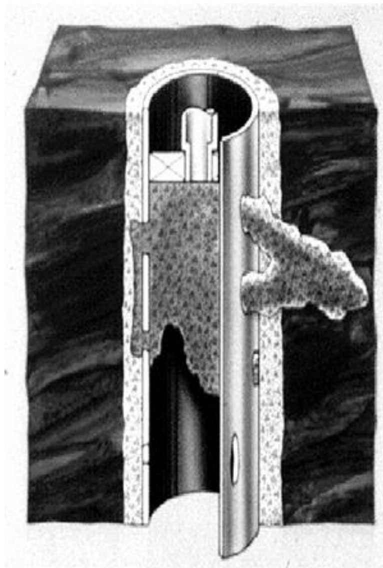

Figure 8.1 – Squeezing to repair casing.

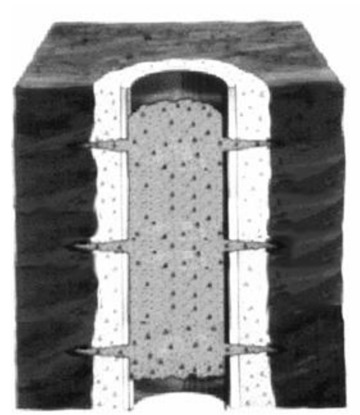

Figure 8.2 – Whole cement slurry does not enter the formation

Squeeze Cementing Terminology

In order to understand the different methods used in squeeze cementing, it is necessary to first be familiar with the following terms:

- Cement dehydration
- Pump-in pressure and injection rate
- Low- and high-pressure squeeze
- Block squeezing

Cement slurry is composed of cement, additives and water. When slurry reaches a permeable formation, only the water (filtrate) will pass into the cracks of the formation (Figure 8.2). **Cement dehydration** is the process by which the cement forms a cake and hardens on the face of the formation.

In squeeze jobs, forcing the formation to fracture is not the objective. If the formation fractures, it will break down. Then whole cement slurry (not just the filtrate) will be displaced into the formation. Therefore, care must be taken so that the pump pressure and the pressure exerted by the weight of the fluid are not sufficient to force a fracture of the formation. The pressure required to force filtrate into the formation without fracturing it is called the **pump-in pressure**.

The volume per minute at which the fluid will be pumped during the squeeze job is called the **injection rate**. Both the pressure and rate should be established by performing an injection test in which well fluid is pumped into the formation to determine at what rate and pressure the fluid will be absorbed into the formation.

During a **low-pressure squeeze** job, enough pressure is applied to form a filter cake of dehydrated cement on the formation. In other words, the pump-in pressure or the pressure necessary to place cement against the formation will not cause the formation to fracture.

However, if the formation will not absorb filtrate at the pump-in pressure, (because of blocked perforations or low formation permeability), more pressure may be applied. This will result in a fractured formation - whole slurry will fill the fractures. This is considered a **high-pressure squeeze** job.

Block squeezing requires that perforations be made at the interval to be squeezed. Then, cement is forced into this interval (Figure 8.3). Block squeezing is generally used to isolate the producing zone before completing a well.

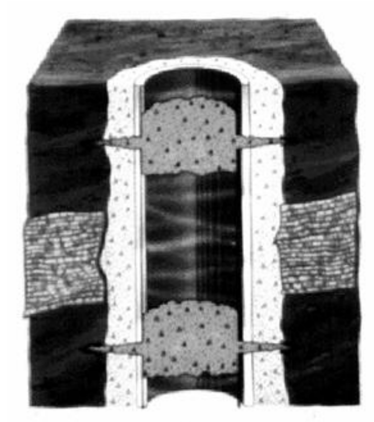

Figure 8.3 – Block Squeeze

Hesitation Squeeze

At some point during a squeeze job, you will have attained the pressure planned for the job. That pressure is then held. If it drops off (that is, bleed off is occurring), you know that your cement is continuing to dehydrate.

In this case, a hesitation squeeze may be conducted. Time is allowed for the cement to begin to set. The pressure is applied again. If bleed off continues, more time is allowed. This is repeated as many times as is necessary; the only limitation is the thickening time of the cement. If too long a period is allowed, the workstring may be cemented up.

