Water Barrier Performance of Rubber Related Geosynthetics for Road Construction

Han-Yong Jeon
Faculty of Applied Chemical Engineering, Chonnam National University,
Gwangju 500-757, Korea

Abstract

4 types rubber related geosynthetics were manufactured to examine the performance to for applications to the civil and geotechnical fields, especially to the road construction. Reinforcement and water barrier function of these geosynthetics were interpreted as the important properties.
Fiber glass mat based and geogrid based geosynthetics showed the excellent mechanical properties as. Also elastomeric bitumen based geosynthetic showed the highest permittivity.
From this, it is thought that this geosynthetic is suitable for water barrier under specific load condition.

Introduction

Geosynthetics which have the special functions such as protection, reinforcement, filtration, drainage, water barrier and containment, load absorption etc. are widely used to the civil and geotechnical fields.[1-2]
Among these materials, elastomeric bitumen geomembranes are made by SBS(Styrene-Butadiene-Styrene) polymer and asphalt with puncture resistant geosynthetics.
These materials are able to consistently maintain their integrities in an ever-changing, inconsistent environment.
These rubber related geosynthetics are used to be needed the excessive high hydrostatic pressure or special substrate or overlay conditions.
In this study, 4 types rubber related geosynthetics were manufactured to examine the performance for applications to the civil and geotechnical fields especially in the road construction.
Reinforcement and water barrier functions of these geosynthetics were interpreted as the important properties.

Experimental

Preparation of samples

Spunbonded polyester nonwoven(;12 denier, 300g/m²), fiber glass mat based(FGMGS), nonwoven based(NWGS), fabric type geogrid based(GGGS), elastomeric bitumen with SBS polymer based(EBGS) were used to manufacture the rubber related geosynthetics.
Thermal bonding method was used to manufacture the elastomeric bitumen geomembranes and the bonding conditions were (a) temperatures : 250~300℃, (b) pressures : 4~10kgf, (c) times : 5~20min.

Measurements

The following properties of the rubber related geosynthetics for civil and environmental end-uses were estimated as reinforcement and water barrier functions in accordance with ASTM related test methods.

* Tensile properties - strength and strain values at break : ASTM D 4632-91
*Tear and puncture properties : ASTM D 4533-91
* Hydraulic properties - permittivity etc. : ASTM D 4491-92

Result and Discussion

Tensile properties

Geosynthetics for reinforcement must have optimum tensile strength and strain to sustain the structural stability.
Especially, tension in geosynthetics is equal to the allowable stress by equation (1).

$$T = \sigma_{allow}\, t = \frac{T_{ult}}{RF}\, t \quad \text{----------} \quad (1)$$

(where, T : tension mobilized in the geosynthetics σ_{allow}: allowable geosynthetic stress, t : thickness of the geosynthetics, RF : total partial factors of safety for geosynthetics.)

Figure 1 shows the tensile properties of rubber related geosynthetics.
FGMGS is the highest tensile strength and EBGS has the highest strain at break.
From this, it was seen that FGMGS is the most excellent reinforcement material of 4 type rubber

related geosynthetics without respect to manufacturing process and cost.

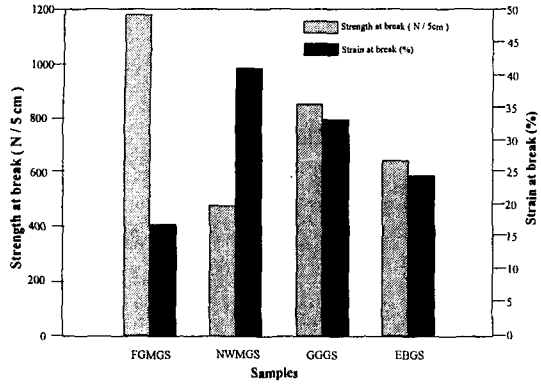

Fig.1. Tensile properties of rubber related geosynthetics

Tear and puncture properties

Figure 2 represents tear and puncture strength values of rubber related geosynthetics. Tear and puncture properties of 4 types geosynthetics are showing same tendency of tensile properties. It was shown that FGMGS and GGGS is the most suitable for reinforcement with respect to their tensile properties.

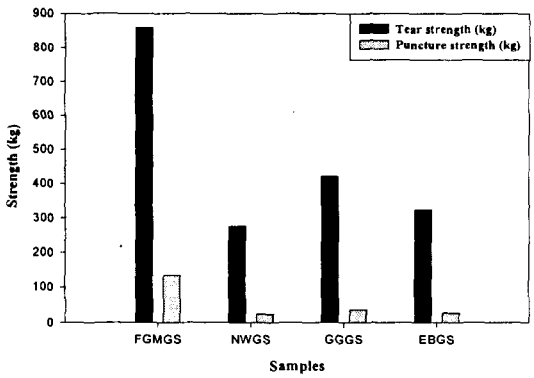

Fig.2. Tear and puncture strength values of rubber related geosynthetics

Hydraulic properties

Geosynthetics which have the water barrier function play an important role as flexible membrane liners to prevent liquid migration and to reservoir specific liquids for waste landfill system. In general, permittivity(Ψ) of geosynthetics is determined from Darcy's formula, equation (2), as follows:

$$Q = K_n \, i \, A = K_n \frac{\Delta h}{t} A \quad \text{----------} \quad (2)$$

$$\text{and } \Psi = \frac{K_n}{t} = \frac{Q}{(\Delta h)(A)} \quad \text{----------} \quad (3)$$

(where, Ψ : permittivity of geosynthetics, K_n : hydraulic conductivity, t : thickness of the geosynthetics, i : hydraulic gradient, Δh : total head lost, A : total area of geosynthetics.)

From equation (3), it is known that permittivity of geosynthetics depend on each hydraulic conductivity and thickness of the composed geosynthetics. Figure 3 represents the hydraulic properties of rubber related geosynthetics. In here, it was seen that 4 type geosynthetics have good hydraulic properties but EBGS has the highest permittivity.

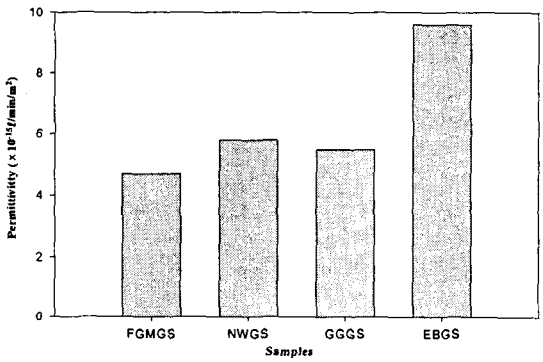

Fig.3. Hydraulic properties of rubber related geosynthetics

Conclusion

FGMGS and GGGS showed the excellent mechanical properties and it is thought that these materials are most suitable for reinforcing geosynthetics. Therefore, FGMGS and GGGS effectively solve most problem with cracking pavement, adding significant strength, crack resistance and concrete repair process. Also, EBGS has the highest permittivity value and provides water resistance and water proofing. From this, it is thought that this geosynthetic is suitable for water barrier under specific load condition.

References

1. R. M. Koerner, "Designing with Geosynthetics", 4th Ed., Prentice Hall, New Jersey, 1998.
2. R. D. Holtz, B. R. Christopher and R. R. Berg, "Geosynthetic Engineering", 1st Ed., Bitech Publishers Ltd., Richmond, Canada, 1997.