# Liner Cementing - Long Life Technique

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## DESCRIPTION

The Long Life Technique is a method of performing the primary cementing of casing in a borehole. Basically, it is a two-step operation in which cement is placed in the bottom of the hole and casing is then lowered into the cement.

This technique has been employed by the oil industry in various forms for many years. In fact, it preceded the two-plug displacement method in the old shallow-hole cable tool areas. However, as drilling progressed to greater depths, with higher temperatures and pressures, applications of this technique became relatively hazardous with available equipment and materials. The two-plug displacement method offered distinct advantages and appreciably reduced hazards inherent to what is now called the Long Life Technique. After the introduction and the widespread industry acceptance of the two-plug displacement method, applications of the older technique rapidly decreased in number and became, until recently, a seldom used practice.

The success of an operation involving cement placement, removal of the placement apparatus and then running casing and lowering it into the cement column depends heavily upon the performance of the cement slurry. Barring severe mechanical failures, time requirements for each step in this procedure are reasonably predictable. Retarders may be added to the cement slurry in sufficient quantities to obtain. with a reasonable safety factor, sufficient fluid time to allow all of the mechanical operations to be completed before the cement becomes set. Another factor equally important as retardation is dehydration rate. The dehydration rate is dependent upon the permeability of the zone or zones exposed at the wellbore and upon the hydrostatic pressure applied to the cement slurry after it is placed adjacent to the zones of permeability. Fluid loss additives are usually incorporated in long life slurries to minimize the dehydration rate. The necessary amounts and types of additives will be dependent upon the individual temperature, permeability and pressure situation in any given case.

The Long Life Technique has been applied in West Texas liner cementing, where:

(1) Liners have been set through open-hole zones of old producing wells in which static fluid level is low, and the open-hole zone is not sufficiently competent to support the hydrostatic load of the cement slurry and fluid column from TD to the surface;

(2) Liners are to be run in small I.D. open hole normally found in deepening projects where the annular space between the liner and the borehole is small.

The programs most successfully employed for both of these situations are outlined in the following text.

## LINER CEMENTING—LOW FLUID LEVEL WELLS

It is often difficult to achieve satisfactory placement of cement by the conventional displacement method when a liner is to be set through an open-hole zone that will not support the hydrostatic load of the fluids in the column. In these projects it is sometimes impossible to obtain and maintain circulation, and significant amounts of cement slurry can be lost to permeable or fractured zones. And, even if cement is properly placed by the displacement method, it is possible for cement losses to continue until the cement becomes set or until static fluid level is reached.

The Long Life Technique has been applied in projects of this general description to minimize the losses of cement and to increase the probability of obtaining required cement fill in the annulus. Cement slurry is placed, the placement apparatus is removed, and the liner is lowered into the fluid cement. During all of these operations, pressures at the bottom of the hole are carefully controlled at a value approximately equal to that applied by the normal static fluid column.

Several important preliminary investigations are usually made when a liner cementing program of this type is considered. These are:

(1) Bottomhole static temperature for laboratory cement testing is determined.

(2) Slurry fluid time requirements are estimated.

(3) Static fluid level and pressure conditions of the subject well are ascertained.

(4) Permeability data are obtained and, if possible, cores from the exposed open-hole section are utilized for laboratory fluid-loss tests.

(5) After data from steps 1 through 4 are obtained, laboratory evaluations are made and cement and additives required to impart desired slurry fluid life are selected. Tests with slurry samples are continued to determine rate and magnitude of compressive strength build-up.

(6) Produced fluid samples from subject well are analyzed; production equipment (if any) that is recovered from the well prior to workover is observed, and formation samples (if clean-out is performed prior to liner job) are inspected to determine the nature of any plugging or scaling material that may be present.

After the cement slurry has been selected and other preliminary investigations have been completed, the field application of the Long Life Technique normally proceeds as follows:

(1) The open hole is prepared to receive the liner by cleaning out to desired TD, checking wellbore I.D., etc.

(2) Tubing or drill pipe is run with a shut-off baffle located at or near the lower end of the string. The lower end of the tubing or drill pipe is positioned at or just above the desired liner TD.

