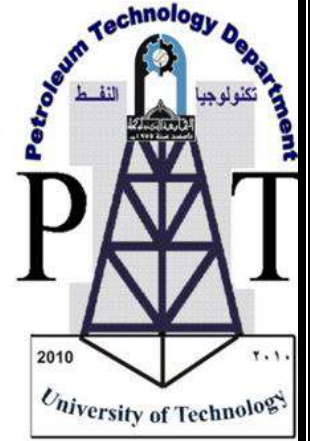




Republic of Iraq
Ministry of Higher Education and
Scientific Research
University of Technology
Petroleum Technology Department



(Petrophysical Properties Laboratory)

Prepared by:

1- Eng.Older Mohammed Abd ulrida

Reservoir Laboratory

Purpose:

The Res. Lab. Known student to petrophysical and hydrodynamics properties of reservoir formation. They are very important for petrolume engineer .

Letter :

Use laboratory equipments to conduct experiments for core sample.

Get petrophysical properties like porosity , permeablity , capillary...etc.

Formation damage a.sessment

Aims :

Measure prorerties core . supply core sample . measure porosity, Saturation , pereablity...etc.

Measure fluids reservoir properties . bubble point pressure . formation

Oil factor , formation gas factor , oil gas ratio ...etc.

Core analysis, cutting and preparation

Core Analysis:

Core analysis is laboratory measurement of Petrophysical properties of core sample recovered from geological formations analysis of reservoir rock specimens (cores) yield fundamental information for effective reservoir exploration, description and exploitation. Core data provides positive evidence of hydrocarbon presence, storage capacity for reservoir fluid (porosity), and flow capacity (permeability). Residual fluid saturation data allow for interpretation of the probable production of oil, gas or water.

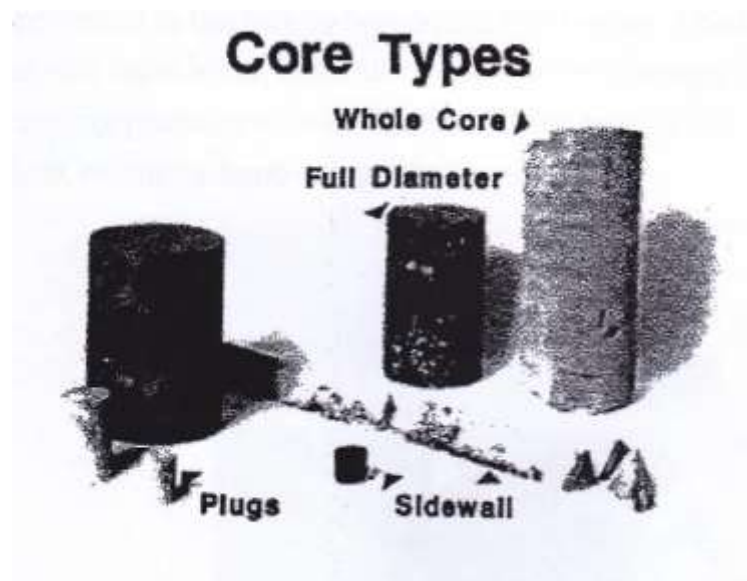
Objective of core analysis:

Common objective for coring program include:

- 1- Definition of porosity, permeability, residual fluids, lithology irreducible water saturation, and prediction of gas, oil or water production.
- 2- Reservoir estimates.
- 3- Formation damage assessment.

Types of core analysis:

- 1- Plug –Type core analysis.
- 2- Full Diameter core analysis.
3. Sidewall core analysis.



2- Drill press for diamond core cutters (Rock well).

Drilling press diamond tool can be supplied with 1" diameter and different Length .the motor operates to rotate the bit between them part important called Swivel connected with water tubing . may be used water, brine , mineral oils and gas for cooling .the rotation speed is manually controlled and easily and the actual speed displayed via digital .



3- Core Grinder (Core saw).

The model 380 Core Saw is used to trim core specimens and it is easy to operate and incorporates a water cooling system to promote efficient cutting.



4- Core Cleaning and Drying

Clean all the fluids from the samples used for to measure porosity and permeability by certain techniques and used of solvents (toluene, benzene and methanol) to remove oil ,water and residual salt .

