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Injection Well Field Optimization using Analytical Methods

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Summary

Disposal of waste fluids through injection is a common and economical means of managing oilfield waste. Responsible planning and design of disposal wells and well fields are critical to energy production success.

Hydrogeologists are specialists in subsurface fluid mechanics and can characterize fluid storage and flow within the disposal reservoir. Technical expertise in hydrogeology must be applied to optimize disposal operations, increase reliability and therefore, minimize disposal costs by securing a dependable fluid waste management option. Disposal well fields must be developed in consideration of multiple parameters: maximum expected injection rates, formation properties, waste fluid compatibility and duration.

Unfortunately, insufficient planning and poor management of fluid volumes leads to reaching early maximum well head injection pressures, leaving operations personnel with limited injection availability.

Analytical scoping and sensitivity analysis can initiate individual disposal well and well field design. Design factors, including well numbers, configuration and injection rates, control the disposal network's effectiveness. A multitude of injection scenarios can be assessed analytically (using different material properties, well spacings, spatial deviations, TDS concentrations, and well sequencing). This assessment allows operations to better understand the uncertainty associated with these design parameters and will focus design efforts. Solutions can then be refined to optimize the injection well field (via rates, sequencing, spacing, and number of wells) over the life of an operation.

Analytical solutions, grounded in hydrogeology principals, such as the Theis transient solution and the principle of linear superposition, can be applied to address disposal well challenges. These challenges include poorly constrained and complex variables. If there are a number of operators in an area, consideration for other users is also required. A cumulative impact assessment can then evaluate the effect of a new or expanded well field on the disposal reservoir and existing operations.

This presentation will provide some insight to responsible planning and management of disposal wells and well fields. The presentation will provide an overview of analytical assessment for injection pressures and will be practical for those involved with feasibility, design, and operation of injection well fields. The talk will specifically address what a hydrogeologist can provide to operations groups in planning and managing disposal wells. Therefore, the content will be focused toward operations managers and practicing hydrogeologists.