



**ORISSA SCHOOL OF MINING ENGINEERING  
KEONJHAR**

**DEPARTMENT OF DRILLING ENGINEERING**

**LABORATORY MANUAL**

**ADVANCED DRILLING TECHNOLOGY LABORATORY**

**Semester: VI**

**Branch: DRILLING ENGINEERING**

**Course: ADVANCED DRILLING TECHNOLOGY LABORATORY**

**Subject Code: Pr.3**

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**LECTURER, DRILLING ENGG**

### **VISION OF THE DEPARTMENT:**

To produce quality drilling engineers, those can be valuable resources for the nation as well as for the world on problem solving and technological development.

### **MISSION OF THE DEPARTMENT:**

1. To develop state of art facilities for classroom and laboratory related to Drilling engineering which fortify students with strong fundamental concepts, analytical capability, and problem solving skills.
2. To collaborate with different national and international organisations in same dimension which promote learning beyond curriculum and skill of new technology.
3. To develop human potential to meet industrial and societal requirement.

### **PROGRAMME OUTCOMES (PO)**

**PO1.Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

**PO2.Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.

**PO3.Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

**PO4.Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

**PO5.Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.

**PO6.Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

**PO7.Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

### **PROGRAM SPECIFIC OBJECTIVE (PSO)**

**PSO1:** Study about Basic mathematics, Science and Engineering fundamentals, Geology, Surveying Method, different Drilling methods according to application, Machineries associated with it and Terminology used in drilling.

**PSO2:** Select appropriate Surveying method to locate bore holes and drilling site preparation. Tools and drilling methods selection keeping in view of Geological condition of bore hole Drilling rate, Core recovery and purpose of drilling.

**PSO3:** Analyse the problems associated with preparing drilling site, locating bore holes, geological formation, core recovery, drilling tools, drilling procedure and well conditioning during drilling operation and find out the solution to it and design a bore hole.

**PSO4:** Able to manage drilling project, become an entrepreneur in drilling field and practice sustainable development.

**PROGRAMME EDUCATIONAL OBJECTIVE:**

**PEO1:** To gain fundamental and advance knowledge related to drilling engineering.

**PEO2:** To opt out for higher study for carrier development.

**PEO3:** To gain employment in Government, Public and Private sector organisations in India and abroad also.

**PEO4:** To solve industrial problems with/without engagement in industry.

**PEO5:** To become an entrepreneur and create employment opportunities for others.

**Course Outcomes:-**

Course	Statement
C316.1	<b>Summarize</b> advanced technologies those are being used in the field of drilling.
C316.2	<b>Explain</b> mechanism & technology of different advanced drilling technologies used in drilling
C316.3	<b>Apply</b> reverse circulation and Con-Cor method in drilling for better core recovery.
C316.4	<b>Evaluate</b> offshore platform, rig and advanced tool for and technologies for oil well exploration.
C316.5	<b>Propose</b> application and development method of advanced drilling technology for oceanographic research for mineral, oil and natural gas exploration.

**CO-PO matrices of courses**

**Semester-6<sup>th</sup> Semester Subject-Advanced Drilling Technology Lab & Sub Code:**

**Pr-3**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C316.1	3	1	1	1	1	1	1
C316.2	3	2	2	2	1	1	1
C316.3	3	3	3	3	3	3	3
C316.4	3	3	3	1	2	2	3
C316.5	3	3	3	1	2	2	3
<b>C316 TOTAL</b>	15	12	12	8	9	9	11
<b>Correlation Level</b>	3	2.4	2.4	1.6	1.8	1.8	2.2

<b>Course Outcome</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
C316.1	3	3	1	3
C316.2	3	3	1	3
C316.3	3	3	3	3
C316.4	3	3	3	3
C316.5	3	3	3	3
<b>C 316 TOTAL</b>	15	15	11	15
<b>Correlation Level</b>	3	3	2.2	3

1: LOW 2: MEDIUM 3: HIGH

## Pr3. ADVANCED DRILLING TECHNOLOGY LAB

Name of the Course: Diploma in Drilling Engineering			
Course Code	:Pr.3	Semester	: 6th
Lab Periods	: 4 Periods/week	Sessional	: 25
Total Periods	: 60	End Semester Examination	: 50
Examination	: 3 Hours	Maximum Marks	: 75

### RATIONALE

In view of the rapid change in technological development coupled with globalization of India economy a drilling engineer needs to know the current trends in drilling methods.

### OBJECTIVE

Considerable research is going on throughout the world to develop new methods of drilling and excavating rocks. Knowledge of the developing technology is a necessary pre requisite to growth of any Industry. After completion of the course, students will be able to:

1. Developed the basic concept of advanced drills.
2. Recognize the application of development method of drilling technology for oceanographic research for mineral, oil and natural gas exploration.
3. Explain the mechanism and technology of different surface exploratory methods, drilling rigs, tools and equipment.

### COURSE CONTENTS

Study and sketching from cut sections of

1. Types of casings.
2. Fire jet drill.
3. Electric heater drill.
4. Odex drill.
5. Submersible rigs.
6. Maricore drill.
7. Offshore platforms.
8. Sonic drill.
9. Down the Hole Motor Electro drill.
10. Reverse circulation drill.
11. Con-core coring operation.

## **Dos**

- **Wear Proper Protective Gear:** Always wear lab coats, safety goggles, gloves, and appropriate footwear.
- **Read Instructions Carefully:** Follow the procedural guidelines provided for experiments or tasks.
- **Label Everything Clearly:** Make sure all chemicals and samples are labeled properly.
- **Maintain Cleanliness:** Keep your workspace tidy to prevent accidents.
- **Dispose of Waste Responsibly:** Use designated bins for hazardous and non-hazardous waste.
- **Report Incidents Immediately:** Inform the supervisor if any spills, breakages, or accidents occur.
- **Use Equipment Properly:** Operate lab instruments only after receiving proper training.

## **Don'ts**

- **Avoid Eating or Drinking:** Never consume food or drinks in the lab to prevent contamination or ingestion of harmful substances.
- **Don't Work Alone:** Always ensure that a supervisor or colleague is present while conducting experiments.
- **Don't Ignore Labels:** Misinterpreting labels can lead to dangerous mishaps.
- **Don't Use Damaged Equipment:** Broken or malfunctioning tools can compromise safety.
- **Avoid Unnecessary Experimentation:** Stick to the planned procedures unless approved by the supervisor.
- **No Loose Clothing or Accessories:** These can get caught in equipment or cause spills.
- **Don't Leave Chemicals Unattended:** Ensure chemicals are stored securely after use.

## Experiment No 1: Types of Casing

**Aim of the Experiment:** To study about different Casings used in Oil well drilling.

**Apparatus Required:** Model of Nested Oil well casing.

**Theory:** Casing is hollow steel tube which has numerous functions in oil well drilling.

### Functions of Casing

Casing serves several critical functions in the drilling process. Here are the key functions summarized:

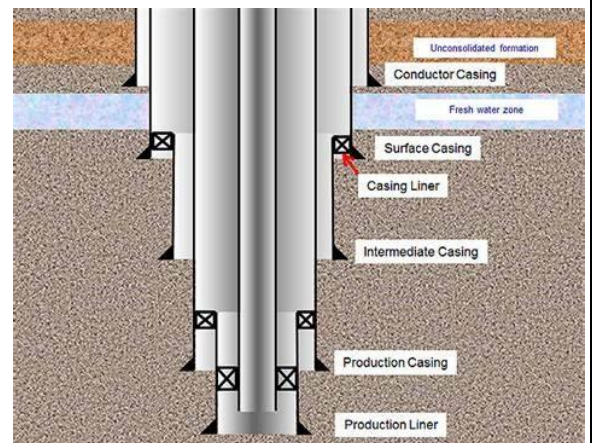
1. **Hole Stability**
  - a. Keeps the hole open.
  - b. Provides support for weak or fractured formations.
  - c. Prevents caving in of the formation, which would necessitate re-drilling.
2. **Fluid Isolation**
  - a. Isolates porous media with differing fluid and pressure regimes.
  - b. Prevents contamination of the pay zone.
  - c. Achieved through the combination of cement and casing, allowing targeted production.
3. **Protection of Freshwater Zones**
  - a. Prevents contamination of near-surface freshwater zones.
4. **Hydrocarbon Passage**
  - a. Provides a passage for hydrocarbon fluids.
  - b. Most production operations utilize special tubings within the casing.
5. **Wellhead Equipment Connection**
  - a. Connects to wellhead equipment, such as the Christmas tree.
  - b. Serves to connect blowout prevention equipment (BOP) for well control while drilling.
6. **To provide a hole of known diameter and depth** to facilitate the running of testing and completion equipment.