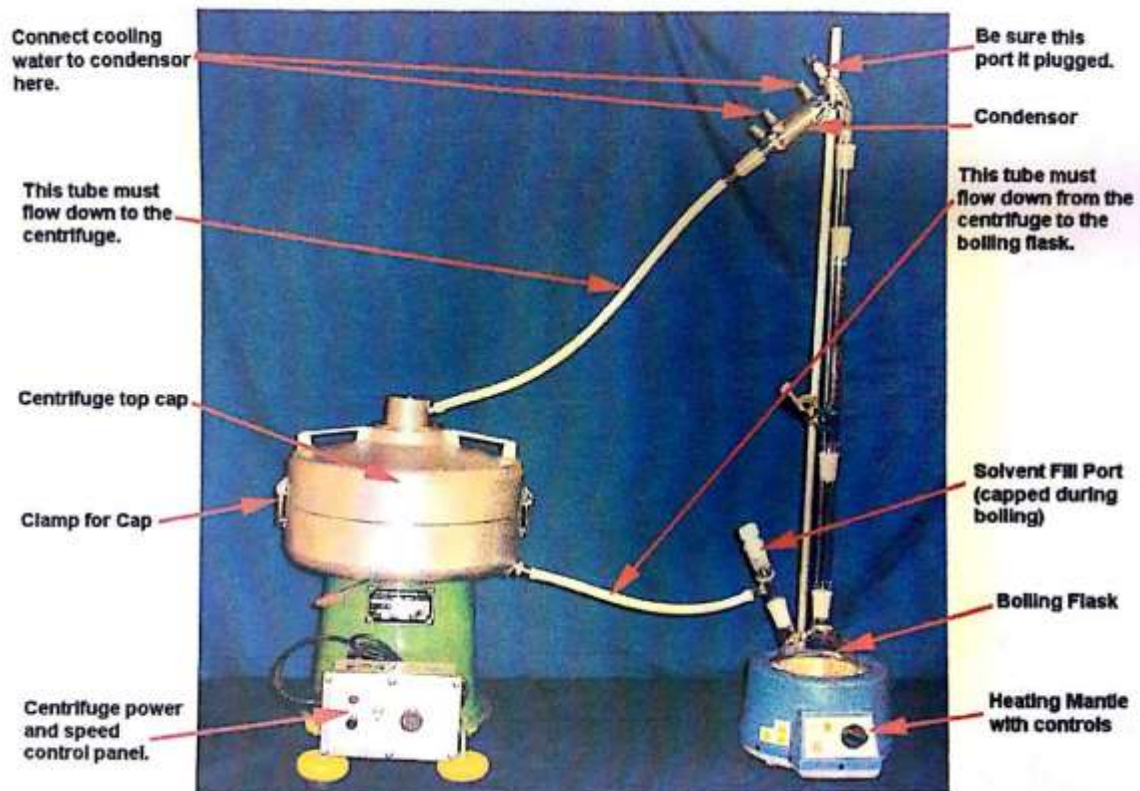
A- Soxhlet Extractor

The apparatus is composed of core holder with a different size .it is circular flask with 500 ml size placed the material in equal rates of benzene ,toluene and methanol .Contain condenser works to condensate and continue the work of 2 hours to a few days or week sometimes. The electrical power 220 volt used for heater.



B- Centrifugal Extractor

The CE-520 centrifugal extractor is an instrument that provides one of the fastest core cleaning .the eight samples are placed into chamber that rotates while hot distilled solvents are dispensed to the cores .the solvent is forced into the core samples by centrifugal force .solvents are then recycled into a distillation unit where they are distilled back into the core sample chamber . maximum operating speed 3600 RPM .



Drying By Oven And Dessicator :

Oven : The core sample is dried for the purpose of removing connate water from the pores or to remove solvent used in cleaning the cores. . Drying temperatures range from 180- 240F.

Dessicator: This is metal container dividing into top and bottom sections the bottom section contains chemical particular which absorb moisture as (cuso4).



