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Deep Geological Disposal High-Level Radioactive Waste

Byung Leey

Department of Energy Engineering, Dankook University, Dongnam-gu, Cheonan, Chungnam South Korea

***Corresponding Author:** Byung Leey, Department of Energy Engineering, Dankook University, Dongnam-gu, Cheonan, Chungnam South Korea, E-mail: Byung@gmail.com

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Description

Socio-technical ensembles with social, political, economic, and technical components can be used to describe energy technologies. This contribution investigates the dynamics and interactions that can occur within the socio-technical ensemble of a Deep Geological Disposal (DGD) for High-Level Radioactive Waste (HLRW) on the basis of this concept as well as other theoretical approaches dealing with the deployment and development of technologies (such as the multi-level perspective of Geels. Three energy technologies with extensive infrastructures are compared and their findings are linked to a DGD. The purpose of the analysis, which is based on a comprehensive literature review, is to learn indirect information about nuclear waste management (NWM) from the dynamics that occur within the socio-technical ensembles of wind farms, frocking, and carbon dioxide capture and storage. A comprehensive literature review with eight distinct criteria, including public participation, conflicts, and the role of science, serves as the foundation for the analysis. However, the transferability of those findings is extremely limited due to the varying social contexts. As a result, we have chosen a different method that enables us to gain indirect knowledge of the search for a repository's dynamics and designs. This allows for the early identification of potential issues and solutions. The purpose of our analysis is to describe the socio-technical ensembles of the three energy technologies and their respective large-scale infrastructures based on a set of criteria. To transfer these insights to nuclear waste management (NWM), we are looking for socio-technical analogues, which are insights regarding factors that could have stabilizing or destabilizing effects on large-scale infrastructure projects. In contrast, we determine their characteristics and relationship to a DGD.For the verification of nuclear waste, an alternative to the more typical borosilicate glass is emerging in the form of Iron Phosphate Glass (IPG).

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As a result, research into how the structure and stability of IPG are affected by the loading of various elements produced as nuclear fission waste is urgently required. The melt quench method was used to try to immobilize tellurium (Te) and inactive antimony (Sb) in IPG in this study. To determine the extent of individual and co-loading of Sb/Te, which is capable of forming homogeneous melts without crystallization, in-depth studies on the structure and composition of the resulting IPG glass form have been carried out. The temperature distribution is an important factor in the design and safety evaluation of the High-Level Radioactive Nuclear Waste (HLW) disposal repository. A solution to the temperature distribution is obtained by combining the two parts listed below in order to analyze the heat conduction property close to the HLW canister under three-dimensional heat transfer conditions. The temperature ratio between the point source heat transfer model's solution and the Finite Length Heat Source (FLHS) and the Infinite Length Heat Source (ILHS). A two-dimensional heat transfer analytical solution for double-layered media's lateral temperature distribution near the HLW canister. Then, the solution of temperature near the HLW canister under three-dimensional heat transfer is checked against the ones that are already in the literature for a special case. In the end, a parametric study with various parameters is carried out to investigate the temperature performance of the buffer layer and surrounding rock. We demonstrated that long-term storage accounts for the majority of technology development. Both advanced and developing nations can benefit from this strategy. We are increasingly confronted with the issue of nuclear waste as a result of the United States' continued reliance on nuclear energy. Some of the techno-economic and political realities that have pushed US nuclear waste management into a liminal space of uncertainty include growing quantities of spent nuclear fuel, the absence of permanent storage, and an increasing number of nuclear reactors that are no longer in operation. We investigate this liminality and the subsequent emergence of a new political economy for spent fuel management by employing a qualitative methodology that incorporates policy analysis and case studies. According to our findings, a number of regulatory, organizational, and spatial "fixes" have recently emerged in an effort to take advantage of the liminality of nuclear waste management in the United States. Policy solutions in a variety of contexts, including nuclear waste management and other rapidly evolving energy sectors, should be carefully evaluated, the findings suggest. For the permanent disposal of spent nuclear fuels and high-level radioactive waste, safety assessments of geological nuclear waste repositories are necessary. The Thermo-Hydro mechanical (THM) state of the repository is significantly disrupted by decay heat from nuclear waste canisters, which will last for thousands of years. As a result, the host rock's long-term integrity as well as the engineered barrier system surrounding the canisters are of particular importance. To find out how time-dependent deformation of shale, also known as creep, affects the long-term integrity of a typical subsurface nuclear waste repository, THM coupled simulations were used in this study. The power-law creep that occurs in shales was simulated using the Norton-Bailey creep model, also known as the Lemaitre-Menzel-Schreiner model. The repository was THM-coupled modeled using the TOUGH-FLAC simulator. In recent years, there has been a growing interest in using Data-Driven Machine Learning (DDML) to get rid of High-Level Nuclear Waste (HLNW).In the area of HLW disposal, the purpose of this review is to systematically elaborate, analyze, and summarize recent advancements in DDML. To begin, a comprehensive investigation of the DDML for the disposal of HLW is conducted. The Linear Regression (LR), Principle Component Analysis (PCA), and artificial neural network (ANN) are examples of five DDML algorithms. Then, it provides a summary of the typical DDML algorithms as well as the primary DGR inputs and outputs. In addition, the hybrid DDML algorithms are found to be effective choices. Additionally, the DDML demonstrates a wide range of application in the multi scale and multi physics field simulation.

Lastly, the physical-informed DDML might make all algorithms work better. During the verification of high-level nuclear waste, a number of chemical reactions take place. One of the most important aspects of today's strategy for improving numerical tools' prediction capabilities is the incorporation of these chemical aspects into process numerical simulation tools. We propose a modeling of the kinetics of chemical reactions that take place when nuclear glass precursors are subjected to constant heating in this study, based on simultaneous differential scanning calorimetry-thermo gravimetry (DSC-TGA) and the run/rerun method.

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A weighted sum of nth-order reactions was used to describe the overall mechanism for the mathematical modeling. The apparent kinetic parameters were found using a hybrid strategy that combined the Kissinger and least squares methods. Through microstructural evolution and evolved gas analyses, in addition to the thermal characterization, we offer some insight into the primary reactions' nature. India is developing a nuclear reactor called the Fast Breeder as part of its clean nuclear energy program.The platinum group of elements will be present in concentrations that are higher than their respective solubility limits within borosilicate melts in high-level nuclear wastes that are likely to be produced as a result of the reprocessing of its spent fuel. To this end, Palladium Telluride (PdTe) was subjected to interaction studies with waste glass and sodium barium borosilicate base glass. Spherical PdTe mostly settled at the bottom of ceramic crucibles without interacting with base glass in any way. The nuclear waste water incident in Japan will be dealt with safely as a result of this. Second, a synergistic regulation may result from the Japanese public's participation. However, a free-rider phenomenon is also a possibility. Thirdly, the Japanese government's decision-making process is primarily influenced by costs associated with nuclear waste water storage and treatment. Last but not least, pertinent recommendations and countermeasures are presented to encourage efficient monitoring by domestic and stakeholder nations. Additionally, it encourages the Japanese government to adhere to the policy on marine environmental protection. Under the circumstances, it is possible to influence recommendations for the formulation of international marine environmental policies by studying the strategic decisions made by stakeholders.