### Types of Casing

Currently, several types of casing are in use, one of which is described below:

#### 1) Stove Pipe

- a) Also known as marine conductor or foundation pile (for offshore drilling).
- b) Prevents washout of near-surface unconsolidated formations.
- c) Provides a circulation system for drilling mud.
- d) Ensures stability of the ground surface for the drilling rig.
- e) Does not carry wellhead equipment and can be driven into the ground with a pile driver.
- f) Normal size ranges from 26in to 42in.



## 2) Conductor Pipe

- a) The conductor pipe is installed from the surface to a shallow depth.
- b) Its primary functions include:
  - i) Protecting near-surface unconsolidated formations.
  - ii) Sealing off shallow-water zones.
  - iii) Providing protection against shallow gas flows.
  - iv) Offering a circuit for drilling mud to protect platform foundations (offshore).
- c) One or more Blowout Preventers (BOPs) may be mounted on this casing or a diverter system.
- d) Typical sizes:
  - i) Middle East: 18.5 in (473 mm) or 20 in (508 mm).
  - ii) North Sea: 30 in (762 mm).
- e) The conductor pipe is always cemented to the surface and supports subsequent casing strings and wellhead equipment or may be cut at the surface after setting the surface casing.

## 3) Surface Casing

- a) The surface casing is run to prevent caving of weak formations encountered at shallow depths.
- b) It should be set in competent rocks (e.g., hard limestone) to avoid fracturing at high hydrostatic pressures.
- c) Functions include:
  - i) Providing protection against shallow blow-outs during drilling.
  - ii) Connecting the BOPs to the top of this string.
- d) Setting depth is chosen to protect against:
  - i) Troublesome formations.
  - ii) Thief zones.
  - iii) Water sands.
  - iv) Shallow hydrocarbon zones.
  - v) Deviated well build-up sections.
- e) Typical sizes:
  - i) Middle East: 13.5 in (340 mm).
  - ii) North Sea: 18.5 in or 20 in.

## 4) Intermediate Casing

- a) Intermediate casing is set in the transition zone or to seal off over-pressured zones.
- b) Its purpose includes:
  - i) Protecting against problem formations (e.g., salt sections, caving shales).
  - ii) Ensuring good cementation to prevent communication between hydrocarbon zones and upper water formations.
- c) Multi-stage cementing may be used for long strings of intermediate casing.
- d) Typical size: 9.5 in (244.5 mm).

## 5) Production Casing

- a) The production string is the last casing string installed.
- b) Its roles include:
  - i) Isolating producing zones.
  - ii) Controlling reservoir fluid.
  - iii) Allowing selective production in multizone production.
- c) This string is through which the well will be completed.
- d) Typical size: 7 in (177.8 mm).

## 6) Liner Casing

- a) A liner is a string of casing that does not reach the surface and is hung on the intermediate casing.
- b) Key features include:
  - i) Uses a packer and slips called a liner hanger.

- ii) Both the liner and intermediate casing act as the production string.
- c) Major design criterion: withstand maximum collapse pressure.
- d) Advantages of Liner
  - i) Total costs of the production string are reduced.
  - ii) Running and cementing times are minimized.
  - iii) Reduced diameter allows for adequate sizes of production tubing.
- e) Disadvantages of Liner
  - i) Possible leaks across a liner hanger.
  - ii) Difficulty in achieving good primary cementation due to the narrow annulus between the liner and the hole.
- f) Types of Liner
  - i) Drilling Liners: Used to isolate lost circulation or abnormally pressured zones for deeper drilling.
  - ii) Production Liners: Installed instead of full casing for isolation across producing or injection zones.
  - iii) Tie-back Liner: Extends from the top of an existing liner to the surface or wellhead.
  - iv) Scab Liner: Does not reach the surface; used to repair damaged casing, sealed with packers and sometimes cemented.
  - v) Scab Tie-back Liner: Extends from the top of an existing liner but does not reach the surface, typically cemented in place.

### **Conclusion:-**

From above the experiment, able to know different types of casing, their specification and application in oil well drilling.

### **Questions:-**

- What is the primary purpose of oil well casing?
- Describe the different functions of casing in an oil well.
- Why is it necessary to case an oil well?
- What are the main types of forces and stresses that oil well casing must withstand?
- Explain the concept of zonal isolation in the context of well casing.
- What is the role of casing in well control?
- How does casing facilitate well completion and production operations?
- What are the key properties that define oil well casing?
- Explain the significance of API (American Petroleum Institute) standards in oil well casing.
- What are the implications of casing failure in an oil well?

## Experiment No 2: Fire Jet Drill

**Aim of the Experiment:** To study about Fire Jet Drill

**Apparatus Required:** Model of Fire Jet Drill

### Theory:

#### Purpose

To outline the procedures for the safe and efficient operation of the jet-piercing drill, which utilizes an oxygen-fuel oil flame to spall rock.

#### Equipment Overview

- Jet-Piercing Drill: Utilizes a high-velocity flame for rock penetration.
- Combustion Chamber: Cooled by water to maintain optimal operating conditions.
- Burning Nozzles: Designed to withstand high temperatures and pressures.
- Water System: Cools the combustion chamber and nozzles, solidifies molten rock, and assists in debris removal.

#### Operating Characteristics

Operating Characteristics of Fire Jet Drill	
Hole diameter	16-32 cm
Drilling rate	3-12 m/hr
Oxygen consumption	28,000 std. l/hr. at 10.5 kg/cm <sup>2</sup>
Fuel oil consumption	150 l/hr. at 7.0 kg/cm <sup>2</sup>
Fuel oil-oxygen ratio	0.355 kg fuel oil/kg oxygen
Water consumption	3000-3800 l/hr. at 4.2 kg/cm <sup>2</sup>
Flame temperature	2400°C
Flame velocity	1800 m/sec
Power output	Approx. 500-1000 hp

Refer to the Table for specific operational parameters, including flame velocity, temperature, and material compatibility.

#### Materials Required

- Oxygen: Pure, high-pressure oxygen.
- Fuel Oil: High-quality, compatible fuel oil.
- Cooling Water: Clean and sufficient quantity for cooling and steam generation.

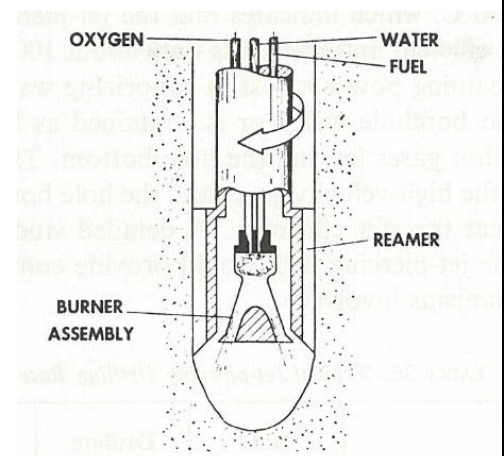
#### Safety Precautions

- Ensure all personnel wear appropriate personal protective equipment (PPE).
- Maintain a safe distance from the drill during operation.
- Monitor gas levels and ensure proper ventilation in the work area.
- Have fire suppression equipment readily available.

