

PE8604 - Drilling fluids and Cementing Techniques.

Unit - III

1. Types of equipments and methods used in cementing operations.

* Cementing in an oil well is the process of placing a cement slurry of appropriate volume and (parameters) properties behind the casing in the annular space between the casing and the bore hole for an intended length and depth.

* For a casing cementation job to be successful the following are required to be achieved.

- first of all the casing must be lowered to the bottom of the drilled hole (or) target depth.
- Cement slurry must be placed correctly in its intended place or interval.
- The cement slurry should displace the mud completely and later the mud should displace the cement slurry without any mixing.
- The cement slurry should surround the casing equally on all sides.
- The cement should bond well with the casing and formation, so that there is perfect sealing of the space between the casing and the borehole.

* The equipments used to achieve the above are called cementing tools and they are discussed below.

1. Floating and Guiding equipment:

* It normally consists of a guide shoe attached to the bottom end of the casing and a float collar

attached to the top of the last joint of the casing.

* These equipment guide the casing into the hole away from ledges etc., and also allow the casing to be floated to reduce the load on the rig.

Casing Guide Shoes:

* A guide shoe is basically a short section of steel pipe with the lower end rounded to facilitate passage of the casing through irregular places in the borehole.

* The lower portion of the guide shoe. It also usually contains a back pressure valve arranged to permit circulation from the inside of the casing to the outside only.

* The primary purpose of this valve assembly is to prevent the cement slurry from reentering the inside of the casing after it had been placed.

* Also it allows the casing to be floated down the hole. That is, the inside of the casing of the casing is left empty, or only partly filled to reduce the load on the derrick.

Float collar:

* If the lowest joint of the casing is left filled with cement, the hazards of a pure cement job at the bottom of the casing are reduced.

* If the top of the cement is slightly contaminated with the displacing fluid, the contaminated portion will probably be lifted in this last joint of casing.

* The collar joint has a back pressure valve similar to that of the guide shoe.

* The internal diameter of the float collar is reduced by cement or other drillable materials to provide a positive seat for the cementing plug.

Casing Cementing Heads:

- * It is used to provide continuous cementing operations.
- * A cementing head is fixed to the top most joint and designed to receive the cement plug(s).
- * Modern heads provide a quick change cap that can be removed to insert the cement plug.
- * The bottom plug is inserted through the plug container into the casing before mixing starts.
- * The top plug is loaded into the cementing head through the cap, resting on a special support bar that can be released by turning a specially designed releasing handle.
- * Bottom plug is released a head of cement, top plug behind the cement.

Cone Jet Mixer:

* Jet mixers making use of venturi effect are very popular. Mixer of this type is simple in design reliable and rugged in operation.

- * The control mixing rate is dependent upon:
 - ⇒ Regulation of the volume of water forced through the jet,
 - ⇒ Keeping the hopper full of dry cement
 - ⇒ A by-pass line can supply extra water for lowering slurry weight by increase of water cement ratio.

Cementing plugs:

It consists of an aluminium body encased in a milled

(12)

rubber cast in the desired shape.

* Bottom plug is used ahead of the cement it prevent contamination with the mud ahead of the slurry and it wipes off the film of the mud that adheres to the inside of the casing.

* When it reaches the float collar, the diaphragm in the plug ruptures to permit the cement slurry to proceed down the casing and up the annulus.

* Top plug serves to signal the proper placement of the slurry and prevents mixing of cement and displacing fluid.

* Strong undiluted cement is specially desirable near the casing shoe.

Wall Scratchers:

* They are used to improve the bonding properties of cement to the formation by removing the mud cake from the wall of the hole.

* They are reciprocating or rotating.

* Reciprocating scratchers are normally spaced at 15-20 ft intervals through out the section to be cemented, but rotating are usually placed opposite pay zone only.

* Casing that is equipped with reciprocating scratchers will be worked up and down for a distance depending on the spacing of the devices on the casing.

Centralizers

These devices are designed to:

* Ensure a reasonable uniform distribution around the casing.

* Obtain a competent seal between the casing and the formation

* Centralizers must have sufficient strength to center the casing reasonably in the hole and must leave enough space for the flow of circulating fluid.

formation packer collars & shoes:

* These are float shoes/collars with an expandable packers outside the casing. They are used when a sensitive formation below is required to be isolated from the hydrostatic head of the cement column.

* The expandable packer can be set by appropriate twists or motions of the casing and once set isolates the bottom portion of the open hole.

* Till the packer is set the circulation is done through a flapper valve at the bottom.