Planning Squeeze Cementing Jobs

Before any type of squeeze job is undertaken, information must be obtained and choices must be made, including

- the types of well fluids to be used, which will affect the pressure to reverse out, and the necessity of using a spacer (in case of fluid incompatibility)
- the bottomhole static temperature, which affects the setting time of the cement
- the difference between the depths of the perforations and the packer (if used), which should from 100 to 150 ft to allow enough volume to continue the squeeze after the cement has cleared the workstring
- the maximum pressure to be used, which cannot exceed the pressure limitations of the workstring, casing, BOPs, and other equipment to be used
- the type of cement to be used, in that fluid-loss additives are used to ensure that a small amount of cement filter cake will form against the formation, while the slurry in the casing remains fluid enough to reverse out
- the amount of cement to be used, which depends on the volume of the workstring (volume of cement should not exceed the capacity of the tubular goods) and the length of the interval to be squeezed (a rule of thumb is to use 2 sk/ft).
- testing all wellhead equipment and annulus to the pressure required to reverse out the maximum height of cementing the workstring.

Unit A Quiz

Fill in the blanks with one or more words to check your progress in Unit A.

1. Common reasons for performing a squeeze job are to ___________ a defective primary cementing job or to __________ holes in casing caused by corrosion. In addition, the ______________ ratio is improved.

2. When the filtrate enters the formation, cement ____________ to form a cake on the formation.

3. The pressure required to force filtrate into the formation without ___________ it is called the ___________ pressure. This pressure is established by pumping _________________ into the formation to be squeezed.

4. If the formation fractures during a squeeze job, then a _________ pressure squeeze job is being performed.

5. If the pressure drops off during a squeeze job, this is called ______________. To correct this condition, a _______________ squeeze may be performed.

6. The ____________ pressure to be used during a squeeze job cannot exceed the limitations of the equipment being used.

7. Cement used for squeeze job usually contains ______________ additives.

Unit B: Squeeze Cementing Calculations

Before beginning a squeeze cementing job, several calculations must be performed. The types of calculations to make depend on the nature of the job. Following are the basic squeeze problem calculations (Fig. 8.3,4):

1 Volume of cement (bbl).

2 Pressure to reverse one barrel of slurry from workstring.

3 Minimum water requirements.

4 Displacement volume to spot cement one barrel above packer.

5 Pressure to reverse cement when spotted.

6 Pressure to reverse cement from workstring when cement reaches top perforation.

7 Pressure to reverse cement from workstring when cement reaches bottom perforation.

8 Pressure to reverse out at the completion of the job.

9 Amount of cement pumped though the perforations.

Following are the well parameters needed for the calculations (Fig. 8.3):