#### Procedure

##### Pre-Operation Checks

1. Inspect Equipment: Check the drill, combustion chamber, and nozzles for any damage or wear.



## 2. Verify Material Supply:

- Confirm the availability of oxygen and fuel oil.
- Ensure cooling water supply is adequate.

## 3. Check Safety Equipment: Ensure that all safety equipment is in place and functioning.

### *Fuel-Oil to Oxygen Ratio*

- Stoichiometric Ratio: 0.28 kg of fuel oil per kg of oxygen.
- Optimal Ratio for Drilling: Adjust to a range of 0.33-0.36 for maximum rates in spallable rocks.

### **Operating Steps**

1. Start the Cooling System: Activate the water cooling system prior to ignition.
2. Ignite the Fuel-Oil and Oxygen Mixture: Follow the ignition procedure for the combustion chamber.
3. Adjust Fuel and Oxygen Supply: Tune the mixture to achieve the optimal ratio for the specific rock type.
4. Monitor Operation:
  - Keep an eye on the flame velocity (1800 m/sec) and temperature (2400°C).
  - Observe the spalling process and adjust parameters as necessary.
5. Remove Debris: Utilize steam generated from cooling to assist in debris removal.

### **Post-Operation Procedures**

1. Shut Down Equipment: Safely turn off the fuel and oxygen supplies.
2. Drain Cooling Water: Ensure that the water system is drained properly to prevent damage.
3. Clean Work Area: Remove any residual materials and ensure the area is safe.

### **Maintenance**

- Regularly inspect and maintain equipment to ensure optimal performance and safety.
- Schedule routine checks on combustion chamber and nozzles for wear and tear.

### **Documentation**

- Log all operational parameters, including fuel ratios, flame characteristics, and any anomalies during the operation.

### **Conclusion:-**

Following this SOP will ensure the safe and effective use of the jet-piercing drill, maximizing efficiency while minimizing risks associated with high-temperature operations.

### **Questions:-**

- What is Fire Jet Drilling and what is the fundamental principle behind it?
- How does Fire Jet Drilling achieve rock or material removal?
- What are the primary potential advantages of using Fire Jet Drilling compared to conventional mechanical drilling methods?
- What are the typical applications where Fire Jet Drilling might be considered?
- What are the key components of a Fire Jet Drilling system?
- Describe the process of generating the high-temperature, high-velocity jet in Fire Jet Drilling.
- What types of fuel and oxidizer are typically used in Fire Jet Drilling?
- How does the standoff distance (distance between the nozzle and the rock surface) affect the drilling process?

- What are the limitations and challenges associated with Fire Jet Drilling?

### Experiment No 3: Electric Heater Drill

**Aim of the Experiment:** To provide guidelines for the safe and efficient operation of the electric heater drill for drilling holes in basalt and granite.

**Apparatus Required:** Model of Electric Heater Drill

**Theory:**

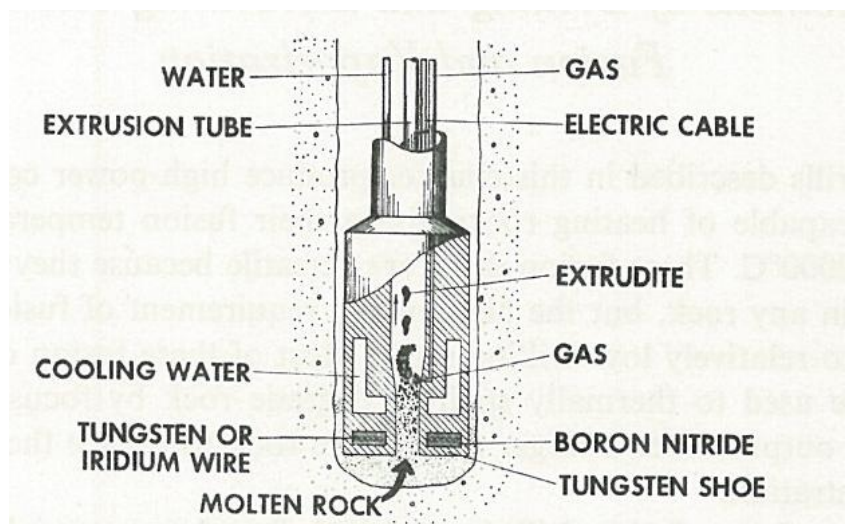
The electric heater drill is used to drill holes in basalt and granite. The operating characteristics of this drill are given below.

Bit diameter	5.1cm
Power Output	5kw
Cooling Fluid	Water
Drilling Fluid	Helium Gas
Drilling Fluid Velocity	200cm/sec
Bit Thrust	200-400kg
Resistance Wire	Tungsten or Iridium
Drilling Rate (Basalt)	1.2 cm/min

This drill uses a tungsten or iridium resistance wire to heat the tip of the drill to 1200-1600°C. The resistance wire is surrounded by boron nitride, a good electrical insulator and an excellent heat conductor.

A downward thrust forces the molten rock up through a short tube in the center of the drill. As the molten rock extrudes from this tube, a high-velocity stream of helium gas solidifies it into small "popcorn" - like particles (having amorphous, glass-like structure) that are blown

from the hole. Water is used to internally cool the sides of the drill to prevent the hot, viscous rock from sticking to it.



**Equipment Overview**

- Drill Type: Electric Heater Drill
- Heating Element: Tungsten or Iridium Resistance Wire
- Temperature Range: 1200-1600°C
- Insulation Material: Boron Nitride
- Cooling Method: Internal water cooling

**Operating Characteristics**

- Power Rating:
  - 5 kW: 5.1 cm diameter hole at 1.2 cm/min
  - 2.25 kW (15 V; 150 A): 0.41 cm/min in basalt
- Specific Energy:

- 12,300 joules/cm° at 5 kW
- 17,300 joules/cm° at 2.25 kW
- Penetration Rate: Up to 15 cm/min

## **Procedure**

### **Preparation**

1. Inspect Equipment:
  - Check for damages or wear on the drill and components.
  - Ensure the cooling system is operational.
2. Set Up Work Area:
  - Ensure that the area is clear of obstructions.
  - Provide adequate safety gear for all personnel involved.

### **Operation**

1. Power On the Drill:
  - Connect the drill to the power source.
  - Set the desired power setting (5 kW or 2.25 kW).
2. Drill Initiation:
  - Begin the drilling process by applying a downward thrust.
  - Monitor the temperature of the drill tip to maintain optimal heating.
3. Molten Rock Removal:
  - Ensure that the molten rock is guided through the short tube.
  - Confirm that the high-velocity stream of helium gas is functioning effectively to solidify the rock particles.
4. Cooling System Monitoring:
  - Regularly check the water cooling system to avoid overheating.
  - Ensure that water is flowing adequately to prevent rock adhesion to the drill.

### **After Drilling**

1. Core Retrieval:
  - Once the drilling is complete, retrieve the core and melt water.
  - Use appropriate lifting equipment to pull the drill back to the surface.
2. Bore Hole Filling:
  - Fill the bore hole with diesel oil to prevent wall collapse.
3. Equipment Maintenance:
  - Clean the drill and inspect for any wear or damages post-operation.
  - Report any issues to the maintenance team for further inspection.

### **Safety Precautions**

- Always wear appropriate personal protective equipment (PPE).
- Be aware of hot surfaces and molten materials during operation.
- Maintain a safe distance from the drill while in operation.
- Ensure proper ventilation when operating in enclosed spaces.

### **Conclusion**

Following this SOP will ensure safe and efficient drilling operations using the electric heater drill, contributing to successful projects involving basalt and granite drilling. Always adhere to safety standards and report any abnormalities to the supervising personnel.

## Experiment No 4: ODEX Drill

**Aim Of the Experiment:** To drill and case deep holes simultaneously utilizing the ODEX method, by ensuring efficiency and safety in various geological formations.

