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Recommended Effective Diffusion Coefficient for FTF Base Mat Surrogate and Tank Grouts

Literature and SRS site-specific values of saturated hydraulic conductivity and effective diffusion coefficient for cementitious materials are provided in Phifer et al. (2006). As outlined in Phifer et al. (2006) the effective diffusion coefficient varies directly with saturated hydraulic conductivity. The same factors that reduce the saturated hydraulic conductivity of cementitious materials also reduce the effective diffusion coefficient. The saturated hydraulic conductivity of cementitious materials (excluding Controlled Low Strength Material (CLSM)) generally ranges from about 1.0E-08 to 1.0E-13, whereas the effective diffusion coefficient generally ranges from 5.0E-07 to 1.0E-08 cm^2/s. The range of cementitious material saturated hydraulic conductivity spans five orders of magnitude, whereas the effective diffusion coefficient spans a much narrower range of one and a half orders of magnitude.

A significant proportion of the cementitious material saturated hydraulic conductivity data presented by Phifer et al. (2006) is SRS site-specific data, whereas the bulk of the effective diffusion coefficient data is literature derived (the only SRS site-specific diffusion coefficient data currently available is for the Saltstone waste form). Based upon this lack of site-specific diffusion coefficient data and the reliance upon literature values, in general Phifer et al. (2006) assigned effective diffusion coefficient values to cementitious materials based upon their saturated hydraulic conductivity. Phifer et al. (2006) assigned effective diffusion coefficients to cementitious materials based upon the criteria shown in Table 1. The effective diffusion coefficients assigned by Phifer et al. (2006) were biased toward the upper end of the range, since essentially no SRS site-specific data was available.

Consistent with Table 1, effective diffusion coefficients have been assigned to FTF base mat surrogate and tank grouts as shown in Table 2, based upon the saturated hydraulic conductivity of the material as determined by Dixon and Phifer (2007).

Table 1. Cementitious Material Effective Diffusion Coefficient Assignments

Cementitious Material Category	Relative Saturated Hydraulic Conductivity (cm/s)	Representative Saturated Effective Diffusion Coefficient (cm^2/s)
Low Quality Concrete	High (> 5.0E-09)	8.0E-07
Ordinary Quality Concrete	Moderate (5.0E-09 cm/s ≤ Ksat ≥ 1.0E-10)	1.0E-07
High Quality Concrete	Low (≤ 1.0E-10)	5.0E-08

Table 2. FTF Base Mat Surrogate and FTF Tank Grout Effective Diffusion Coefficient Assignments

Mix	Saturated Hydraulic Conductivity [1] (cm/s)	Assigned Saturated Effective Diffusion Coefficient [2] (cm^2/s)
Strong Grout	1.7E-08	8.0E-07
Reducing Fill Grout	3.6E-08	8.0E-07
Alternative Reducing Fill Grout 1A	8.9E-09	8.0E-07
Alternative Reducing Fill Grout 1B	1.3E-08	8.0E-07
Alternative Reducing Fill Grout 2	6.6E-09	8.0E-07
Base Mat Surrogate	3.4E-08	8.0E-07

From Dixon and Phifer (2007)
Based upon Phifer et al. (2006)

References:

Dixon, K. L. and Phifer, M. A. 2007. Hydraulic and Physical Properties of Tank Grouts and Base Mat Surrogate Concrete for FTF Closure, WSRC-STI-2007-00369, Revision 0. Washington Savannah River Company, Aiken, SC 29808. October 2007.

Phifer, M. A., Millings, M. R., and Flach, G. P. 2006. Hydraulic Property Data Package for the E-Area and Z-Area Soils, Cementitious Materials, and Waste Zones, WSRC-STI-2006-00198, Revision 0. Washington Savannah River Company, Aiken, SC 29808. September 2006.