolled gushing of hydrocarbons in the borehole and manage equipment inside.
- **Mud-logging**- The process of recording rock cuttings by depth and studying their properties is called mud-logging.
- **Drill bit descent-** As the drill bit descends, the drill pipe length is increased by adding extensions, the drill pipe can also be pulled up if replacement is needed.
- **Sophisticated drilling rigs**- They come equipped with generators and batteries to power various steps.Offshore rigs have additional facilities to enhance stability and aid extraction through the water column.

Extraction of hydrocarbons	
Process	**About**
Completion stage	• After drilling, the well undergoes completion, which prepares it to drain hydrocarbons. • Engineers remove the drill string and punch holes in the casing to allow hydrocarbons to flow into the well.
Natural pressure flow	• Often, the pressure inside the well is lower than in the surrounding rock, causing hydrocarbons to flow upward naturally. • A narrower tube at the top directs the fluids to flow out in one direction.
Production stage	• The flow of hydrocarbons signifies the end of the completion stage and the start of production. • Systems at the wellhead control the outflow using valves.
Pump jacks	• If the pressure difference is insufficient, pump jacks may be used to mechanically lift hydrocarbons from the well.
Work-overs	• Long-standing wells might need workovers, which involve adding or replacing components to enhance hydrocarbon recovery.

Production phases	• **Primary phase**-Relies on natural processes like pressure differences and buoyancy. • **Secondary phase**- Involves inducing artificial pressure to maintain flow (e.g., water injection). • **Tertiary phase**- Uses enhanced recovery methods like steam injection to force remaining hydrocarbons out.
Yield percentages	• During petroleum recovery, a well might yield approximately 15% in the primary phase, 45% in the secondary, and 15% in the tertiary phase

- **Stopping extraction**- The contractor may cease extraction activities if the well is not producing enough to be profitable.
- **Plugging the well**-The well must be plugged to prevent hydrocarbons and gases from escaping into the environment. Plugs can be temporary (if there's a possibility of recommissioning the well) or permanent.
- **Plugging issues**- Improperly plugged wells can lead to environmental issues. Plugs may deteriorate or fail due to quality issues or external disturbances.
- **Decommissioning**- The most thorough method of concluding operations is decommissioning the well. The process is comprehensive but can be expensive and sometimes commercially unfeasible.
- **Environmental concerns-** Improperly abandoned wells can be significant sources of methane emissions. The production and use of equipment for hydrocarbon extraction also contribute to emissions.

A study from 2018 estimated that 9,000 oilfields across 90 countries released 1.7 billion tonnes of carbon dioxide in 2015.

Reference

The Hindu- How are hydrocarbons are extracted?

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