Title: **Sealing Characteristics of Sodium Bentonite Slurries for Water Wells (Study No. 33)**

Investigators:

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Objectives: To determine the effectiveness of various annular space sealing materials using laboratory experiments.

Background/Need: Well installation creates a circular gap between the well casing and borehole. This space is commonly filled to prevent preferential channelization of surface water to shallow groundwater. Water supply wells and groundwater quality monitoring wells will both benefit from an adequate seal.

Methods: Material properties of mud slurries and various types of well construction experiments were conducted and examined in a sand tank environment using four separate well models. The slurry viscosities used in the 4 wells were 50, 70, 90 & 170 seconds per quart (sec/qt). A computer model of the seepage through the annular space was developed and used to help with the interpretation of the experimental results.

Results: Studies of the effects of aging showed that pure bentonite-water slurries having viscosities of 70 and 90 sec/qt performed reasonably well as annular space seals and significantly better than the slurries having 50 and 170 sec/qt viscosities. The 50 sec/qt slurry experienced a near 100% volume reduction due to settling loss to the sand in the model and aeration. Therefore, it was concluded that this slurry failed as an annular space seal. This was confirmed by the dye migration test. The 170 sec/qt slurry developed desiccation cracks which allowed dye to migrate down through most of the annular space seal, even though there was little settling of this seal. Quick-Gel was shown to rapidly form a filter cake of low permeability, on a

porous formation, which sustains hole stability and maintains sealing properties. Quick-Gel experiences near 100% volume reduction due to mud aeration. The sealant slurries became more permeable soon after the application of the driving head due to compression of the gel structure. Infiltration of water in the well model starts at a rapid rate, decreases and stabilizes after some time, and increases at close to a doubling rate when the infiltrometer casing is pulled out. Observations made from the examination of each sealant are generally supported by the quantitative data obtained in the course of this investigation.

Conclusions:Investigators concluded that Quick-Gel slurries without entrained formation materials provide varying degrees of sealing in the annular space of a well in a coarse sand formation. The infiltration rate of water through the annular space takes place primarily by exfiltration laterally into the formation through the filter cake. Cracks and other volume defects in the Quick-Gel slurries result in infiltration rates higher than is consistent with the bentonite permeability. Medium range viscosity slurries are more resistant to cracking than low or high viscosities.

Recommendations/ Implications:

Investigators suggest further examination of basic material properties, including permeability, stability and volume change to monitor performance of a sealant. The entrainment of cuttings in the bentonite slurry, non-bentonite solids which may increase the mud-weight and stability, along with bentonite and cement grouts as sealants are recommended for study as likely factors affecting these characteristics.

Availability of Report:

This report is available for viewing and loan at:

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Related Publications:

Edil, Tuncer B., Lan, L.T., Chang, Michael K., and Riewe, Tom, 1990. Sealing Characteristics of Selected Grouts for Water Wells. Groundwater, 36 pp.

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Annular space seal, well construction

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