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Impact of hydrogen generated by iron corrosion on compacted bentonite in deep geological repository

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A large number of processes will influence performance of deep geological repository of radioactive wastes until the activity of radionuclides decay to a negligible level. One of the very important processes is generation of gases, and particularly of hydrogen, which will be formed primarily by anaerobic corrosion of metals and by radiolysis of water. High pressure formed in the vicinity of waste packages due to accumulation of hydrogen can cause failure of sealing materials and contribute to fast release of radionuclides to the geosphere after waste package failure. This contribution presents the results of laboratory experiments, which simulated the phase of repository evolution after ingression of water in failed canister with spent fuel assemblies, which is connected with significant generation and accumulation of hydrogen in free voids of waste packages and at interfaces of waste packages and compacted bentonite used as a sealing material. Corrosion of carbon steel canisters inside walls is simulated by corrosion of iron powder with high surface. It was found that after an increase of pressure of hydrogen to the values exceeding some threshold values, which depends on density bentonite, hydrogen is released to geosphere in pulses due to formation of preferential paths. This is connected with a significant increase of permeability of bentonite from values of approximately 10-24 m2 to 10-18 m2 within the breakthrough time. The pressure needed to reach breakthrough is decreased with number of breakthrough pulses. Data obtained in experiments enable us to understand more closely to the processes occurring in a repository and to avoid conditions, which could lead to the failure of sealing materials and fast release of radionuclides to the geosphere and the environment.

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