### Equipment Required:

- ODEX drill rig
- ODEX bits (various sizes: ODEX 90 to ODEX 240)
- Casing tubes (both standard steel tubes and threaded casing tubes)
- Compressed air supply
- Foaming additive (for improved flushing, if needed)



### Procedure

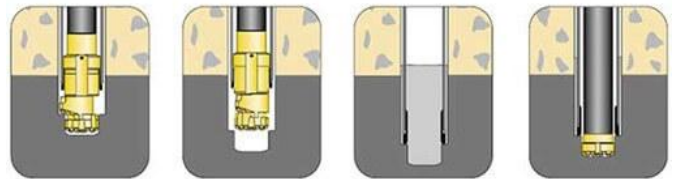
#### 1. Preparation

- Inspect all ODEX equipment and ensure it is in proper working condition.
- Select appropriate casing diameter based on the specific project requirements (114mm for ODEX 90 to 273mm for ODEX 240).
- Ensure that all necessary safety gear is available for personnel.

#### 2. Drilling Setup

- Position the drill rig over the designated drilling site.
- Connect the ODEX bit and casing tube to the drill rig.
- Ensure the backward-pointing flushing holes on the guide device are clear and functional.

#### ODEX drilling step-by-step:



#### 3. Drilling Process

- Begin drilling with the ODEX equipment:
- The eccentric bit will drill a hole larger than the outer diameter of the casing tube.
- Monitor the drilling progress and adjust the drilling speed as necessary.

#### 4. Casing Installation

- As the hole is drilled, the casing tube will be inserted simultaneously:
- Impact energy will be diverted to the casing tube via the shoulder on the guide device.
- The casing shoe will impact the bedrock, facilitating the installation.

#### 5. Depth Achievement

- Upon reaching the desired depth:
- Lift off bottom briefly and apply reverse rotation carefully to allow the reamer to turn in.
- This action reduces the overall diameter of the drill bit assembly.

#### 6. Pulling the Drill String

- Once the reamer has turned in, carefully pull the entire drill string up through the casing tubes.
- Ensure that the casing remains embedded in the bedrock.

#### 7. Continuing Drilling

- After the drill string is withdrawn, continue drilling into the bedrock using conventional drilling equipment

## **8. Flushing Improvement**

- For enhanced flushing, utilize backward-pointing flushing holes.
- If drilling conditions are challenging, consider adding a foaming additive to the compressed air supply.

## **9. Casing Management**

- Use commercially available steel tubes welded together for standard casing applications (ODEX W).
- For applications requiring casing reuse, opt for threaded casing tubes (ODEX-T).

## **Safety Considerations**

- Ensure all personnel are trained in ODEX operation and safety procedures.
- Conduct regular safety checks on all equipment.
- Always wear appropriate personal protective equipment (PPE) during drilling operations.

## **Conclusion:-**

This SOP provides a comprehensive guide for the effective implementation of the ODEX method for drilling and casing. Following these procedures will enhance operational efficiency and safety during drilling activities.

## **Questions:-**

- What does ODEX drilling stand for? Explain the core principle of the method.
- What are the primary applications of ODEX drilling?
- In what type of ground conditions is ODEX drilling most effective?
- What are the main advantages of using the ODEX system compared to other overburden drilling methods?
- What are the key components of a typical ODEX drilling system?
- Explain the function of the pilot bit and the reamer shoe in the ODEX system.
- Describe the eccentric reaming action of the ODEX system.
- What is the purpose of the guide device in some ODEX systems?
- Explain how the ODEX system allows for simultaneous drilling and casing.
- What are the limitations of the ODEX drilling method?
- Describe the design and function of a typical ODEX pilot bit. What features are important?
- What is the role of the reamer shoe (or wing bit) in enlarging the borehole? How does it retract?
- Explain the different mechanisms for retracting the reamer shoe (e.g., reverse rotation, loss of feed pressure).
- What are the different types of starter sets used in ODEX drilling?
- Describe the function of the guide body or drive shoe that connects the drill string to the ODEX assembly.
- What types of drill rods or pipes are typically used with ODEX drilling?
- Explain the importance of proper alignment and connection of the ODEX components.
- What are the common materials used in the construction of ODEX drilling tools?
- How does the size and design of the ODEX system relate to the casing diameter?
- What are the maintenance requirements for ODEX drilling tools?

# Experiment No 5:- Diver Operated Drill Rig/ Submersible Rig

**Aim of the Experiment:-** Outlines the operational procedures for the diver-operated and remotely controlled drill rig deployed on the seabed for offshore development and seabed mineral exploration.

## Equipment Overview

- Drill Rig: Capable of operating at depths up to 30 meters.
- Core Barrels: Typically two, one in use and one on standby.
- Hydraulic System: Powered by a hydraulic pump driven by a petrol engine located on the vessel.
- Communication System: Telephone line for diver-vessel communication.
- Air Supply: Airline connected to the vessel for diver breathing.

## Procedure Steps

### 1. Site Selection

- Identify and assess appropriate drilling locations prior to deployment.

### 2. Transportation to Site

- Transport the drill rig to the selected site using a vessel or ship.
- Ensure all safety checks and equipment inspections are completed before departure.

### 3. Positioning the Rig

- Accurately position the drill rig over the designated drilling location.
- Lower the rig to the seabed carefully to avoid damage.

### 4. Operational Setup

- Connect the hydraulic line from the vessel to the rig.
- Verify all connections and ensure the hydraulic system is functioning properly.

### 5. Drilling Operations

- Utilize one core barrel for drilling while the second remains in standby mode.
- Monitor the drilling process closely, ensuring communication with the diver remains constant.
- Upon retrieval of core samples, lower the second core barrel into the drill hole to maintain continuous operations.

### 6. Sample Retrieval

- After completing a drilling operation, retrieve the core barrel filled with samples.
- Send the core samples to the vessel for testing and analysis.

## Safety Considerations

- Ensure the diver is equipped with proper diving gear, including a tether for safety in currents.
- Monitor sea conditions and currents as they can complicate operations.
- Be aware that logging of boreholes can present challenges due to weathered rock, with core recovery ranging from 70% to 80%.

## Challenges and Limitations

- Drilling in hard rock may result in slower advancement rates.
- Poor underwater visibility may complicate the diver's operations.
- Maintain constant communication and air supply to ensure diver safety.

## **Conclusion**

Adhering to this SOP will ensure the safe and effective operation of the diver-operated drill rig in marine environment

## **Questions:-**

- What are the primary applications of diver-operated drills in underwater environments?
- What are the key differences between diver-operated drills and surface-operated drilling equipment?
- What are the main challenges and limitations of performing drilling operations underwater?
- Explain the importance of proper planning and risk assessment before commencing any underwater drilling activity.
- What are the different types of power sources used for diver-operated drills? What are their advantages and disadvantages underwater?
- Describe the basic working principle of a typical diver-operated drill.
- What factors influence the selection of a specific type of diver-operated drill for a particular task?
- Explain the concept of buoyancy control and its importance for divers operating drills.
- What are the typical materials that divers might need to drill into underwater?
- What are the potential environmental considerations associated with underwater drilling?

# Experiment No 6:- MariCore/MeBo Drill

**Aim of the Experiment** :- To prepare as Standard Operating Procedure (SOP) for MeBo Drilling System

## Introduction

The MeBo drilling system is a sophisticated and versatile tool developed for scientific investigations in marine environments. This document outlines the standard operating procedures for the operation and deployment of the MeBo system, including its functionalities and applications.

## Equipment Overview

- Components of MeBo System:
- Drill rig
- Operator's cabin
- Launch and recovery system
- Umbilical winch

## Work Sequence

### 1. Deployment:

- The MeBo is remotely controlled from a vessel to be deployed to the sea bed using a steel armored umbilical.
- Maximum operating depth: up to 4,000 m.

### 2. Stabilization:

- Four legs are extended to increase stability and ensure leveling on uneven sea beds.

