



## Statewide Advisory: Sealing Materials for Water Wells, Monitoring Wells, Cathodic Protection Wells, and Geothermal Heat Exchange Wells

This advisory is to inform well drillers, local enforcing agency staff, and others about important sealing material considerations for well construction (annular seals) and destruction in the unsaturated zone in California.

Studies have shown that a sealing material included in the [California Well Standards](#)<sup>1</sup> may not perform adequately in the unsaturated zone. While DWR plans to update the Well Standards in the future (subject to funding), an increase in well-drilling activities in response to the continuing drought and declining groundwater levels has reinforced the need for this advisory.

In a multi-year study of grout performance, the Nebraska Grout Task Force<sup>2</sup> evaluated several sealing materials, including sand-cement<sup>3</sup>, high solids bentonite grout<sup>4</sup>, non-slurry bentonite<sup>5</sup>, and bentonite slurries<sup>6</sup>, by using downhole cameras and dye testing in installed wells.

Task Force findings indicate that bentonite slurries (as defined in footnote 6) do not perform adequately as a sealing material in the unsaturated zone. Bentonite slurries can shrink and crack when they dry out, and they do not adequately hydrate and swell once water is reintroduced to the seal.

Although, in general, sand-cement, high solids bentonite grout, and non-slurry bentonite performed adequately in the unsaturated zone, the Task Force found that the local subsurface environment's *soil particle size and composition* and *soil moisture content* have the largest impact on the stability of the grout over time. When selecting sealing materials, it is important to consider these and other site-specific factors, including, but not limited to, groundwater level and chemistry, compatibility with well-casing material, and known or suspected contaminants. Please refer to the [California Well Standards](#)<sup>1</sup> for additional information.

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<sup>1</sup> Water Well Standards: State of California, Bulletin 74-81, California Department of Water Resources, December 1981; and, California Well Standards, Bulletin 74-90 (Supplement to Bulletin 74-81), Draft, California Department of Water Resources, June 1991.

<sup>2</sup> Lackey, S.O., W. Myers, T.C. Christopherson, and J.J. Gottula, 2009. In-Situ Study of Grout Materials 2001-2006 and 2007 Dye Tests. Nebraska Grout Task Force, Lincoln, NE: University of Nebraska, October 2009 and subsequent unpublished research.

<sup>3</sup> Sand-cement, in accordance with the California Well Standards<sup>1</sup>:

*"Sand Cement. Sand-cement shall be mixed at a ratio of not more than 188 pounds of sand to one 94-pound sack of Portland cement (2 parts sand to 1 part cement, by weight) and about 7 gallons of clean water, where Type I or Type II Portland cement is used. This is equivalent to a '10.3' sack mix."*

<sup>4</sup> High solids bentonite grout has:

- 1) Solids content from sixty-four to seventy-two percent (64% - 72%) by dry weight of solids (sand and sodium bentonite) to the total weight of mixed grout (solids and water); and
- 2) Sand-to-bentonite ratio of 4:1 to 8:1 by dry weight.

<sup>5</sup> Non-slurry bentonite is bentonite chips or pellets placed without water.

<sup>6</sup> Bentonite slurries are mixtures of bentonite suspended in water. The Nebraska Grout Task Force studied various bentonite slurry mixtures ranging from less than 20 percent to greater than 20 percent active solids by dry weight.