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The Groundwater Assessment for the Young Dong Model by EPM Modeling

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1. Introduction

One of the options being considered by several countries for the long term disposal of radioactive waste material is deep burial in stable geological formations. In Korea it is intended that spent nuclear fuel(SNF) and long-lived low- and intermediate-level wastes will be disposed of a deep repository.

In order to achieve long-term safety, the repository system is designed so as to ensure that several factors contribute to the overall performance. The part of the repository system concerned with the waste form, containers and the immediate physical and chemical environment of the repository is generally referred to as the near-field. The transport pathways and dilution and retardation mechanisms in the rocks between the repository and the biosphere, i.e. the far-field mechanisms of transport through the geosphere generally make a very important contribution to the overall performance of the repository. Finally, the distribution of radionuclides in the biosphere and the consequent exposure pathways also play an important role in an evaluation of overall performance.

Analysis and understanding of the groundwater flow and radionuclide transport in and around a site for a radioactive waste repository will play important roles in a performance assessment. The radionuclides from the wastes will dissolve in the groundwater and may then be transported back to man's immediate environment by the groundwater flowing through the geological formation. Groundwater flows slowly, particularly in regions that are considered suitable for the location of a repository. Thus the timescales of interest are very long and the only method available for assessing the consequences of this groundwater pathway is mathematical modeling of the physical and chemical process involved. However, the models are often too complicated to solve analytically and so they must be incorporated into computer programs. It is very important to ensure that features of the site and processes occurring at the site that could have an important influence on flow and transport are appropriately represented by the numerical model.

Therefore this study evaluates the groundwater flow of the typical Korean site and to promote proposals of further investigations of the hydro-geological conditions at the site.

2. Numerical Analysis

The modeling of the groundwater flow has been carried out with the finite element code NAMMU that uses a porous medium approach.

The movement of groundwater is described quantitatively by the specific discharge, **q**, sometimes called the Darcy velocity [1]. This is the volumetric rate of flow of water per unit cross-sectional area. The specific discharge **q** is calculated in NAMMU from Darcy's law,

$$q = -\frac{k}{\mu}\left(\nabla P^T - \rho_l g\right) \qquad (1)$$

where P^T is the groundwater pressure,

ρ_l is the groundwater density,

g is the gravitational acceleration,

μ is the viscosity of the groundwater, and

k is the permeability of the rock, a measure of its ability to permit flow.

Figure 1 shows that the actual surface compares with the modeling region.

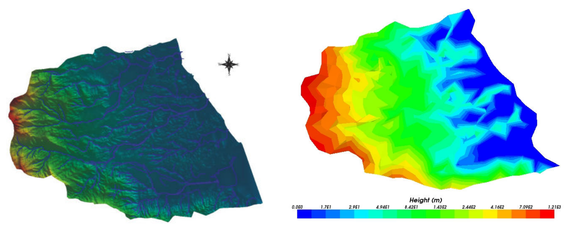

Figure 1. Comparison of the actual surface with the modeling region.

Figure 2 shows the grid structure in three dimension modeling.

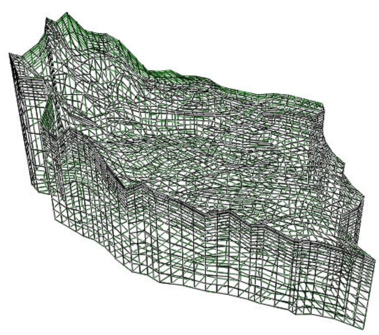

Figure 2. Grid Structure in three dimensional modeling

The left side sets up the topographical feature with water-divided region and the right side does the sea. The soil of weathered rock has 25m thickness, the upper bedrock established z=-300m and the bottom bedrock z=-1000m considered not to influence the groundwater flow from the HLW repository(z=-500m).

Table 1 shows the permeability and porosity as the input data for the groundwater assessment.

Table 1. Input Data for the assessment on a groundwater flow

Item	Permeability(m2)	Porosity
SOIL	1.0E-13	0.1
UROCK	5.0E-16	0.01
LROCK	5.0E-19	0.01

3. Results

Figure 3 and table 2 show the groundwater pathway with the saline effect.

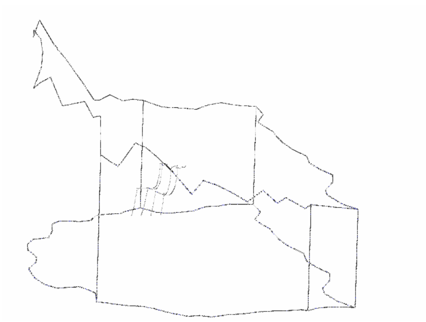

Figure 3. The groundwater pathway

Table 2. Output data of the groundwater flow

	ROCK	Travel time (yr)	Path length (m)	Darcy vel. (m/yr)
1	UROCK	2.87E+05	3.84E+02	1.34E-05
	LROCK	2.31E+03	1.46E+03	3.16E-16
	SOIL	3.36E+01	3.20E+02	9.51E-13
2	UROCK	4.15E+05	4.23E+02	1.02E-05
	LROCK	1.65E+03	9.48E+02	5.75E-03
	SOIL	5.55E+01	3.84E+02	6.93E-01
3	UROCK	3.52E+05	3.26E+02	9.24E-06
	LROCK	2.75E+03	1.11E+03	4.02E-03
	SOIL	5.55E+01	5.55E+02	1.00E+00
4	UROCK	5.45E+05	3.59E+02	6.57E-06
	LROCK	2.45E+03	9.37E+02	3.82E-03
	SOIL	6.75E+01	5.52E+02	8.18E-01

4. Conclusion

The groundwater flow is seriously influenced on the saline effect.

REFERENCES

[1] NAMMU Release 9.3 User Guide, Serco Assurance, United Kingdom, 2006.

Acknowledgement

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