### 3. Drill Rig Operation:

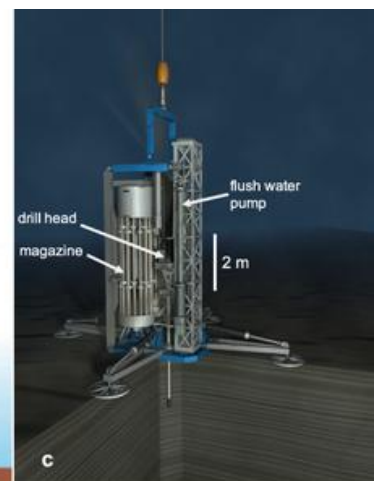
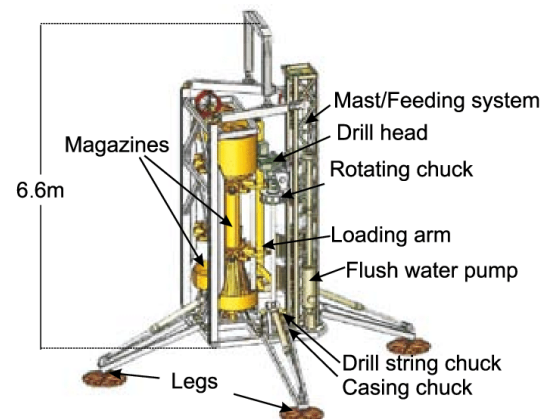
- The mast with the feeding system and power swivel is the central part of the rig, mounted on a guide carriage.
- Maximum push force: 5 tons.

### 4. Water Pump Functionality:

- A water pump supplies sea water for:
- Flushing the drill string
- Cooling the drill bit
- Removing drill cuttings
- Utilizes rotary core barrels with diamond or tungsten carbide bits.

### 5. Storage Capacity:

- The MeBo is equipped with two rotating magazines for storing drilling rods and core barrels.
- It has a storage capacity for core barrels up to 3.5 m in length, enabling drilling depths of 200 m and core recovery with diameters of 54 – 63 mm.



## **6. Enhanced Drilling Capability:**

- Optional rotary vibratory drill allows for high drilling speeds and continuous coring.

### **Advantages of MeBo System**

- Stability: Operates from a stable platform on the sea bed, unaffected by ship movements due to wind or waves.
- Optimal Control: Ensures optimal control of drill-bit pressure, crucial for high-quality core samples.

### **Main Applications**

- Soil sampling from soft sediments to hard rock.
- Geotechnical exploration for offshore foundation installation.
- Exploration for minerals in marine environments (e.g., diamonds).
- Drilling tests for gas hydrate studies.

### **Technical Specifications**

- Operating Weight: 17.5 t (approx., in air with drill string and core)
- Coring Diameter: 54 - 101 mm
- Drilling Depth: 200 m
- Maximum Water Depth: 4,000 m
- Torque Rotary Drive (Max): 1,800 Nm
- Speed Rotary Drive (Max): 400 kNm
- Feed Force: 50 kN
- Pulling Force: 100 kN
- Pump Capacity (Max): 160 l/min
- Pump Pressure (Max): 60 bar
- Tool Length: 3.5 m

### **Conclusion**

The MariCore/MeBo drilling system is a crucial tool for marine scientific research, offering robust capabilities for deep-sea exploration and resource evaluation. Proper adherence to this SOP will ensure safe and effective operation of the MariCore/MeBo system.

### **Questions:-**

- What are the key features and components of the MEBO Drill [Specify Model if known]?
- Describe the operating principles of the MEBO Drill.
- What are the different drilling methods that can be employed using the MEBO Drill?
- What are the typical applications of the MEBO Drill?
- What are the technical specifications of the MEBO Drill [Specify Model if known]? (e.g., power, torque, drilling depth, etc.)
- What are the advantages and disadvantages of using the MEBO Drill compared to other similar equipment?
- What are the different attachments and accessories available for the MEBO Drill?
- How do you interpret the control panel and instrumentation of the MEBO Drill?
- What are the routine maintenance procedures for the MEBO Drill?
- What are the common troubleshooting steps for the MEBO Drill?
- How do you set up and calibrate the MEBO Drill for a specific drilling task?

## Experiment No.7:-Offshore Platforms

**Aim of the Experiment** :- To recognize application and challenges in different offshore platforms.

### Theory:-

Offshore platforms are large, complex structures located in the ocean, designed for the exploration and extraction of oil and gas resources from beneath the seabed. These platforms serve as the operational base for drilling wells, processing hydrocarbons, and sometimes even temporarily storing the extracted resources before they are transported to onshore facilities. Here's a brief overview:

### Functions of Offshore Platforms

Offshore platforms serve several essential functions in the oil and gas industry, including:

- **Drilling and Production:** Host drilling rigs and equipment for extracting hydrocarbons from beneath the ocean floor.
- **Storage:** Feature storage tanks for temporary holding of extracted oil and gas before transportation to onshore facilities.
- **Living Quarters:** Provide accommodations for personnel on-site, including living quarters, kitchens, and recreational facilities.

### Types of Offshore Platforms

Offshore platforms come in various types, each designed for specific water depths and conditions:

#### Fixed Platforms:

Suitable for shallow to moderate water depths, includes jacket platforms and gravity-based platforms.

#### Jack-Up Rigs

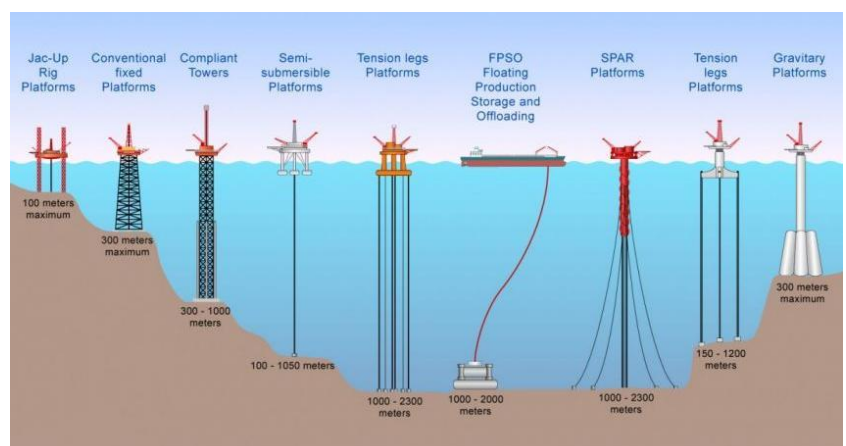
- Depth Range: Up to 400 feet (122 meters)

- Description: Elevated above the water surface using legs that lower to the seabed, suitable for shallow water drilling.

#### Fixed Drill Rigs

Depth Range: Up to 1,700 feet (518 meters)

Description: Anchored to the seabed, suitable for shallow to moderate depths.



### **Floating Platforms:**

Designed for deepwater applications, includes tension leg platforms (TLPs), spar platforms, and semi-submersibles.

#### **Semi-Submersible Rigs**

- Depth Range: Up to 10,000 feet (3,048 meters)
- Description: Floating rigs supported by submerged pontoons for deepwater and ultra-deepwater drilling.

#### **Drillships**

- Depth Range: Up to 12,000 feet (3,658 meters)
- Description: Maritime vessels with drilling apparatus, suitable for ultra-deepwater environments.

#### **Submersible Rigs**

- Depth Range: Up to 80 feet (24 meters)
- Description: Ballasted units that rest on the seabed, suitable for very shallow water drilling.

#### **Tension Leg Platforms (TLPs)**

- Depth Range: 1,000 to 5,000 feet (305 to 1,524 meters)
- Description: Floating platforms anchored with tensioned tendons for deepwater drilling.

### **Compliant Towers:**

Tall structures that sway with the waves, ideal for deepwater environments.

water depths ranging from 1,500 to 3,000 feet (450 to 900 meters)

### **FPSO Units**

- Depth Range: Varies water depths ranging from 500 to 2,500 meters (1,640 to 8,200 feet) (typically used in deepwater)
- Description: Floating vessels for oil and gas production, storage, and offloading, adaptable to various depths.

