THE REMOVAL OF MUD DURING CEMENTING

The success of a cement job necessitates that all annular spaces be filled with cement and the creation of a good bond at the cement/formation and cement/casing interfaces. As a consequence, the slurry has to displace all the drilling mud that originally occupied the annular space. Therefore, mud removal is a very critical step in the cementing process.

Mud has no strength and is therefore easily flocculated by formation fluids. If all the mud is not removed, stringers of mud that can easily be converted into channels are formed along the pipe or borehole. Therefore, a lot of emphasis is placed in completely replacing to column of drilling mud with cement.

Channels lead to migration of well fluids which can result in major economic losses. Hydrocarbons can migrate form high pressure zones to other zones; stimulation treatment cannot be confined to any one specific zone, casing can be attacked by corrosive waters due to the production of unwanted fluids, and, loss of treating chemicals to unwanted zones when acidizing or fracturing will occur if a zone is not isolated by a proper cement sheath.

It is necessary to perform a squeeze operation if a primary cement job is poorly done. Great effort is placed towards the improvement of remedial squeeze techniques. However, the success is at a low level and very expensive. As a consequence, every precautionary step possible is implemented to ensure the success of primary cement jobs. The following su-titled paragraphs discuss the special materials, hardware and techniques used in primary cementing.

MECHANICAL HARDWARE

CENTRALIZERS

Cement slurries readily pass through the area of least resistance. Consequently if the casing is in contact with the formation at any point, the cement will pass through the wide side of the hole. Therefore mud will remain on the narrow side as no cement will displace it. This problem is rectified with the use of CENTRALIZERS which ensure a solid cement sheath surrounds the entire pipe, by providing adequate stand off.

SCRATCHERS

One of the tools used to effect good bonding is a SCRATCHER. It is extremely useful in high-density mud systems where a viscous filter cake is left on the formation. The scratcher serves to remove the thick wall of mud in the areas where good bonding is very necessary. However with low fluid loss muds, a very thin filter cake which may enhance cement bonding is usually built up.

MUD CONDITIONING

Ideally, the mud should be reconditioned by the mud engineer to provide a good quality fluid having a low fluid loss, as well as low viscosity and gel strength. A good quality drilling mud is essential to a good cementing job.

After the casing or liner has been run to the desired depth, circulation is established to condition the mud. Formation cuttings and entrained gas must be removed. Mud that has remained static develops a high gel strength and is difficult to displace with a cement slurry.
The gel strength must be broken back by circulating the mud.

MOVEMENT OF PIPE

Reciprocation of pipe in 20 or 15 feet strokes is necessary to assist in breaking the gel strength of mud and to achieve adequate mud removal. Rotational movement achieves better mud removal, however, the reciprocating technique is more commonly practiced.

Despite the ease with which reciprocation is performed, there are some disadvantages. There is the tendency to swab on the upstroke and to surge on the down stroke. This is undesirable especially where a high-pressure zone could cause a blowout or where a zone could be easily fractured. There is also the added risk of sticking the pipe above the desired set point.

Rotating the casing requires a special cementing head. For deep wells and larger sized casings, additional torque (which could twist off the pipe) is needed.

The method of pipe movement is not advised when cementing liners due to the proximity of clearance at the liner hanger. There is the risk of sticking the liner off bottom during reciprocation and as some hanger mechanisms depend on rotation for release, there is the danger of premature release during rotation.

TECHNIQUES FOR DISPLACEMENT

There are two acceptable methods of displacement that provide good mud removal. The more promoted is the method of turbulent flow. P-DIS serves to induce turbulence at a reduced pump rate. The use of chemical washes has also contributed to the use of the technique of turbulent flow. If turbulent flow can be maintained past a reference point for ten minutes, good mud removal is achieved. Turbulent flow can best be realized in wells where the annulus is not very large and/or where the hole is in gauge.

Plug flow is the term used to describe the other flow regime. It is basically the opposite of turbulent flow. Laminar flow regime is the flow regime which lies between plug flow and turbulent flow. Changes from a maximum rate at pipe center to static flow velocities along the wall are the characteristics of laminar flow in a pipe. However, this flow regime is highly undesirable as it results in very inefficient displacement of the drilling mud. Problems occur because the cement would move more rapidly at the center thus channeling through the mud and leaving material at the sides, this is perhaps the worst condition for well cementing.

CHEMICAL WASHES

Any mud-thinner that has been dispersed in water is basically referred to as a chemical wash. Chemical washes are a very important part in mud removal and they are manufactured for oil and water based muds. A volume capable of providing 500 ft. of column wash is recommended to be placed ahead of the slurry. Because of their low viscosity, chemical washes go into turbulent flow at very low pump rates. Adequate dilution and dispersion of drilling mud can be achieved with a 500 ft. column of chemical wash. Even if the slurry is only in upper laminar flow, as long as the chemical wash remains in turbulent flow, it will aid in preventing slurry channeling.

SPACERS

Fluids used to separate the cement slurry from the drilling mud are termed "SPACERS". They are made in a manner to be compatible with both the cement slurry and the drilling mud in use. It is very important that the fluids be compatible as the majority of drilling muds are flocculated by cement slurries. If a spacer is not used, there could be a very thick build up at the cement mud interface. There is also the possibility of an added build up of displacement pressure posing a problem. The major problem occurs when the viscosity of the slurry is less than that of the interface, as the slurry would now channel through contaminated mud, thus worsening the situation while it makes contact with additional drilling mud. The end result would be that the cement job has failed due to the fact that the cement slurry has by passed stringers of contaminated mud.

Spacers are designed in a manner such that their densities, gel strengths and viscosity are more than that of the drilling fluid and less than or equal to that of the cement slurry. An adequately designed spacer is capable of maintaining a separation between cement slurry and drilling mud under the worst possible casing to hole size ratios. In enlarged sections, excellent mud removal can be achieved. Performance under plug flow conditions can be more successful when it is impossible to achieve turbulent flow, if an adequately designed spacer is used.