A Drillpipe/tubing size

B Packer depth

C Top of perforations

D Bottom of perforations

E Casing size

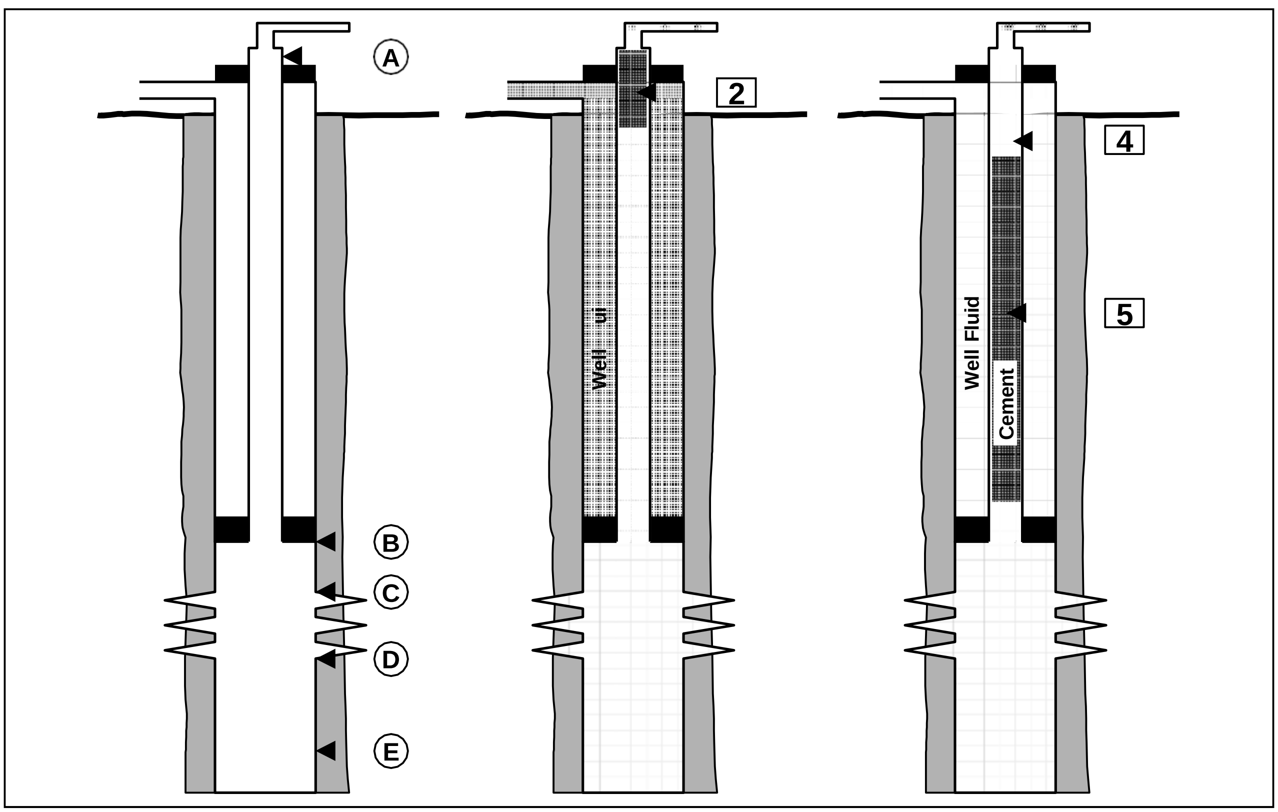

Figure 8.3 – Well schematic showing squeeze calculations and parameters.

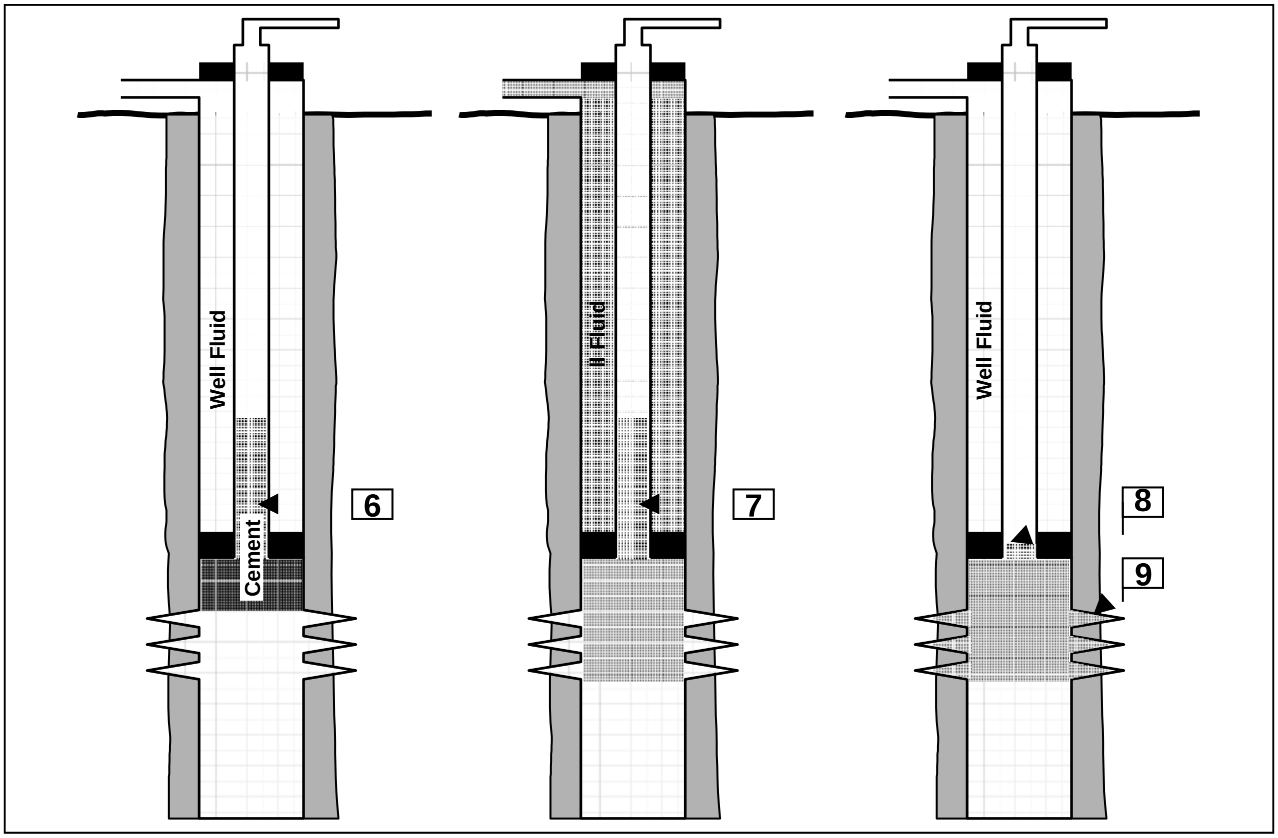

Figure 8.4 - Well schematic showing squeeze calculations and parameters.