## **Engineering Challenges of Offshore Platforms**

Offshore platforms face numerous engineering challenges, including:

### **Environmental Factors**

- Wave Loads: Significant forces from ocean waves and swells can impact the structure.
- Wind Forces: High winds create pressure on the platform, affecting stability.
- Current Loads: Subsurface water currents can influence positioning and stability.
- Seismic Activity: Risks from earthquakes must be considered in design.

### **Structural Integrity**

- Material Selection: Choosing materials resistant to corrosion and fatigue is crucial.
- Structural Design: Must handle combined loads while maintaining stability.

### **Geotechnical Challenges**

- Foundation Design: Requires designs that support various seabed conditions.
- Soil-Structure Interaction: Understanding how the soil interacts with the foundation is essential for stability.

### **Operational Challenges**

- Maintenance and Inspection: Regular checks are needed for safety and functionality.
- Safety Regulations: Compliance with international safety standards is critical.

### **Technological Challenges**

- Sensing and Monitoring: Advanced technology ensures real-time monitoring of status and environment.
- Control Systems: Robust systems are needed to manage operations and respond to environmental changes.

## **Comparison of Challenges by Platform Type**

Different offshore platforms encounter unique challenges based on their design:

### **Fixed Platforms Challenges:**

- Wave and wind loads must be withstood.
- Requires a strong foundation, challenging in soft seabeds.
- Corrosion from seawater requires regular maintenance.

### **Floating Platforms Challenges: (e.g., Semi-Submersibles, Spar Platforms, TLPs)**

- Mooring and anchoring in deep waters can be complex.
- Stability and motion control are vital.
- Advanced dynamic positioning systems are necessary.

### **Compliant Towers Challenges:**

- Must flex with environmental forces while maintaining integrity.
- Installation in deepwater poses logistical challenges.

### **FPSO Units Challenges:**

- Safe storage and offloading mechanisms are required.
- Mooring systems must maintain position securely.
- Regular maintenance is crucial for integrity.

### **Subsea Systems Challenges:**

- Remote operations complicate maintenance and repairs.
- Pipeline integrity is essential for connection to surface platforms.
- Must endure high pressures and low temperatures.

### **Conclusion:**

Able to understand different application and challenge faced in different offshore oil well drill platforms.

### **Questions:-**

- What is an offshore platform and what are its primary functions in the oil and gas industry?
- Describe the typical lifecycle of an offshore platform, from design to decommissioning.
- What are the key factors that determine the type of offshore platform used in a specific location? (e.g., water depth, environmental conditions, reservoir characteristics).
- Explain the difference between fixed and floating offshore platforms, providing examples of each.
- What are the main components and systems found on a typical offshore production platform?
- Describe the role of offshore platforms in the overall oil and gas supply chain.
- What are the different types of activities that can take place on an offshore platform besides drilling and production? (e.g., accommodation, storage, processing).
- What are the challenges associated with designing, constructing, and operating offshore platforms compared to onshore facilities?
- Discuss the importance of metocean (meteorological and oceanographic) data in the design and operation of offshore platforms.
- Describe the characteristics, water depth suitability, and advantages/disadvantages of the following fixed platforms:
  - Jacket Platforms (Steel Template Structures)
  - Gravity-Based Structures (GBS)
  - Compliant Towers
- Describe the characteristics, water depth suitability, and advantages/disadvantages of the following floating platforms:
  - Semi-Submersible Platforms
  - Drillships
  - Tension Leg Platforms (TLPs)
  - Spar Platforms
  - Floating Production Storage and Offloading (FPSO) vessels

## Experiment No.8:- Sonic Drill

**Aim of the Experiment** :- Study about Working and Application of Sonic Drill

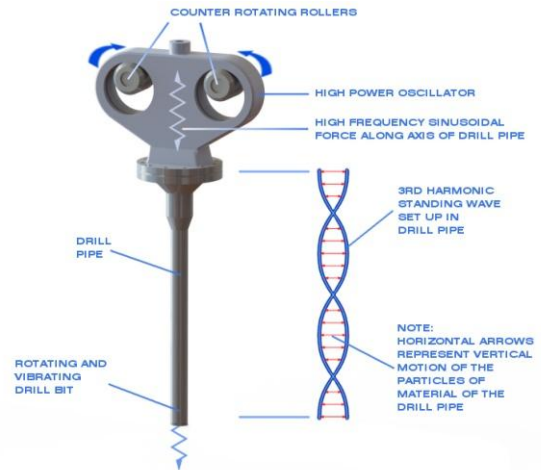
### Theory:

Sonic drilling is a specialized drilling technique that employs energy resonance to minimize friction on the drill string and drill bit. This method enhances the ability to penetrate various soil types, particularly in challenging conditions where maintaining the integrity of core samples is critical.

### How Sonic Drilling Works

Sonic drilling utilizes high-frequency vibrations to achieve the following:

- 1. Reduction of Friction:** Sonic vibrations help to liquefy loose materials or fracture hard rock, allowing for easier advancement of the drill string.
- 2. Energy Generation:** Inside the sonic head, two counter-rotating weights (eccentrics) create resonant frequencies between 50 to 150 Hz, optimizing drilling efficiency.
- 3. Resonance Effects:** When the sonic energy matches the natural frequency of the drill string, maximum energy is delivered to the drill bit, significantly reducing soil friction.
- 4. Faster Penetration:** The combination of shearing and displacement allows for quicker borehole advancement.
- 5. Easy Retrieval:** Sonic vibrations facilitate the retrieval of the drill string even in difficult conditions like expanding clays or boulders.



### Effects on Soil

Sonic drilling impacts the soil in several ways:

- **Liquefaction:** Sonic vibrations cause the fluidization of alluvial soils at the contact point with the drill head, enabling continuous sampling through various soil layers.
- **Fracturing Hard Rock:** While harder rock may require additional rotation, sonic energy still reduces friction, allowing for effective drilling.

### Steps for Sonic Drilling

The typical process for sonic drilling includes:

- 1. Core Barrel Advancement:** The core barrel is advanced using sonic frequencies, reducing sidewall friction.
- 2. Casing Advancement:** The casing is sonically advanced over the core barrel to protect the borehole.
- 3. Sample Retrieval:** The core barrel is retrieved, yielding an undisturbed sample with near 100% core recovery.
- 4. Repeat Process:** Steps are repeated until the desired depth is reached, allowing for continuous core sampling.

### Benefits of Sonic Drilling

Sonic drilling is advantageous for several reasons:

1. **Speed:** It is 3-5 times faster than conventional drilling, achieving rates of up to 260 feet (80 m) per day.
2. **Cleanliness:** The technique can be performed with minimal to no liquids, producing up to 80% less waste than traditional methods.
3. **Versatility:** It can handle a wide range of soil types, from pebbles to boulders, and can adapt to hard rock conditions.
4. **Accuracy:** Offers a continuous, relatively undisturbed core sample with only 1% deviation.
5. **Quality Results:** Continuous cores can be obtained at depths up to 700 feet (215 m), preserving volatile organic compounds.
6. **Safety:** Reduced drilling fluids create a safer work environment, minimizing risks of slips and operator exposure to contaminants.

### **Applications of Sonic Drilling**

Sonic drilling is commonly utilized in various fields, including:

- Environmental Exploration
- Geo-Technical Sampling and Testing
- Construction
- Water Wells Construction
- Lithological Profiling (observation wells)
- Mineral Exploration/Sampling
- Dewatering Wells
- Groundwater Exploration
- Remediation
- Seismic Drilling

### **Conclusion:-**

At the end of the experiment able to know about sonic drilling.

### **Questions:-**

- What is sonic drilling and how does it differ from conventional drilling methods (e.g., rotary, direct push)?
- Explain the principle of resonance and its application in sonic drilling.
- What are the primary advantages of using sonic drilling?
- What are the typical applications of sonic drilling across various industries?
- What are the key components of a sonic drilling rig and tooling system?
- Describe the role of the sonic head (oscillator) in the drilling process.
- How does the high-frequency vibration aid in soil and rock penetration?
- Explain the concept of liquefaction in the context of sonic drilling through unconsolidated materials.
- What are the limitations of sonic drilling?
- How does sonic drilling affect soil structure and sample integrity compared to other methods?
- Describe the function and design of a sonic drill head (oscillator). What are the key components?
- Explain the role of the isolator in a sonic drilling system.
- What types of drill rods and casing are typically used in sonic drilling? Are they specialized?

