USE OF EXPANDING CEMENT FOR SQUEEZING CASING LEAKS

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INTRODUCTION

In the West Central Texas area, formations containing highly corrosive water exist between the surface and the producing formation. Until recently, it was not common practice to use enough cement to cover these formations during primary cementing operations. In some cases where the formations *were* covered, the cement was not sulfate-resistant and was rapidly degraded by the sulfate-containing water in the formation. In these cases contact between the pipe and corrosive waters existed. The high corrosion rate resulted in rapid deterioration of the pipe; often there were numerous holes in the pipe and, in some cases, complete sections of the pipe were corroded away.

Squeeze cementing under these conditions proved to be a long and costly operation. Although techniques varied from area to area because of different well conditions such as water crossflow and permeability, most jobs were hesitation-type squeezes using Class C cement with a fluid loss additive. Normally, several stages, and at best several hours, were required.

EXPANDING CEMENT

During the past two years expanding cement has been used very successfully in West Central Texas for repairing casing leaks and isolating the pipe from corrosive action of the formation waters. While some additives such as calcium sulfate and calcium chloride can cause expansion in cement, the expanding cement used in this area is a manufactured product. The expanding component, calcium sulfoaluminate, is added during the manufacturing process. The resulting cement has a greater and more rapid expansion than the high sulfate and salt cements. Both the cement and its use have been discussed in previous papers.[1,2]

Expanding cement derives its success in squeeze treatments from its high gel strength and thixotropic properties as well as its expansion. The slurries are thixotropic in that they develop a high gel strength and become rigid rapidly when pumping or agitation stops, yet become thin and fluid again when shear stress is applied. High gel strength cements have been mentioned earlier as a possible method of patching casing leaks.[3] This was accomplished with high-density slurries. Expanding cement, however, achieves a high gel strength without extreme slurry weights. It is normally mixed at 15.5 to 16.0 ppg. Its physical properties at these weights are shown in Table 1.

TABLE 1—PHYSICAL PROPERTIES OF EXPANDING CEMENT

Slurry Weight (lb/gal)	Slurry Yield (cu ft/sk)	Water (gal/sk)
15.0	1.30	6.3
15.6	1.20	5.2
16.0	1.00	4.9

Temp. (°F)	Thickening Time (hrs: min)	Compressive Strength(psi) 8 hrs	Compressive Strength(psi) 24 hrs
80°	2:30	1500	2500
90°	2:00	2000	2850
100°	1:45	2400	3500
120°	1:00	2600	4000

Squeeze Technique

Field experience in the West Central Texas area has shown that casing leaks (one or more holes) may be located and repaired in about two hours. Locating the hole generally requires the most time; the actual squeeze operation requires only about 30 minutes and consists of placing the cement behind the pipe at.the desired place. Squeeze pressures are low since the slurry is not pumped into the formation. This is advantageous in the corroded sections since a high squeeze pressure would probably rupture the pipe at another point.

When the cement is in place and the pumps shut down, a high gel strength develops rapidly and keeps the cement in place until it sets. The cement reaches 85% of its expansion in 24 hours after placement and the expansion is great enough to prevent formation of a microannulus.

In wells where crossflow in the annulus between the formation and the casing or near the wellbore is a problem, several stages of a regular cement system are normally required to shut off this water. The reason for this is that the water dilutes and carries the cement away from the wellbore area or away from the fractured system. When the expanding cement is put into the area of the crossflow, however, its high gel strength provides a greater resistance to dilution, allowing the cement to reach an initial set without being removed or diluted to a great extent. In some severe cases of crossflow the expanding cement is preceded by a gum-bentonite-kerosene slurry that forms a thick gel. This gel slows down the movement of the crossflow, helping the cement remain in place more effectively.

CONCLUSIONS

In West Central Texas, the use of expanding cement has proved to be very beneficial in repairing casing leaks. The high gel strength of the cement is the main reason for its success; but also, the expansion is great enough to seal off any microannuli which might be present or develop from the use of ordinary oilwell cements. Approximately 85% of its expansion is reached in the first 24 hours, shutting off fluid movement and preventing the possibility of keeping a microchannel open. Other advantages of expanding cement for repairing casing leaks are that jobs can be completed in a relatively short time and high squeeze pressures are not required.

The cement's major limitation is temperature. At slurry weights of 15.6 ppg, 170°F bottomhole static temperature is the upper limit even with specially designed retarders for expanding cements.

REFERENCES

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