* Once the packer is set, the flapper valve is closed by a falling ball and circulation is established though latch down valve on the sides of the packer collar and cementation is completed with the bottom formation untouched.

Stage Cementing Tools:

* When it is desirable to cement two or three separate sections behind the same casing string or when a long section of the annulus is to be cemented in two or three stages, stage cementing tools are used.

* Stage tools are installed at specific points in the casing string, while the casing is being run.

* After the cement is placed around the bottom of the casing (the first stage), the tool can be opened hydraulically either with a free falling opening plug dropped down or

with a plug pumped down the casing.

Special equipment:

a) Bridge plugs

* These are plugs that can be set in open hole or within a casing as temporary plugs or permanent drillable plugs.

* These are used to

i) Isolate a lower zone while a upper section is tested
ii) to isolate the sections above to perforate and test a zone.

iii) To seal off zones that are abandoned.

b) Cement baskets:

* These are external packers used with casings at points where weak formations require to be protected by supporting the cement column until it takes its initial set.

2. Enumerate on the drilling fluids and cement slurry hydraulics.
/ Also discuss the mechanisms in detail.

Hydraulics:

* Hydraulics is the study of physical properties related to flow of liquids in pipes or confined spaces.

* The study of fluid flow and deformation is termed as Rheology.

* The study of rheology and hydraulics is important in the circulation of drilling fluids and cement slurries as these properties determine the success or otherwise of the Drilling and cementing operations respectively.

* In drilling fluids, hydraulics has significant contributions in,

- i) Lifting of drill cuttings efficiently
- ii) Maximising bit penetration rates
- iii) Lower Swab and surge pressures and pressure required to break the gel and start circulation.
- iv) Separate drilled cuttings & entrained gas at the surface
- v) Minimise hole erosion.
- vi) Minimise pumping costs.

* While cementing a casing, the hydraulics help in arriving at

- i) Annular velocity required to achieve the required type of flow in the annulus
- ii) The pressure loss in the pipe and the annulus
- iii) expected well head pressure as the cement slurry moves up the annulus.
- iv) Hydraulic horse power required at the well head to complete the pumping of cement slurry into the annulus and when the top plug hits the bottom plug.
- v) Time required for completing the cementing operation.

Mechanism:

* Hydraulic system use the pump to push hydraulic fluid through the system to create fluid power.

* The fluid passes through the valves and flows to the cylinder where the hydraulic energy converts back into mechanical energy.

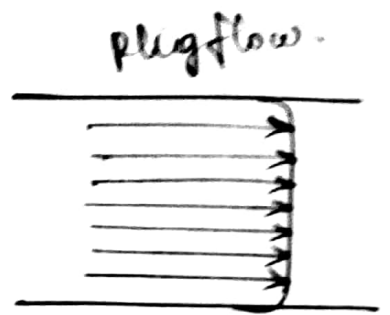
* The valves help to direct the flow of the liquid and relieve pressure when needed.

Types of fluid flow:

a) plug flow:

* This happens when the entire mass of the fluid moves as a plug and the shearing effect is only present at the pipe wall.

* This is in a way a special laminar flow and occurs at very low velocities. The velocity profile has a flat central portion as shown above.



* In an oil well situation, this happens when drilling fluid viscosity is high.

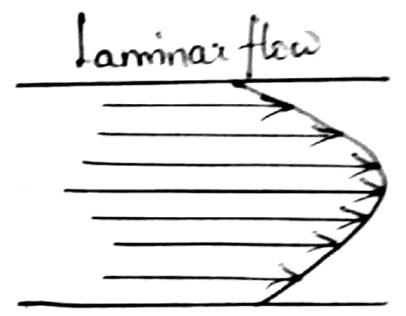
b) Laminar flow:

* In this flow type, the flow pattern is smooth each fluid layer travelling in straight line.

* The velocity of each layer increases gradually towards the middle of the pipe until a maximum velocity is attained at the centre.

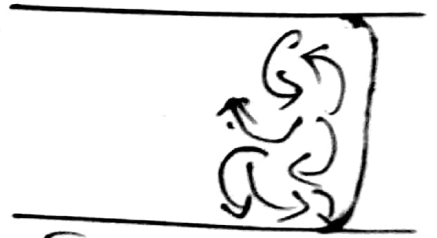
* In this type of flow, there is only one component of fluid velocity i.e., longitudinal component.

* Also the shear resistance is caused by the sliding action only and is independent of roughness of the pipe.



Turbulent flow:

* This type of flow is characterised by a chaotic and disordered motion of fluid particles and occurs at high velocities and low viscosities.



Turbulent flow.