## **Experiment No.9:- Down the Hole Motor Electro Drill**

**Aim of the Experiment** :- Study about Working and Application of Down the hole motor electro Drill

**Apparatus Required:-** Down Hole Motor Electro Drill

### **Theory:**

#### **Introduction to Electrodrilling Technology**

Electrodrilling technology offers several advantages over traditional hydraulic downhole motors and rotary drilling methods. This guide will introduce you to the key features, benefits, and components of electrodrilling, as well as address some of its challenges.

#### **Key Advantages of Electrodrilling**

##### ***Energy Control***

Energy transmitted to the motor is independent of flow rate and drilling fluid parameters.

Complete control over the shaft's output rotational speed irrespective of:

- Weight on the bit
- Flow rate
- Torque on the bit (within a defined range)

##### ***High-Speed Data Transmission***

Electric wire communication channel allows:

Ultra-high-speed two-way data transmission.

Monitoring of drilling parameters:

- Borehole direction
- Rock characteristics
- Pressure and temperature distribution
- Downhole dynamics and mechanics

Capability to utilize seismic while drilling technology.

##### ***Motor Characteristics***

Constant motor characteristics, unaffected by circulation hours.

No wearing elastomer, enhancing durability compared to traditional motors.

##### ***Computing and Monitoring Capabilities***

Transfer of computing capability to the surface allows for:

- Real-time monitoring and optimization of drilling parameters.
- Simplification of downhole equipment circuits.
- Reduced risk of malfunctions under extreme conditions.

##### **Benefits of Using Electrodrilling**

Immediate reflection of energy used to destroy rock in consumed current.

Ability to:

- Control load on the bit via an ammeter.
- Determine bit performance and select optimal parameters.
- Identify bit wear and prevent critical wear.
- Conduct detailed geology and lithology identification.
- Interpret downhole dynamics, including vibrations and shocks.

## Enhanced Monitoring

More accurate monitoring of drilling performance indicators:  
Bit rotation speed  
Torque  
Weight on Bit (WOB)  
Real-time adjustments for optimal drilling efficiency.

## Automation

Automation of drilling parameter selection to:  
Improve rock destruction efficiency.  
Align actual profiles with planned ones.  
Mitigate vibrations and predict accidents.

## Historical Context and Development

Over 7.5 million meters drilled in Bashkortostan from 1960-2009 using electrodrilling.  
Cost reductions in drilling by 10-25% compared to rotary and turbine drilling.  
Interest in permanent magnet motors (PMM) for better efficiency and reliability emerged in the late 80s and 90s.

## Components of Electrodrilling Complex

1. Surface equipment for bit feed regulator
2. Control unit for M/LWD engineer
3. PMDM control station
4. Current lead
5. Cleaning device for contacts
6. Drill pipes with cable sections
7. Jars and drill collars with cable sections
8. Float valve with cable sections
9. Hydraulic insulation for downhole motor
10. PMDM with hydraulic insulation
11. Gearbox and spindle with cable sections
12. Controllable downhole deflector with M/LWD modules

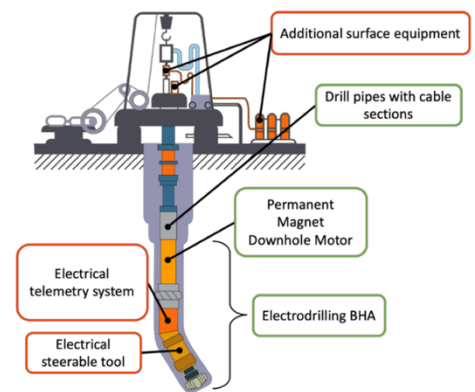


Figure 1:-Down the Hole Motor Electro Drill

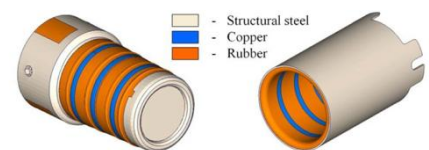


Figure 2:-Structure and material distribution of the pin & box module

## Challenges and Considerations

Shortage of electric drilling equipment and spare parts.  
Reliability issues, particularly with electric power cable connections.  
Higher starting currents of induction motors increasing the risk of electrical breakdowns.  
Need for sophisticated surface control equipment.

## Future Prospects

Ongoing development of electrodrilling technologies focusing on:  
Directional drilling of complex trajectories.  
Integration with coiled tubing drilling.

Incorporation of digital platforms for autonomous drilling operations.

### **Conclusion:-**

At the end of the experiment, able to know that Electrodrilling technology presents a promising evolution in drilling methods, combining the advantages of rotary and mud motors. By embracing this technology, drillers can enhance drilling efficiency, reduce costs, and improve the safety of operations in challenging environments.

### **Questions:-**

- What is a downhole motor electrodrill and what is its primary function in drilling operations?
- How does an electrodrill differ from a conventional mud motor (hydraulic motor) used in drilling?
- What are the key advantages and disadvantages of using an electrodrill compared to a mud motor?
- Describe the basic working principle of a downhole motor electrodrill.
- What are the main components of a typical downhole motor electrodrill system?
- Explain the role of the power cable (or electric telemetry) in operating an electrodrill.
- What are the typical applications of electrodrills in drilling (e.g., vertical drilling, directional drilling, coring)?
- Explain the concept of "steerability" in the context of electric Rotary Steerable Systems (RSS).
- What are the limitations of using electrodrills in certain drilling environments?
- How does the use of an electrodrill impact the overall drilling efficiency and rate of penetration (ROP)?
- Describe the function and design of the electric motor within the electrodrill assembly. What are the key considerations for its underwater operation?
- What is the role of the transmission or gear section in an electrodrill?
- Explain the function of the bearing assembly in supporting the rotor and stator.
- Describe the design and materials used for the power cable that supplies electricity to the electrodrill. What are the challenges of running this cable inside the drill string?
- What are the different types of connections used to integrate the electrodrill into the bottom hole assembly (BHA)?
- Explain the purpose of the telemetry system used in conjunction with electrodrills (if applicable, especially for RSS). What kind of data can it transmit?
- Describe the components of a surface power and control unit for an electrodrill.
- What are the safety features incorporated into the design of downhole motor electrodrills?

## Experiment No.10:- Reverse Circulation Drill

**Aim of the Experiment :-** Study about Working and Application of Reverse Circulation Hammer Drilling

**Apparatus Required:-** Reverse Circulation Drill Model

### Theory:-

Reverse circulation drilling, or RC drilling, is a form of percussion drilling that uses compressed air to flush material cuttings out of the drill hole in a safe and efficient manner.

### Short History of Reverse Circulation Drilling

**Origins:** Claimed to be invented in Western Australia, specifically Kalgoorlie, in the mid-20th century.  
**Initial Development:** Traditional open-hole drilling faced challenges in soft iron ore and mineral sands.

**Technological Advancements:**

1972: Development of the first specific RC drill pipes.

1990: Introduction of the first RC hammer for cleaner cuttings.

1990s: Addition of high-pressure boosters to enhance performance and penetration rates.

### How does Reverse Circulation Drilling Work?

RC drilling uses a drill bit that features round, protruding tungsten-carbide buttons, to cut through hard rock and earth. The drill rods themselves are hollow and feature an inner tube with an outer barrel (similar to air core drilling).

A pneumatic reciprocating piston (also known as a downhole hammer) delivers rapid impacts to the drill stem, transferring this energy through the drill bit. This extra concussive force hammers the bit into the rock, pulverising it, while a rotational device ensures that the drill bit hits new sections of rock with each impact.