The remainder of this section presents two sample squeeze problems and shows, step by step, how to calculate all the needed data. You will need a copy of the *Halliburton Cementing Tables* (the *Red Book*) to use during the samples.

Squeeze Problem One

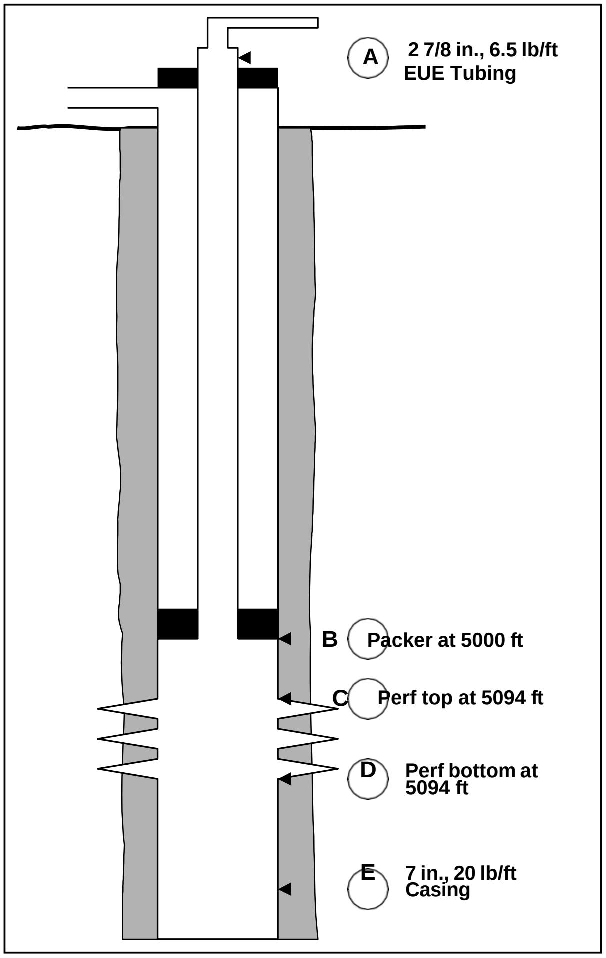

Figure 8.5 – Parameters for Sample Problem A.

API CLASS G CEMENT
SLURRY PROPERTIES

Per Cent Bentonite	Water Requirement Gal./Sk.	Water Requirement Cu. Ft./Sk.	Slurry Weight Lbs./Gal.	Slurry Weight Lbs./Cu. Ft.	Slurry Volume Cu. Ft./Sk.
0	5.0	0.67	15.8 ⬅	118	1.15
2	6.3	0.84	14.8	111	1.34
4	7.6	1.02	14.2	106	1.52
6	8.9	1.19	13.6	102	1.71
8	10.2	1.37	13.2	99	1.89
10	11.5	1.54	12.8	96	2.08
12	12.8	1.71	12.6	94	2.26

Figure 8.6 – Class G data from Red Book.

Well Parameters	
Drillpipe/tubing size	2 7/8 in., 6.5 lb/ft EUE
Packer Depth	5000 ft
Top of perforations	5094 ft
Bottom of perforations	5136 ft
Casing size	7 in., 20 lb/ft
Cement type	Class G
Cement volume	75 sk
Displacement/well fluid	Fresh water (8.33 lb/gal)

1 Volume of Cement (bbl)

To convert the given volume of cement from sacks to barrels, you must determine the yield of the slurry.

1. Using the "Technical Data" section of the *Red Book*, determine the yield of a neat "Class G" slurry, given its weight of 15.8 lb/gal. The table shown in Fig. 8.6 (extracted from the Class G section of the *Red Book*) shows this to be 1.15 cu.ft/sk.
2. Multiply the volume of cement in sacks by the slurry yield to determine the volume in cubic feet.

   75 sk × 1.15 cu.ft/sk = 86.25 cu.ft

   Now, convert cubic feet to barrels using the conversion constant found in the "Technical Data" section of the *Red Book*:

   86.25 cu.ft × 0.1781 bbl/cu.ft = 15.36 bbl