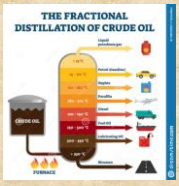
A Journey of Fossil Fuels: Field to Market

Introduction to the lecture

- This lecture provides an overview of the journey of fossil fuel from field to market.
- This lecture discusses the key concepts such as exploration and survey for fossil fuel in terms of geology, rock formation, porosity, permeability, seismic technology.
- It also introduces the way of retrieving oil in the field through permitting, drilling, well completion and casing well and cementing in the field.

Introduction to the lecture

- This lecture provides an overview of planning production of oil in the field, shipping crude oil, refining through distillation, processing and preparation to market and finally shipping petroleum products.



Aim and Learning outcomes

- The aim of the lecture is to provide a brief concept to understand the importance of fossil fuel and its journey from field through production to market by shipping.
- After completing lecture “Journey of fossil fuel from field to market” students will be able to:
  - Understand the exploration process of fossil fuel in the field i.e. geology, rock formation, porosity and permeability, geological history.

Aim and Learning outcomes

- After completing lecture “Journey of fossil fuel from field to market” students will be able to:
  - Know the process of retrieving fossil fuel in the field through several procedures i.e. drilling, well completion, casing, cementing.
- Know about fossil fuel production in onshore and offshore through several process i.e. cleaning oil, shipping crude oil, refining (distillation, processing) and finally to market.

Talk outline

Exploration and Survey
- Geology
- Rock Formation
- Porosity & Permeability
- Seismic technology

Retrieving the Oil
- Permitting & Leasing land
- Drilling
- Well completion
- Casing well & Cementing

Production
- Subsea operation
- Cleaning oil

Talk outline

Shipping Crude Oil

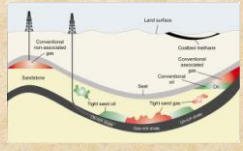
Refining

- Distillation
- Processing
- Preparation to market

Shipping Petroleum Products

Exploration - Geology

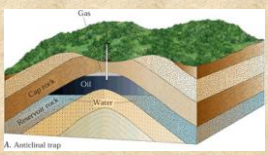
- Geologist use knowledge on rock, geological history and technology
- Sedimentary rocks are more potential for petroleum



- Drill exploratory wells/ wildcat

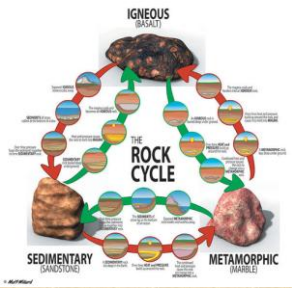
Exploration – Rock Formation

- Stratigraphy is the study of rock formation, age and other information



- Different types of rock have varying potential for holding oil or gas in reservoir

Exploration – Rock Formation



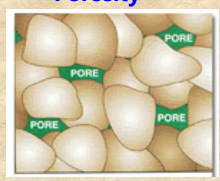
Igneous rock: formed from magma or liquid rock.

Metamorphic rock: Due to heat and pressure, igneous or sedimentary rock transformed to metamorphic rock.

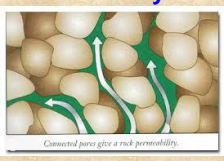
Sedimentary rock: Build by layer of sediment over time. Most oil found in sedimentary rock. It has many pores and ideal for oil and gas reservoir.

Exploration – Porosity & Permeability

Porosity



Permeability

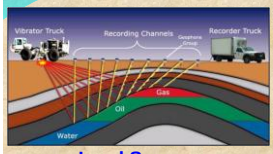


- Rocks are not completely solid ,have tiny holes, in which air or other fluids were trapped during formation
- Porosity measure the number and kind of pores in rock
- Fluid can move between these pores in varying degree
- Permeability is a measure of the ability of a rock to move fluid through its pores.

