

# **INJECTION - RELATED PROBLEMS ENCOUNTERED IN GEOHERMAL PROJECTS AND THEIR MITIGATION: THE UNITED STATES EXPERIENCE**

**Sanyal, S.K., Granados, E.E., and Menzies, A.J.**  
**GeothermEx, Inc., 5221 Central Avenue, Suite 201, Richmond, California 94804 USA**

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*Field management, injection problems, tracer tests, cooling, mitigation*

## **ABSTRACT**

Underground fluid injection is important to a geothermal project for a number of reasons: (i) to avoid any environmental impact arising from surface disposal, (ii) to provide pressure support to the reservoir, (iii) to scavenge heat from the rock matrix, and (iv) to avoid any ground subsidence.

A survey of some 70 commercial geothermal projects in the United States shows that the following problems have been encountered or suspected in connection with the injection of waste geothermal fluids: (i) lack of suitable injection sites, (ii) cooling of the produced fluid, (iii) excessive injection pressure, (iv) loss of productivity of steam wells, (v) ground water contamination, (vi) ground heaving, (vii) leakage of the injection fluid to the surface, (ix) adverse impact on the chemistry of the produced fluid, and (x) induced seismic activity. About 20% of the projects have experienced such problems. However, typically no more than one of these problems has affected a single project.

Most of these problems, except for the first one noted above can be avoided by means of careful siting of injection wells based on exploration, well testing and conceptual modeling of the reservoir, and through proper well design and prudent field operation. Experience has shown that such problems can be mitigated even if they occur unexpectedly. Tracer testing and numerical modeling of the reservoir can help in developing an optimum injection strategy. Cooling due to injection can be fully reversed if mitigation measures are taken promptly; the mitigation plan ideally should be based on a numerical model of the reservoir calibrated against the cooling history. The mitigation plan typically calls for re-completing or relocating production or injection wells.

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