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The Groundwater Assessment for the Young Seo Model by EPM Modeling

Mi-Seon Jeong,a Yong-Soo Hwang
Korea Atomic Energy Research Institute
jeongms@kaeri.re.kr

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 in 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 impact on the groundwater flow field of the site around KAERI 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.

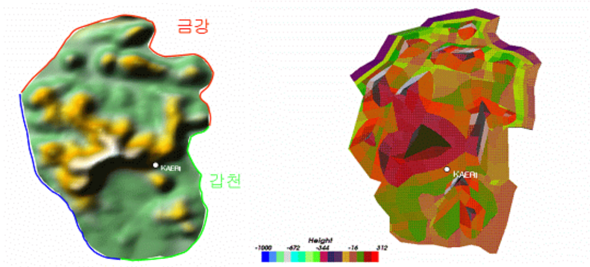

Figure 1. Comparison of the actual surface with the modeling region

Figure 2 shows the grid structure and the fracture's location in three dimension modeling.

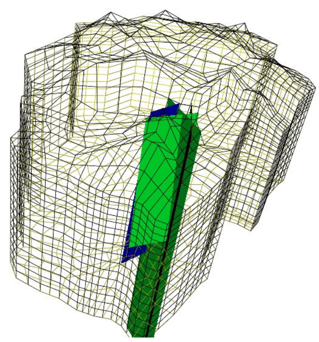

Figure 2. Grid structure and the fracture's location

Table 1 shows the permeability and porosity as the input data for the groundwater assessment. The soil of weathered rock has 45m thickness, the upper bedrock established z=-250m and the bottom bedrock z=-1000m considered not to influence the groundwater flow from the HLW repository (z=-500m).

Table 1. Input data for the groundwater assessment

Item	Permeability(m^2)	Porosity
SOIL	1.0E-13	0.2
UROCK	1.0E-16	0.02
LROCK	8.0E-17	0.02
Fracture 1	1.0E-07	0.02
Fracture 2	1.0E-07	0.02
Fracture 3	1.0E-07	0.02
Fracture 4	1.0E-07	0.02

3. Results

Figure 3 and table 2 show the groundwater pathway at the repository position (z=-500m). The traveling time of the groundwater takes about 40 thousand year from the repository to the ground.

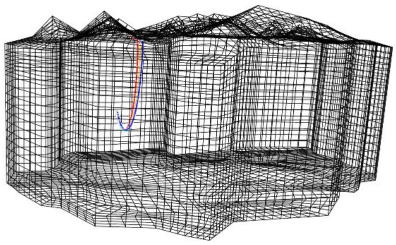

Figure 3. The groundwater pathway at the repository position

Table 2. Output data in arbitrary positions

	ROCK	Travel time (yr)	Path length (m)	Darcy vel. (m/yr)
1	LRock	3.52E+04	1.12E+03	6.36E-04
	URock	6.90E+03	2.98E+02	8.64E-04
	Soil	2.68E+02	7.25E+02	5.41E-01
2	LRock	3.97E+04	1.16E+03	5.84E-04
	URock	8.17E+03	3.08E+02	7.54E-04
	Soil	3.23E+02	8.58E+02	5.31E-01
3	LRock	4.41E+04	1.18E+03	5.35E-04
	URock	1.00E+04	3.18E+02	6.36E-04
	Soil	3.91E+02	1.02E+03	5.22E-01
4	LRock	4.80E+04	1.18E+03	4.92E-04
	URock	1.27E+04	3.10E+02	4.88E-04
	Soil	5.11E+02	1.22E+03	4.77E-01
5	LRock	5.09E+04	1.14E+03	4.48E-04
	URock	9.86E+03	2.85E+02	5.78E-04
	Soil	2.30E+02	4.62E+02	4.02E-01

Figure 4 and table 3 shows the groundwater flow of a site around the fracture. The groundwater pathway around fractures moves through fractures. So, timescale of the groundwater is shorter than without fractures.

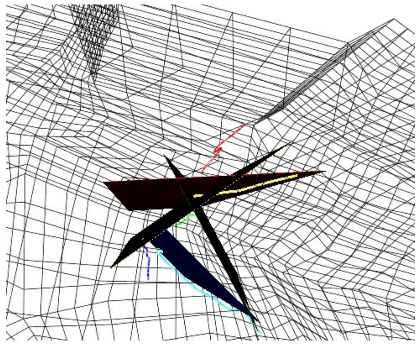

Figure 4. The groundwater pathway around fractures

Table 3. Output data of the groundwater pathway around fractures

	ROCK	Travel time (yr)	Path length (m)	Darcy vel. (m/yr)
1	LRock	5.80E+03	2.19E+03	7.55E-03
2	LRock	1.27E+03	2.19E+03	3.45E-02
	URock	9.35E+02	4.50E+02	9.63E-03
	Soil	9.94E-04	4.82E+01	9.70E+03
3	LRock	4.99E+02	1.96E+03	7.86E-02
	URock	9.65E-04	3.59E+02	7.44E+03
	Soil	9.41E-04	4.86E+01	1.03E+04
4	LRock	1.71E-03	1.12E+03	1.31E+04
	URock	1.65E-04	2.92E+02	3.54E+04
	Soil	1.44E-04	5.26E+01	7.31E+04
5	LRock	1.87E+03	4.00E+02	4.28E-03
	URock	1.93E+03	8.18E+02	8.48E-03
	Soil	2.27E-03	5.84E+01	5.15E+03

4. Conclusion

We know that the fracture location have influenced the repository safety. If the site is close to the fracture, someone claims not to establish the repository around this site as the repository safety may be seriously affected. But for this claims it is necessary to have the safety assessment in detail.

REFERENCES

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

Acknowledgement

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