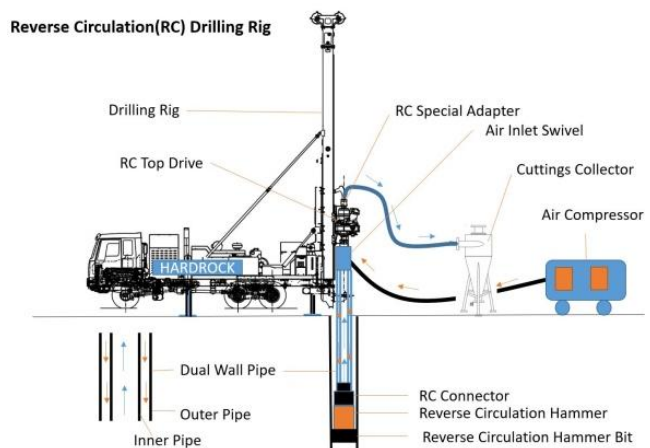
Inside the drill bit, a dual-walled drill pipe is used to achieve circulation, with compressed air getting injected between the tubes to flush the cuttings from the hole and up through the inner tube. The cuttings travel back up the tube to the surface, into a cyclone, where they go over a splitter that delivers the samples into a sample bag.

The exploration team then collects the samples, align them to the hole depth, and layout for their client to log. From here the sample is transported to their lab for assay.

RC drilling typically produces dry cuttings, as their compressors also pump air ahead of the drill bit, drying the rock in the process.

While the process itself is typically dry, water can be injected when collaring a new hole as a way to reduce dust and assist in lifting cuttings to the surface. When water is injected, an additive gets mixed into the water, known as Super Foam. This makes the cuttings bind to each other, increasing sample recovery.

### How is Reverse Circulation Drilling Applied?



Commonly used in open-cut mines for pit grade control and mine planning.  
Effective in defining boundaries between ore bodies and waste rock.  
Provides contaminant-free samples collected at the drill site for immediate assessment.  
Reduces handling time and overall program costs.

### **Depth Capacity of Reverse Circulation Drilling**

Typical drilling depth ranges from 300 to 600 metres.  
Some rigs can reach depths over 800 metres, depending on conditions.  
Groundwater can impact depth, requiring more air pressure.

### **Benefits and Advantages of RC Drilling**

Greater penetration in hard rock compared to air core drilling.  
Enhanced sample accuracy with precise location and depth data.  
Ideal for harsh environments, using 40% less water than diamond drilling.  
Reduced risk of cross-contamination in samples.  
Faster and more efficient with production rates up to 200-300 metres per day, leading to cost reductions of 25-40%.

### **Disadvantages of RC Drilling**

More expensive than air core drilling due to larger equipment and skill requirements.  
Requires well-maintained roads for safe operation.  
Provides less geological information due to rock pulverisation.  
Potential for deviation in holes, requiring additional stabilisation measures.

### **Safety and Environmental Considerations**

Lower environmental impact with a smaller footprint than other drilling methods.  
Increased personnel risk due to the percussive nature of drilling and noise.  
Manual handling of equipment poses hazards such as falling objects and physical strain.

### **Difference Between RC Drilling and Air Core Drilling**

Both methods use compressed air to return cuttings to the surface.  
Air core drilling is better suited for unconsolidated ground, while RC drilling excels on harder surfaces.  
RC drilling offers higher speed, efficiency, and capacity, making it preferable for initial exploration stages.

### **Conclusion:-**

At the end of the experiment able to know that RC drilling is high speed and efficient, and the reduced cost per metre, RC drilling is ideal for acquiring mineral samples in an exploration project's initial stages. RC rigs also tend to have a greater capacity, and they're designed to handle larger downhole equipment, so it's better suited to larger drilling programs.

### **Questions:-**

- What is Reverse Circulation (RC) drilling and how does it differ from conventional direct circulation drilling?
- Explain the principle of operation in RC drilling, focusing on the flow of drilling fluid and cuttings.
- What are the primary advantages of using RC drilling?

- What are the typical applications of RC drilling in various industries?
- What are the key components of a typical RC drilling rig and tooling system?
- Describe the function of the dual-wall drill pipe in RC drilling.
- Explain the role of the air compressor in the RC drilling process.
- What is the purpose of the cyclone separator in an RC drilling setup?
- What are the limitations of RC drilling?
- How does RC drilling affect sample quality compared to other drilling methods?
  
- Describe the design and function of dual-wall drill pipe. What are the inner and outer tubes for?
- What are the different types of RC drill bits used for various formations? How do they differ from conventional bits?
- Explain the function and design of the sample handling system at the cyclone separator.
- What are the different types and sizes of air compressors used in RC drilling? How is their capacity determined?
- Describe the design and operation of a cyclone separator. What factors affect its efficiency?
- What are the components of the return air and sample exhaust system?
- Explain the use of boosters in RC drilling. When are they required?
- What are the different types of hammers used in RC drilling (e.g., down-the-hole - DTH)?
- Describe the role of the swivel and rotary head in an RC drilling rig.
- What are the maintenance requirements for RC drilling equipment, particularly the air compressor and cyclone?

## Experiment No.11:- Con Cor Drill

**Aim of the Experiment :-** Study about Working and Application of Con Cor Drilling Process

**Apparatus Required: -** Con Cor Drill Model

### Theory:-

Reverse circulation drilling is essential in mineral exploration, where maintaining sample integrity is crucial. The "Con Cor" method has recently gained popularity in this field due to its effectiveness and reliability.

### Overview of the "Con Cor" Method

The "Con Cor" process utilizes a dual-pipe system for drilling:

- Drilling fluid or air is pumped down the outer tube.
- Return flow occurs through the inner tube.

This technique ensures that geological information obtained during exploration remains uncontaminated.

### Circulation and Fluid Management

- **Fluid Injection:**  
Circulating fluids are injected into the pipe annulus via a dual swivel or a side inlet located just below a standard swivel or top head drive.
- **Fluid Flow:**  
Fluids flow inward across the core bit, returning to the surface with cuttings and cores via the swivel and discharge hose.
- **Static Fluid:**  
A long-chain polymer is introduced into the hole annulus to reduce torque and drag, circulating when necessary.

### Advantages of the "Con Cor" Process

- **Hole Stability:**  
The absence of circulating fluids in the hole annulus contributes to excellent hole stability and straightness.
- **Core Breaker Design:**  
The core breaker is mounted on bearings, allowing it to remain stationary while the pipe rotates, minimizing shearing and premature breakage of fractured cores.
- **High Recovery Rates:**  
Sample recovery rates for cores and cuttings approach 100 percent.
- **Core Recovery:**  
Cores are automatically broken at predetermined lengths and pumped to the surface at speeds of 600 to 800 feet (180 to 240 meters) per minute.

### Chip Drilling

Chip drilling employs air or an air-water mist:

- **Fluid Management:**  
Similar to the "Con Cor" method, circulating fluids are introduced into the pipe annulus via dual swivel or side inlet.
- **Cutting Recovery:**  
Larger cuttings are returned to the surface at high velocities: 600 feet (180 meters) per minute with liquid drilling and 5000 feet (1500 meters) per minute with air.

- **Sample Integrity:**  
This method minimizes contamination from other cuttings or hole sloughing.

#### **Water Exploration with the "Con Cor" Process**

The "Con Cor" method is increasingly used for water exploration, addressing challenges in accurately predicting yields from deeper aquifers.

Key Advantages:

- Continuous representative sample retrieval.
- Accurate sampling and aquifer yield estimation due to borehole cuts with maximum clearance.
- Lower operating costs, reduced fluid loss issues, and faster penetration.
- Easy identification of aquifers' yield potential and chemical characteristics.
- Straighter holes with fewer wash-out zones, facilitating better interpretation of geophysical borehole logs.

#### **Conclusion:-**

The "Con Cor" process represents a significant advancement in drilling technology, providing reliable methods for both mineral and water exploration while ensuring sample integrity and operational efficiency.

**Thank you**