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(54) **CEMENTITIOUS MATERIALS FOR APPLICATIONS IN SUPER-HOT AND SUPERCRITICAL UNDERGROUND WELLS**

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(57) **ABSTRACT**

In one aspect, the disclosure relates to calcium-free aluminum-based cement formulations designed for applications under supercritical conditions and in corrosive environments. In an aspect, alkali activation of aluminum hydroxide at high temperatures leads to the formation of mineral phases stable under supercritical and superhot conditions. In another aspect, these include, but are not limited to, crystalline phases of boehmite and paragonite and, optionally, a minor vlasovite phase. In yet another aspect, the compositions and articles made therefrom, such as geothermal well sheaths, are stable under the extreme conditions, and water-fillable porosity and mechanical properties of these cement formulations persist through super-critical exposure.