THE FUNCTIONS OF RETARDERS

Temperature and pressure are two of the main factors that affect the thickening time of a cement slurry. There are reactions that alter the effect of temperature and pressure on the thickening time. These reactions usually require the use of a retarder. Through the method of an absorption process during the reaction between cement an water, retarders extend the thickening time of a slurry. The degree of retardation primarily depends on the concentration of the retarder used; the temperature and less significantly, the pressure.

Basically, there is a pattern that is observed with variations in the factors that affect slurry retardation. For example, a decrease in the rate of absorption, is caused by an increase in temperature. To achieve a constant thickening time, increases in temperature must be accompanied by corresponding increases in the concentration of the retarder used.

If a curve is constructed to illustrate the relation between thickening time and retarder concentration, a certain pattern is exhibited. This pattern is similar for many slurries and retarders. The similarity shown is such that, increases in retarder result in extended thickening time until saturation point is reached. After this point, a slight increase cause excessively long thickening time and a ratio is no longer existent. The thickening time of a slurry is critically affected near to the saturation point. As a consequence, it is absolutely necessary to run laboratory tests for slurries that require the use of retarders. Generally, higher temperatures causes reduced thickening times and the consequential need for a greater retarder concentration.

TEMPERATURE OF COMMON THICKENING TIME TESTS (AS TAKEN FROM API RP10-B)

Bottom Hole Circulating Temperature °F

Well Depth	Bottom Hole Temperature			
Feet-Meter	**Static °F °C**	**Casing**	**Plug-Back**	**Liner**
2,000- 610	110-(38)	91 (9)*	98 (4)*	91 (4)*
4, 000 - 1220	140 - (60)	103 (14)	116 (7)	103 (7)
6,000 - 1830	170 - (71)	113 (20)	113 (20)	113 (10)
8,000 - 2440	200 - (93)	125 (28)	159 (15)	125 (15)
10,000 - 3050	230 - (110)	144 (36)	186 (19)	144 (19)
12, 000 - 3660	260 - (127)	172 (44)	213 (24)	172 (24)
14, 000 - 4270	290 - (143)	206 (52)	242 (29)	206 (29)
16,000 - 4880	320 - (160)	248 (60)	271 (34)	248 (34)
18,000 - 5490	350 - (177)	300 (67)	301 (39)	299 (39)
20, 000 - 6096	380 - (193)	349 (75)	----------	----------

* Test time in minutes to reach indicated temperature.

Another factor which governs the behavior of retarders is the nature of other additives in the slurry. Generally, additives such as **P-DIS and P-DISL** extend the thickening time of slurries containing retarders. These extensions involve more than just the inherent retardation properties of the added components and result from "synergistic" effects between the various additives. Thus, the thickening time of a complex slurry is often dependent on the concentrations of the dispersant, fluid loss additive, and retarder all at the same time. Effects of this type are more pronounced at circulation temperatures less than 260. F. Other ad additives also influence retard performance in a slurry. For example, the water requirement of some additives result in increased slurry/water ratios which have an effect on thickening time. Additives such as P-EBA can strongly absorb part of certain retarders and compete with the cement in this regard. For example, competition of this type probably accounts for the unusual response of P-LTR in P-EBA slurries. High concentrations of salt likely decrease retarder solubility and have a detrimental effect on performance while lower salt concentrations usually have little effect.

Most retarders can be used with all API Classes of cement, and possolan - cement blends, all blended with various additives. However, many of those cements are already retarded (for example, Classes D and E) with such compounds as lignin (salts of lingosulfonic acid), gums, starches, weak organic acids, and cellulose derivatives. The compounds in commercially retarded cements are not always compatible with additive retarders. It is this problem of compatibility that led to the development of API Classes G and H Cement, which are not permitted to contain a chemical retarder as manufactured. Classes G and H Cement can be used to 8,000 ft as received, and normally respond to retarders at depths as great as 30,000 ft.

Where depths exceed about 10,000 ft (3048m) and circulating temperatures exceed 144.E (62. C), it is best to run laboratory thickening time tests on the materials to be used on a specific job. Sometimes irregularities in the basic cement can cause variations in thickening time.