Bulk Volume Measurement :

the bulk volume may be computed from measurements of the dimensions of a uniformly shaped sample, the usual procedure utilizes the observation of the volume of fluid displaced by the sample. The fluid displaced by a sample can be observed either volumetrically or gravimetrically.

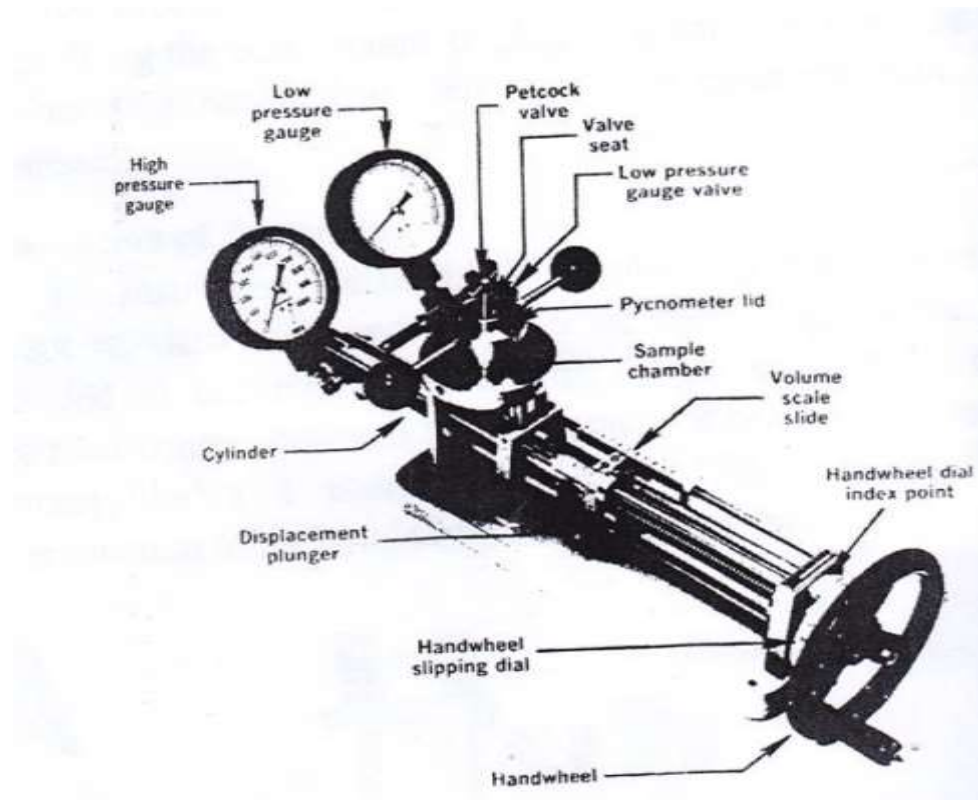
Archimedes bulk volume

The Archimedes bulk volume measurement system is designed to rapidly and accurately determine the bulk volume (VBulk) of saturated or partially saturated sample gravimetrically. The VBulk is determined by weighing a sample suspended in air followed by a weighing submerged under liquid the weight difference is then divided by the liquid density to give the VBulk of the sample.



Mercury pump porosimeter

The mercury pump porosimeter consists of a 100 cc volumetric mercury pump to which a pycnometer vessel is attached. The pycnometer will take core plug 1" long and 1.5" in diameter. Volumetric readings to an accuracy of 0.01cc can be measured and read directly with the porosimeter. The difference between the two readings represents the bulk volume in cm^3 .



Porosity:

Porosity is defined as the ratio of pore volume to bulk volume in the core. they are two types of porosity:

1-Effective porosity: the interconnected pores divided on bulk

volume. **Porosity percent = pore volume /bulk volume**

2-Absolute porosity : all pores space divided on bulk volume .

$$\text{Porosity percent} = (\text{bulk vol.} - \text{grain vol.}) / \text{bulk volume}$$

1- Apparatus of porosity determination by liquid

saturation by vacuum pump: the model DS-602 vacuum Pump to determine effective porosity. Techniques include evacuation and pressure saturation with liquid.

a clean dry sample is weighted (W_d), then saturated 100% with a liquid and weighted again (W_s), Knowing the density of the saturation fluid (ρ) yields the pore volume (VP). It is calculated using the following equations:

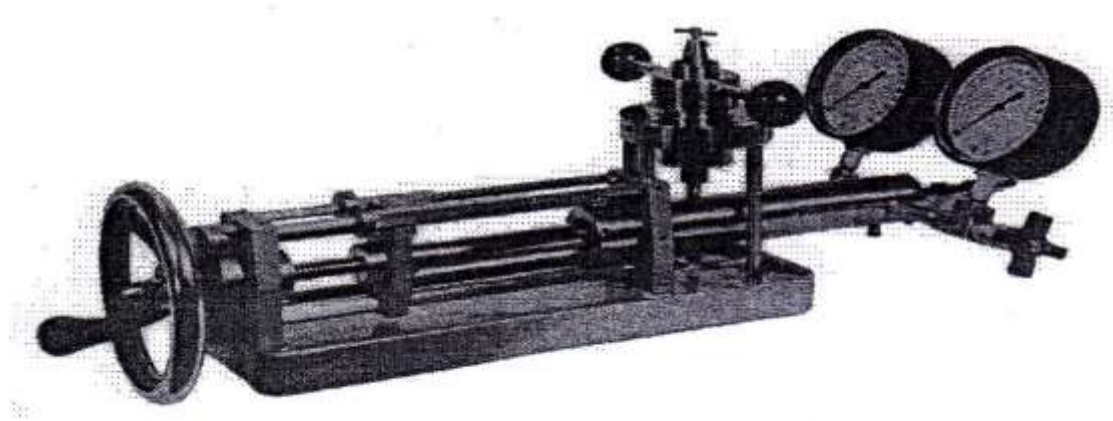
$$V_p = (W_s - W_d) / \text{density}$$



2-Apparatus of porosity determination by injection mercury for porosimeter:

mercury injection is used, the principle consist of forcing mercury under relatively high pressure, (usually 760 psi) in the rock pores. A pressure gauge is attached to the pump for reading pressure under which measured

fluid is forced into the pores .the volume of mercury entering the core sample is obtained from the device . Errors result when air is trapped in and around the sample. The sample cannot be reused or data checked by a second run since the pore spaces have been filled with mercury.



Absolute porosity by crushing :

This method applies specifically to rock material which has grains such as sands and sandstone sand can be crushed with mortar and pestal . Weight sample after drying and record weight.

Obtained the bulk volume by any method previously . The volume of the crushed sample is then determined by immersing in a suitable liquid. It is very important that no grains or fluids are lost in making the following measurement. record the increased volume of fluid.

$$\text{Porosity percent} = (\text{bulk volume} - \text{grain volume}) / \text{bulk volume}$$



Permeability:

Permeability is a property of the porous medium and is a measure of capacity of the medium to transmit fluids. It is applying Darcy's law. Permeability measurements of cores depend on sample dimensions and shape, degree of consolidation, type of fluid used and fluid pressure applied and range of permeability of the core sample. Various permeabilities are absolute, effective, and relative. These types depend on fluid phase to pass in the pores.

1-Liquid permeameter

The model PERL-200 provides a modern device for measuring absolute permeability for a core by liquid. The sample must be saturated 100% before used to ensure flowing one phase. Record the time for amount of liquid to pass through the pores. The fluid is assumed to be incompressible. The holder of the sample dimensions $L=1.5$ in, $D=1$ in.



2-gas Permeameter :

Apparatus Cement Permeameter provides absolute permeability by using gases (CO₂ or N₂). The sample must be dry. The dimensions of holder core 1 in length and 1 in diameter. The core placed in rubber sleeve holder by forcing. The values represent permeability must be corrected because effecting slippage of gas.



Saturation :

The ratio between volume of fluid (water, oil or gas) to the pore volume of core. Must be no cleaning the sample to keep the fluid in it .

Saturation determination by Dean- Stark:

Dean- Stark distillation assembly (Plug core), six-unit(220-volt) for extraction of water and oil by distillation from plug size core samples. Water is measured accurately in graduated tubes, oil content is determined by weight loss using , option precision balance .Toluene uses as solvent in it. The power 220 volt to heater.

