New Concept for Cementing of Super Hot Geothermal Wells based on Polycondensation

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Cementitious mixtures with Portland cement and high silica flour content are commonly used in modern well completions for both, the petroleum and geothermal industry. While those mixtures are sufficient for shallow and middle depth drilling projects, new extreme and more severe conditions are faced in deep drilling projects. Many wells are collapsing and therefore a new approach is needed. Today’s common cement mixtures are not designed to withstand extreme temperatures up to 450 degrees Celsius (e.g. wellhead temperature of IDDP-1 well in Iceland). Not only the phenomena of strength retrogression occurring at temperatures of 110 degrees Celsius, but also the thermal expansion of quarzitious aggregates at high temperatures, the shrinkage of cement, cycle loads during the fluid production and low pH-values of downhole environment that cause problems for the binding matrix of cementitious systems. The research work carried out at the International Geothermal Centre aims to find an applicable replacement for commonly used cement mixtures. First laboratory tests have proven that geopolymers seem to be a good candidate. This special form of polymers shows higher compressive strength values and chemical resistance while their self-induced shrinkage is marginal. Additionally they are economically feasible and their CO_2 emission is low compared to OPC. Regarding those points GZB research is focussed on those alkali activated alumina silicates (geopolymers) and hybrid cements. In order to further improve the ductile behaviour and tensile strength of the polymers additional investigations the influence of different fibres are centre of interest as well. Therefore the test specimen are stored under different in-situ conditions (temperature and pressure) as well as storage under the absence of water in order to simulate severe dehydration conditions. Next to this different pH-values for the mixtures and storage times, ranging from one to seven days, are adjusted. During standardized test procedures the compressive and flexural strengths are measured to receive and produce a comparable workability. The simulation of cycling loadings is applied to dedicated mixtures as well by cementing steel pipes and carrying out predefined temperature cycles.