

STATE OF MICHIGAN



JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

"Better Service for a Better Environment"

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REPLY TO:

DRINKING WATER & RADIOLOGICAL
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May 10, 1999

TO: Water Well Drilling Contractors
Local Health Departments
Attn: Environmental Health Directors
Field Sanitarians
Grout Manufacturers and Suppliers

FROM: Michael S. Gaber, Chief
Well Construction Unit
Drinking Water and Radiological Protection Division

SUBJECT: **Advisory on Settling of Well Grout Slurries**

Grout slurries are used in the well drilling industry to seal the annular space surrounding water well casings or to plug abandoned wells. Current grout slurry products (bentonite and cement-based) occasionally settle after placement. Settling of more than 50 feet has been reported with bentonite grout. Settling occurs most often when highly permeable or fractured geologic materials have been penetrated, and most settling reports have been associated with bentonite grouts rather than cement grouts.

While settling of grout into borehole voids and irregularities may be beneficial, it results in an open annular space in the upper portion of the well. The open space can act as a channel for downward movement of contaminants from the surface. Settling can result in a violation of the grouting or well plugging provisions of the state well construction code. When settling occurs within a large diameter abandoned well or borehole, a serious safety hazard can result.

In 1998, the Department of Environmental Quality (DEQ), Drinking Water and Radiological Protection Division, surveyed registered well drilling contractors to obtain data on grouting field practices and experiences. Of the 241 survey respondents, 104 reported observing settling of "one sack" bentonite grouts, 101 reported settling of granular bentonite/polymer slurry grouts, and 35 reported settling of neat cement grout. A study conducted by the Western Michigan University, Department of Geology in 1996 and 1997 evaluated the field performance of common water well grouts. The study showed bentonite grouts settling an average of 13 percent of the total grouting depth. Almost no settling occurred with neat cement grout or cement grout with 5 percent bentonite. Most settling occurred within 24 hours of grout placement. The DEQ field staff has observed substantially less settling with neat cement grouts than bentonite grouts. The rate of settling of neat cement is usually less than 5 percent of the total grouting depth.

Grout settling may be attributed to the following factors or circumstances:

- The weight of slurry that returned to surface was less than the pumped-in slurry weight, so grout in the upper part of the well was of poorer quality.
- The grout was not brought up to ground surface initially.
- The grout is intruding into permeable zones and borehole washouts because of grout weight.
- Water from the grout slurry is lost to permeable vadose zone and remaining solids settle out.
- The borehole was inadequately flushed before grouting and grout was placed over an unstable drilling mud/cuttings base.
- An insufficient length of tremie pipe was used during grouting.
- Settling occurs because of a loss of bentonite gel strength due to chemicals added by the manufacturer to control grout setup.
- Bentonite grout washed out due to artesian conditions.
- Too much water was added to slurry.
- The chemistry of make-up water adversely affected grout performance.

ADVISORY:

The DEQ encourages grout manufacturers and suppliers to review their product use instructions to ensure optimum field performance. Well drilling contractors and regulatory officials have found that product mix recipes can sometimes be modified by adding a smaller amount of water. Water reduction elevates the solids level and reduce settling, but can be more difficult to pump. The addition of granular bentonite to a "one sack" bentonite slurry grout has also been shown to reduce settling.

Contractors should be aware that grout settling is more likely to occur if highly permeable geologic formations were encountered while drilling. Contractors who routinely encounter grout settling problems should evaluate their field practices to see if any of the factors listed above may be contributing to the problem. Contractors experiencing routine settling are advised to consult with their supplier or grout manufacturer. Switching to neat cement grout or another product may reduce settling. It is the responsibility of the well drilling contractor to take necessary steps to ensure that grouting procedures used by the firm comply with the state well construction code.

Cases of grout settling should be reported on water well records and abandoned well plugging records.

Check Annular Space Sealing

The DEQ recommends that well drilling contractors who use bentonite slurry grouts check for settling at least 24 hours after completion of grouting.

Refilling After Settling

Settling beyond the pitless adapter will require that more grout be added to bring it up to at least the pitless adapter. If the annulus above the settled grout has remained open, and the depth of settling is 10 feet or less from ground surface, bentonite chips may be used to reseal the

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annulus. Where caving has occurred, or if settling is beyond 10 feet, regrouting must be done by pumping neat cement or bentonite slurry grout through a tremie pipe. The annulus must be cleared of any caving before regrouting.

If the annulus cannot be cleared of caving, or if it cannot be demonstrated that the well was initially grouted, redrilling of the well and abandonment of the defective well along with removal or perforation of the casing, may be necessary.

Abandoned Well and Dry Hole Plugging

Settling of grout within an abandoned well or borehole can cause a serious safety hazard. The DEQ urges well drilling contractors to check all abandoned wells or boreholes for settling at least 24 hours after completion of plugging. Any open void space must be sealed back up to surface to eliminate physical hazards and prevent accidents. A temporary steel plate, fencing, or other protective device should be placed over or around abandoned wells and boreholes larger than 6 inches in diameter until the holes are checked for settling and refilled if needed.

If you have any questions, please contact either me at 517-335-8304 or Ron Holben at 517-335-8329.

MSG:ckh