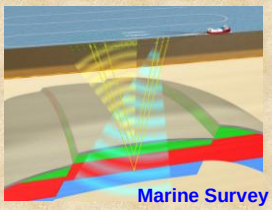
Exploration - Geologic History

- Geological history is an important factor to
- Understand the environment that existed million years ago
- Oil and gas are the remains of ancient sea life
- Important to locate the area of ancient ocean existed

Exploration - Seismic Technology



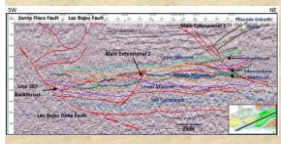
Land Survey



Marine Survey

- Seismic technology uses sound waves
- To know deep in the ground
- Seismic waves can travel through some materials more easily, depend on density of rock
- Marine survey uses air gun

Exploration - Interpreting Seismic Output



- Seismic data is interpreted in high tech ways (3D visualization)
- Advanced 3D visualization project known as CAVE (Cave Automatic Virtual Environment)
- Wall and floor are used as projection surface
- Newest type is 4D seismic technology
- The fourth dimension is time- to see how change over time

Retrieving the Oil - Permitting and Leasing Land

- Companies must get permission to drill
- Permission from state government and leases from landowners to drill private land
- There are also environmental protection measure to take in account before drilling

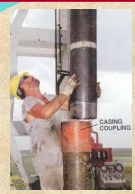
Retrieving the Oil - Drilling

- Large drilling rig is brought to the site
- Drill bits have sharp teeth that rotate to tear apart rock while the well is drilled
- The rock, torn by the drill bit called debris
- Drillers use mud to lift debris out of the well
- Mud is formulated with precise density

Retrieving the Oil - Well completion

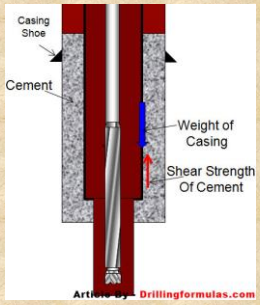
- After drilling, well must be completed before producing
- 3 main steps in well completion
  - allowing oil into the well to bring surface
  - water does not get into the well
  - keeping underground rock out of the wall
- Stability of the reserve must be considered

Retrieving the Oil - Casing



- Drill pipe does not stay in the well
- Replaced by longer, wider casing pipe
- Final & deepest well is placed after drilling complete

Retrieving the Oil - Cementing



- After casing, cement is used to fill gap between casing pipes and wall
- To create a better bond with casing, mud and cement

Production - Onshore and offshore operation

- After well completion, can go into production
- If not enough natural drive
- Need pumps to lift the oil
- Well has a lot of pressure, blow out preventer (BOP) is used
- For offshore, well cap must be resistant to corrosion of saltwater

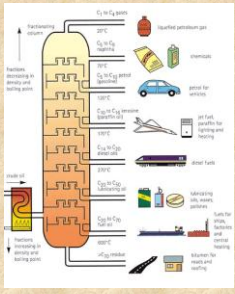
Production - Cleaning the oil

- After bringing (oil) to the surface, must be cleaned
- Refiner have specific standard
- Field processing is used to separate out oil, gas and saltwater
- Simple settling procedure
- Pressurized separators is used to separate quickly
- To remove excess water, heat-water is applied

Shipping Crude Oil

- Refineries are usually near consumption market
- Well to refinery: Pipeline and oil tanker trucks

Refining - Distillation



- Crude oil form-make it into products
- Petroleum must be refined-separated into many parts
- Distillation is a process of separation of substance based on boiling range
- Number of products come from refining process

Refining - Processing

- Different parts go through chemical processing into useful products
- Three main types----
  - •Cracking breaks long HC chain
  - • Unification combines small chain
  - •Alteration rearrange HC chain

Refining - Preparation to Market

- After all the products is separated from the crude oil then prepared to go to market

- This last step is known as treatment
- Additives are used to add with gasoline

Shipping Petroleum Products

Petroleum products are shipped to markets