(3) If laboratory tests indicate plugging or that scaling materials should be removed, a recommended cleaning agent is injected at this time through the tubing. The cleaning agent may be one of several materials, depending upon the type of scale. The cleaning agent is allowed to soak the wellbore for the desired length of time. Then, a spacer fluid (normally brine water containing a water-wetting surfactant in West Texas applications) is injected through tubing to displace the cleaning agent and whatever scale or other material it has loosened or released out of the open-hole portion of the well.

(4) Tubing is pulled and re-positioned at a depth at which the hydrostatic fluid weight will be equal to or is slightly less than (depending upon cement slurry volume requirements) the weight under measured static fluid level conditions. Tubing and annulus are swabbed dry at this depth.

(5) The tubing is lowered and re-positioned with the lower end of tubing at or just above intended liner TD.

(6) Cement slurry is mixed and injected through the tubing. Then, a latch-in wiper plug is released and displaced to a shut-off.

(7) The wet string of tubing or drill pipe is pulled from the well. It is necessary to do this to avoid dumping the displacement fluid, which would result in increased hydrostatic pressure. It is possible to balance a cement plug in a low fluid-level well by conventional plug back cementing; however, the shut-off plug, wet-string method does afford a more positive opportunity for success.

(8) The liner string is picked up and run to bottom with tubing or drill pipe. The extended fluid life of the cement slurry normally will allow sufficient time for reciprocation of the casing at this stage of the operation. Reciprocation should improve the chances of commingling any mud, water or other material left in the annulus with the cement slurry.

(9) The liner is then set or hung and tubing or drill pipe is removed from the well.

(10) Sufficient "waiting on cement" time (based on laboratory tests) is allowed. Then excess cement is drilled out and additional well completion work may proceed in a conventional manner.

## LINER CEMENTING—SMALL ANNULAR SPACE

The Long Life Technique offers several advantages over the conventional displacement primary cementing method in projects where the annular space between the liner and the borehole is small. In projects of this general description it is often most difficult to properly centralize the liner in the wellbore. If the liner is lying against the formation during conventional primary cementing, chances of leaving drilling mud in the annulus, resulting in channeling in the cement, would be increased. If the Long Life Technique is employed, cement may be placed in the well at relatively high displacement rates (much higher rates than by conventional methods because friction losses in the liner-hole annulus will be much more severe than those in the drill pipe-hole annulus) and sufficient slurry volume may be used to completely fill the total open-hole section. Then, the liner may be picked up with tubing or drill pipe and lowered into the cement. The cement slurry fluid time may be especially designed for projects of this type to allow reciprocation of the liner for an extended period of time. This, again, would improve the chances of commingling any drilling mud that might remain in the annulus with the cement slurry. If this operation is successfully performed, mud channeling may be eliminated.

These conditions may be present in both low fluid level wells and wells in which all exposed formation is competent. The techniques outlined above for low fluid level wells will apply equally well if the annular space is small. If it is known that the exposed formation is sufficiently competent to support anticipated hydrostatic weight and friction losses, then the Long Life cement may be placed through drill pipe in a manner similar to that of standard plug-back operations. And, when cementing through competent zones it may even be possible to reverse at least a portion of the excess cement slurry out of the well after the liner is set.

There are, in fact, several possible disadvantages inherent to the application of the Long Life Technique. "Waiting on cement" times are necessarily much longer than those of conventional cementing slurries. If a drilling rig must remain on location throughout the "waiting on cement" time, costs of this application may be excessive. Normally, in West Texas all of the Long Life cementing operations are performed with a workover rig, or if a drilling rig is used it will be moved off location and replaced by a workover rig for well completion purposes. In either case, the "waiting on cement" expense is reduced.

Another factor to be considered is the possibility of contaminating the cement with small amounts of mud remaining in the annulus. If the drilling mud contains certain organic thinners and dispersants, excessive retardation may result and required shut-in time for setting of cement and compressive strength development will be much longer than anticipated. Samples of drilling mud may be analyzed in the laboratory prior to the field application to determine when these conditions may exist.

## CONCLUSION

The Long Life Cementing Technique appears to offer advantages over liner cementing methods in certain special instances in which it is desirable to place a more uniform cement sheath in the annulus. This technique apparently does have other beneficial applications in full-string casing and multiple-string cementing operations.

More than 15 Long Life liner cementing jobs have been performed in West Texas up to this time. Information from these jobs indicates that superior results may be obtained. It is apparent that extensive job planning and laboratory testing is pre-requisite to any individual field application of the Long Life Technique.