HIGH TEMPERATURE TEMPORARY DIVERTER AND LOST CIRCULATION MATERIAL

RELATED APPLICATIONS

This application claims the benefit of and priority to U.S. Provisional Patent Application No. 61/422,738, filed Dec. 14, 2010, U.S. Provisional Patent Application No. 61/438,767, filed Feb. 2, 2011, U.S. Provisional Patent Application No. 61/441,838, filed Feb. 11, 2011, U.S. Provisional Patent Application No. 61/485,530, filed May 12, 2011, and U.S. Provisional Patent Application No. 61/515,816, filed Aug. 5, 2011, which are each incorporated herein by reference.

BACKGROUND

Wells are drilled in subterranean formations for a wide variety of applications. Geothermal wells can be used to extract heat from geothermal formations for production of electricity. Oil and gas wells can be used to extract valuable fuels and hydrocarbons from formations. During drilling of wells for geothermal, oil and gas, and other energy applications, the sealing of fractures and other places where fluid can exit a well can be of great value. For example, during the stimulation of a geothermal well, the use of a temporary sealant to seal off one stimulated set of fractures can allow for the stimulation of other sets of fractures. This is especially beneficial for an EGS (Enhanced Geothermal System) or conventional hydrothermal well used for geothermal power production. The more fractures created, the potential production increases on a per well basis.

Sealing of lost circulation zones is also an issue while drilling geothermal wells. Loss of drilling fluid into a formation can cause permanent damage to potentially productive zones. There are a number of existing solutions to the problem of multiple zone stimulation and lost circulation. For example, viscous gels or other organic and inorganic materials are used to block flow in permeable zones. However, such materials typically cause permanent damage to the permeability of the fractures and increase near wellbore pressure drops because they are typically insoluble or leave insoluble residues. Conventional lost circulation materials include materials like walnut hulls, cotton seeds, and other organic and inorganic materials. These materials can help seal a lost circulation zone. However, they typically will not degrade and/or dissolve into non-damaging materials and so the sealing of the fractures and/or lost circulation zoned with these materials is usually permanent. Mechanical hydraulic isolation can be accomplished using a number of mechanisms to hydraulically isolate multiple zones for stimulation. Many of these, like open hole packers, are not well suited for high temperatures that are typically encountered in geothermal land, some oil and gas wells. Another disadvantage is that they typically require that a drilling rig or at least a coiled tubing unit be present over the hole during their use, which means that there will be significant added cost and operational risk to the operation. Also, if the wells are already completed with either a slotted liner or a well screen with gravel pack, a packer cannot be used to isolate the zone.

Oil and gas well (O&G) hydraulic fracturing is usually significantly different from EGS stimulation. There are two major differences. The first is that O&G hydraulic fracturing typically involves applying enough pressure and stress on the formation rock to cause tensile failure and the creation of new fractures. In EGS hydroshearing stimulation, pump pressure is maintained at the shear failure pressure and is carefully controlled and limited to prevent tensile failure. EGS hydroshearing stimulation results in the 'opening' of existing fractures and prevents the creation of new fractures. Once the fracture is opened, the rock faces can then slip past each other. When the fractures close slightly after stimulation pressure is relieved, the irregularities and disparities between the shifted rock faces do not allow the fractures to close completely, leaving a path for water flow with increased permeability.

Another major difference between O&G and EGS stimulation is that sand and chemicals are purposefully pumped into the open fractures in O&G hydraulic fracturing operations to hold the fractures open and create a high permeability flow path from the formation back to the wellbore. Table I lists a representative formulation used in O&G stimulation treatments.

TABLE I

2000 bbl Stimulation Treatment

Material	Amount
Sand	300,000 lbs
Guar or other gelling agent	2520 lbs
Borate	84 gal
pH Buffer (NaOH or acetic acid)	84 gal
Surfactant	84 gal
Sodium persulfate (breaker)	84 lbs

In contrast, for EGS stimulation, sand or other proppants are not injected into the formation nor are chemicals typically added to the water that is being used to stimulate the formations.

In the drilling of wells for geothermal, oil and gas, and other energy applications, intervals of formation are often encountered which experience the problem of lost circulation. Lost circulation is the loss of hole drilling fluid into fractures and other openings in the rock formation. These lost circulation fractures, whether induced or naturally occurring, can be potentially productive, especially in geothermal wells. When hole drilling fluid flows into a fracture in a formation it carries with it solid materials such as bentonite, drill solids, barite, lost circulation material, etc. that can be difficult or impossible to remove completely after the well has been drilled and completed. These materials remain in the fractures and can impede production of geothermal fluids, oil and gas, etc. reduce the productivity of the well and the ultimate economic value of the asset.

To solve this problem conventional lost circulation materials and systems are used in the drilling fluid or as a separate treatment to seal off the losses, but this results in permanent damage to flow of geofluids or oil and gas, often, even if they seal off the losses.

Lost circulation can also result in additional problems. The fluid is lost downhole and can become an expensive and dangerous problem. Lost circulation can lead to hole instability, stuck drill pipe, and loss of well control. At the least, it halts drilling operations and requires expensive replacement volume to be used.

SUMMARY

A method can include introducing a particulate diverting agent into a first fracture within an underground reservoir formation. The particulate diverting agent can at least partially hydraulically isolate the first fracture. The particulate diverting agent can also be a temporary material which substantially degrades over an extended time. The underground