* The random movement results in ~~two~~ velocity components; one longitudinal and the other transverse. The transverse component tries to move the liquid in a direction normal (i.e., at 90°) to the pipe axis and hence the shear resistance is many times that in a laminar flow.

3. Discuss the various API classes of cement in detail.

* Oil well cements are used to cement casings in wells having differing temperature & pressure conditions. American petroleum Institute (API) has provided Specification covering Eight (8) classes of oil well cements from class A to class H

class A - For use in depths upto 6000ft when no special properties are needed

class B - For use in depth 0-6000ft with moderate to high sulphate resistant types.

class C - For use in depths 0-6000ft - with high early strength - Moderate to high sulphate resistant types available.

class D - For use in depths 6000-10000ft - with moderate high temperature and pressure conditions - moderate high sulphate resistant types available.

class E - Intended for use in 10000-14000 ft depth conditions of HPHT. Moderate to high sulphate resistant types available.

class F : Intended for use in 10,000 - 16000ft depths conditions of extremely high HPHT - Moderate to High SO₄ resistant types available.

(10)

Class G - Basic oil well cement 0-8000 ft depth can be used with accelerators or Retarders - Moderate to High SO_4 resistant types available

Class H - Basic oil well cement 0-8000 depth can be used with accelerator and Retarders, can go up to a little higher sp-gr. slurry than Class 'G'.

4. What is land cementing unit? Explain with the help of simple sketch.

Land cementing units:

* There are three types of cementation unit.

⇒ onshore

⇒ Truck

⇒ Trailer

⇒ offshore

⇒ skid mounted.

* Land cementing unit refers to onshore cementing unit.

Dual pump cementing trailer:

* Dual pump cementing automatic slurry mixing cementing trailer is a kind of trailer-mounted cementing equipment.

* According to the set density, it can carry out the automatic continuous mixing and pumping the cement slurry under high pressure.

* Such cementing equipment is mainly used for onshore oilfield cementing operation, acidizing and pressure test.

Land cementing unit Specification:

- ⇒ Chassis
- ⇒ Cementing engine
- ⇒ Cementing transmission
- ⇒ Cementing pump.
- ⇒ Plunger pump
- ⇒ Slurry mixing system
- ⇒ circulating pump / booster pump
- ⇒ Slurry mixer skid
- ⇒ Displacement tank.

Trailer:

* Heavy beam drop deck design. Drop deck allows engine position to distribute unit weight as equal as possible to drive and trailer axles.

* Drop deck also lowers the center of gravity allowing for safer transportation of equipment.

Control panel:

* System flow schematic is incorporated in to control panel for ease operation, for standard engine transmission control.

Other Units:

- Coiled tubing
- Evaluation injector
- Nitrogen unit
- slick line
- Snubbing unit
- Swabbing unit
- wireline unit

5. What is unislurry system? Explain.

Unislurry system:

* This technology simplifies job execution because designed slurry properties can be obtained with fewer cement additives used in smaller quantities.

* It also simplifies inventory maintenance and reduce storage requirements.

Benefits:

* Lower cost per barrel of cement.

* Reduces waiting-on-cement time.

* Lowers retarder concentration by as much as two thirds.

* Simplifies slurry design and logistics by reducing the number of additives to transport and store.

Features:

