



California Groundwater Association

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Article 229 USE OF THE LINER METHOD FOR STRATA SEAL OFF IN WELL REHABILITATION

BACKGROUND:

Since the beginning of drilling, the need to seal-off stratas of undesirable inflow has been necessary. In the oil field this was done to seal-off layers of salt water that contaminated petroleum production. In water wells it has been done to prevent intrusion of bacterially, chemically or minerally contaminated water from entering otherwise potable or arable water wells.

Department of Water Resources Bulletin 74-81 in Appendix B "SUGGESTED METHODS FOR SEALING THE ANNULAR SPACE AND FOR SEALING OFF STRATA," describes two methods of sealing off strata in already cased and sealed wells.

1. The "Pressure Grouting Method."
2. The "Liner Method."¹

In the "Liner Method," a liner about two inches less in diameter than the casing is installed in the strata to be sealed. The annulus ten feet above and below the offending layer is then sealed with approved sealing material.

Throughout California where annular seals have either failed or where contaminated stratas of water enter a well below an otherwise perfectly good annular seal, this method has been used to restore wells to a usable state and to prevent the contaminated strata from communicating with clean strata. In this capacity the "liner method" has served to protect aquifers in general, as well as specific wells.

Discussion:

Wells drilled in the mountainous "hard rock" areas of California often are not cased to the bottom. Ten inch or larger holes are drilled into "hard rock" or competent rock layers where the well is cased and sealed, frequently using 6" casing. Thereafter, drilling resumes to total depth with a bit small enough to fit inside the newly installed casing, and what will become a conductor casing in the event of a strata seal off using the "liner method." After sufficient water is found the well is developed and left uncased from the bottom of the conductor casing to the bottom of the well. (See attached figure.) Occasionally bacteriological or other water quality testing subsequent to drilling and sealing the annular space indicates contamination, from portions of the well below the original annular seal. To remedy the situation well rehabilitation using the "liner method" of sealing off strata described in Appendix B of Bulletin 74-81 is employed.

This is usually very effective. However, it can have some undesirable consequences. First, the strata seal-off can result in all or most of the well's water supply being cut off. It is essential, therefore, to have accurate information about the various depths at which water is entering the well in addition to knowing where the bottom of the casing is. If the only water-bearing strata is the contaminated one, then sealing it off is not going to do the well owner any good.

The second thing that can happen is that the strata seal-off is unsuccessful. It may seal off one strata of water but leave another lower strata of contaminated water still open to the well. In sealing off strata one

can never really know from which strata the contamination is entering the well without expensive zone sampling. One has to assume that it is the highest strata. This, most of the time, is a good assumption. However, where there are several high water-bearing strata, one has to choose a proper depth for the seal-off packer, balancing the need to leave as much water as possible in the well with the need to seal off the contaminated flow.

Another instance where the strata seal-off method is used is when salt water is encountered. Unlike bacterial contamination, salt or other mineral contamination can not be assumed to come from high strata. In fact, the opposite is most often the case. Here, the attentiveness of the driller in the original boring is important. Some air rotary drillers in known salt or mineralized water areas make a habit of either tasting or testing the water coming out of the hole as the well is being drilled for total dissolved solids. This can provide the information that is later needed in order to determine the positioning of the strata seal-off packer.

RECOMMENDATIONS:

The California Groundwater Association recommends the following with respect to the use of liners in the rehabilitation of wells:

- 1) A California C-57 Licensed Water Well Contractor should perform all liner and strata seal-off installations.
- 2) Appropriate permits must be obtained prior to installation of a liner and strata seal-off. In most jurisdictions this is called a "well reconstruction permit."
- 3) Prior to the installation of the strata seal off liner and packer, as much as possible should be learned about the well and the existing annular seal. This can be done by means of a DWR well log, a video log, a gamma or cement bond log, or other reliable source. It is essential that the bottom of the existing casing be identified. Knowledge of water bearing strata is also essential to insuring there is flow to the well after the strata seal-off.
- 4) The contractor should carefully evaluate the feasibility of well rehabilitation. This among other things includes knowledge of where the production casing in the well ends and open formation begins. Wells that are cased to total depth or that are cased past all known productive zones should not be considered candidates for the "liner method" of strata seal-off. However, if a well is deepened and can be rehabilitated into a well with higher quality water, then the liner strata seal off method can be used to seal off all water above the deepening.
- 5) Economic considerations should be evaluated. If a reduction in the well's flow as a result of the liner strata seal-off is likely, then the customer's water needs must be taken into account. If the flow after seal-off is less than required, liner rehabilitation should be taken out of consideration. Similarly, if the cost of rehabilitation exceeds or approaches that of drilling a new well and destruction of the original well, the customer and contractor should confer and decide on the most cost effective strategy. In doing this, it should be recognized that neither a new well nor a strata seal off can guarantee the elimination of contamination or the supply of a sufficient flow of water.
- 6) If a liner strata seal-off is undertaken, blank and perforated casing should be employed the full length of the well (from surface to TD). The packer for catching the strata seal-off sealing

material should be set, at least, ten feet below the contaminating strata and the sealing material brought at least ten feet above such strata. Care should be taken that the annular column of grouting material does not exceed the collapse strength of the liner.

- 7) The strata seal-off grout should be put in place with a tremie pipe.
- 8) Placement of the strata seal-off packer should if possible occur at least twenty feet below the bottom of the existing casing. This ensures that the grouting material is between the liner and native formation.
- 9) The liner shall be about 2” smaller than the size of the original casing.
- 10) Where the liner strata seal off is used to isolate bad quality water from entering the well, sampling and appropriate laboratory testing should follow the completion of the rehabilitation.

Selected References

¹ **California Department of Water Resources, 1981:** Water well standards, State of California; Bulletin 74-81, APPENDIX B, SUGGESTED METHOD FOR SEALING THE ANNULAR SPACE AND FOR SEALING OFF STRATA, Page 103-104.

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