



**NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING**

PETROLEUM ENGINEERING PROGRAM

PP321 – DRILLING FLUIDS

I. GENERAL INFORMATION

CODE	: PP321 Drilling Fluids
SEMESTER	: 6
CREDITS	: 4
HOURS PER WEEK	: 6 (Theory-Practice-Laboratory)
PREREQUISITES	: PI311 Fluid Mechanics
CONDITION	: Compulsory
DEPARTMENT	: Petroleum and Natural Gas Engineering

II. COURSE DESCRIPTION

This course prepares students in the understanding and application of drilling fluids used for the drilling of boreholes into the earth. Students analyze the properties and the main functions of drilling fluids regarding the provision of hydrostatic pressure to prevent formation fluids from entering into the well bore, removing cuttings from well, keeping the drill bit cool and clean, avoiding damage and limiting corrosion. Students analyze and compare different types of drilling fluids including water-based muds, oil-based muds and gaseous drilling fluids.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand the importance of drilling fluids, interpret their compositions, properties, types and classification.
2. Understand the functions of drilling fluids making efficient the drilling of boreholes into the earth.
3. Prepare drilling fluids and identify their properties by the use of laboratory equipment.
4. Analyze the factors affecting drilling fluid performance.
5. Understand the function and identify equipment for control of solids after drilling.
6. Understand the process of cutting remediation to avoid environment pollution and contamination.

IV. LEARNING UNITS

1. DRILLING FLUIDS

Introduction / History of muds / Classification and composition of muds / Functions of drilling fluids / Properties of muds.

2. CIRCULATION SYSTEMS

Circulation systems / Drilling conditions that affect muds and well fluids / Relationship and rates of specific gravity, weight and volume of drilling mud.

3. DRILLING FLUIDS EQUIPMENT

Weight, flow and level indications / Agitation and mixing devices / Pumps, sand traps and separators.

4. MATERIALS AND ELABORATION OF DRILLING FLUIDS

Materials for drilling muds / Characteristics of mud solid materials: bentonite, attapulgite and barite / Properties of clays / Types of clays / Clay chemistry / Determination of API quality of bentonite and barite.

5. DRILLING FLUIDS RHEOLOGY

Plastics and Newtonians / Different models of flow / Thixotropy, sedimentation, flocculation, dispersion and other phenomena / Static filtration, dynamic filtration / Filtration evaluation systems / Characteristics of well walls.

6. VISCOSITY DETERMINATION

March funnel / Viscometers Stormer and Fann / Viscometer of multiple velocities / V.G. meter / Plastic viscosity, apparent viscosity and yield point.

7. GEL STRESS DETERMINATION

Viscometers Stormer and Fann / V.G. meter / Dead weight gel meter / Baroid gel meter / Filtration and scab tests / Pollution effects in drilling muds filtration / Solid content / Sand content.

8. DRILLING CUTS

Particles rising capacity by drilling fluids / Particles sliding velocity / Reynolds number for particles / Dragging coefficient / Well mud properties / Muds cleaning impact to circulation losses of muds.

9. SWEET WATER MUDS

Water-clay mixtures / Chemically treated water-clay mixtures / Muds treated with lime / Calculation and preparation of soft water muds / Pollution and treatment / Laboratory analysis / Methylene blue test.

10. SALAD WATER MUDS

Emulsion muds / Types / Preparation and characteristics / Pollution and treatment / Scattered muds.

11. PNEUMATIC MUDS

Air muds / Low solid content muds / Non-scattered muds / Lignosulfonate muds / Polymer muds / Pollution and treatment.

12. OIL-BASED MUDS

Surfactant muds / Other special muds / Preparation and treatment.

13. CIRCULATION LOSSES

Causes / Prevention / Control / Blowout / Causes and effects / Prevention / Control.

14. DIFFERENT CHARACTERISTICS OF DRILLING FLUIDS

Emulsion muds and emulsifier agents / Laboratory analysis / Muds registry / Fluorescence / Lithology of crossed formations.

V. LABORATORY AND PRACTICAL EXPERIENCES

Laboratory 1: Mud density

Laboratory 2: Mud viscosity

Laboratory 3: Clay specific gravity: bentonite, barite, calcium carbonate

Laboratory 4: Mud filtration

Laboratory 5: Solids content: fan method, retor method

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In the theory sessions, the teacher presents concepts and applications. In practice sessions, various problems are solved and their solution analyzed. Laboratories experiences are carried out using a guide with students working in group and presenting a report describing main results, analysis and conclusions. At the end of the course, students complete a project and defend it. Student's active participation is promoted.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

$$\mathbf{PF = (EP + EF + PC + PL) / 4}$$

EP: Mid-term Exam

EF: Final Exam

PC: Practical Work

PL: Laboratory Practice

VIII. BIBLIOGRAPHY

1. SOACO M.
Manual of Drilling Fluids, Alfa Omega Editions, 2008.
2. CANTO Daniel
Manual of Drilling Fluids, National University of Engineering, Peru, 2008.