* Long, predictable thickening times

* Low sensitivity to cement brands

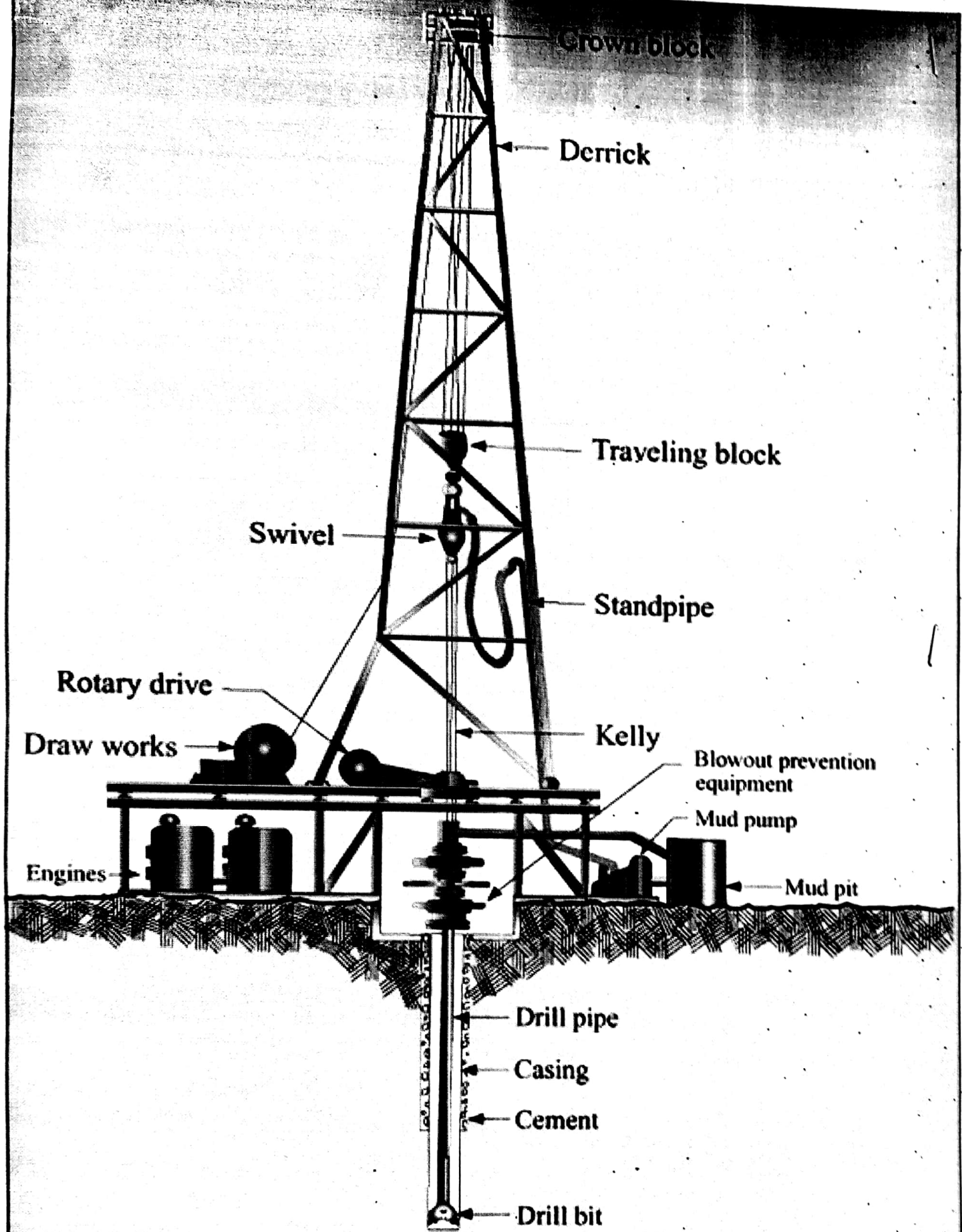
* Low sensitivity to temperature variations and

concentration changes than conventional retarders.

* Compatibility with fluid-loss additive, water or salt water

* High consistency from batch to batch.

* Typical concentrations: 0.05 to 0.30 gal/sk.



Land cementing unit (off shore)

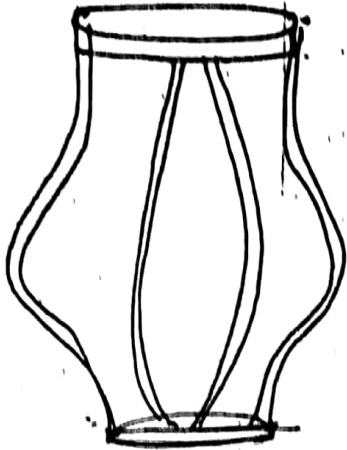
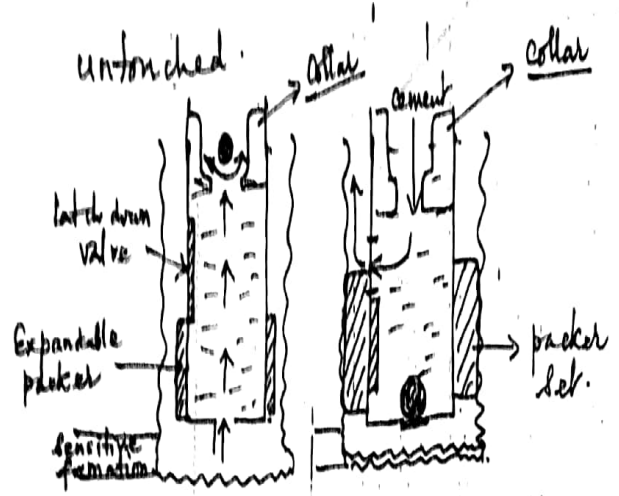
Comencing Equipments



Reciprocating types



Rotary types



"centraliser."