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Technical Review:

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Subject: Cumulative distribution for STEEL:HUMCORR

Based on the data from corrosion experiments performed by Roselle (2013), a cumulative distribution for the STEEL:HUMCORR (humid corrosion rate for steel) has been constructed, as described below. Although Roselle proposed to maintain the HUMCORR parameter at a value of zero, in order to address a comment received from the EPA regarding the CRA-2014 (Letter from J. Edwards, USEPA to J. Franco, DOE, Transmitting Fourth Set of Completeness Comments Related to the 2014 WIPP Compliance Recertification Application, response 4-C-3. July 30, 2015. EPA Docket EPA-HQ-OAR-2014-0609-0024, ERMS 564885.), we found that it was appropriate to construct a distribution of values for the HUMCORR parameter from Roselle's data.

Because there is a predicted value of 3.14 ppm CO_2 in the gas phase when in equilibrium with WIPP brines (Brush and Domski 2013), corrosion rates based solely on 0 ppm CO_2 experiments may not completely reflect iron corrosion under WIPP conditions. Therefore it is appropriate to also consider data from corrosion experiments performed under conditions with nonzero CO_2 concentrations. The data available from Roselle (2013) include corrosion rates for CO_2 concentrations of 0 and 350 ppm. A 350 ppm CO_2 concentration is two orders of magnitude higher than the predicted value, and therefore these data are not directly relevant to WIPP conditions. Instead of using these data directly the 350 ppm with the 0 ppm data is used to construct a distribution for the STEEL:HUMCORR parameter via interpolation between the two data sets, rather than by aggregating the two sets of data.

The humid corrosion rate data in Roselle (2013) comprises 16 data points, 8 for samples tested at 0 ppm carbon dioxide (CO_2) and 8 for samples tested at 350 ppm CO_2. The 350 ppm CO_2 data set was reduced to four samples by excluding nonphysical, negative corrosion rates. Each data set was initially considered separately. The corrosion rates from Table A-1 of Roselle (2013) were converted from units of μm/yr to m/s and sorted in ascending order, with appropriate percentiles assigned to each corrosion rate, resulting in two empirical cumulative distribution functions (CDFs) (see attached Excel spreadsheet for the detailed calculations). For completeness, a value of 0 m/s was assigned to the zeroth percentile for each CDF. In order to combine the CDFs, a common set of percentiles was constructed over the range 0-100 by linearly interpolating the 350 ppm data between existing data points. Finally, a CDF representative of corrosion rates at 3.14 ppm CO_2 was formed by linearly interpolating between quantiles (Figure 1). The result is a CDF that can be used as a cumulative distribution to describe the STEEL:HUMCORR parameter (Table 1). Statistics for the CDF are shown in Table 2.

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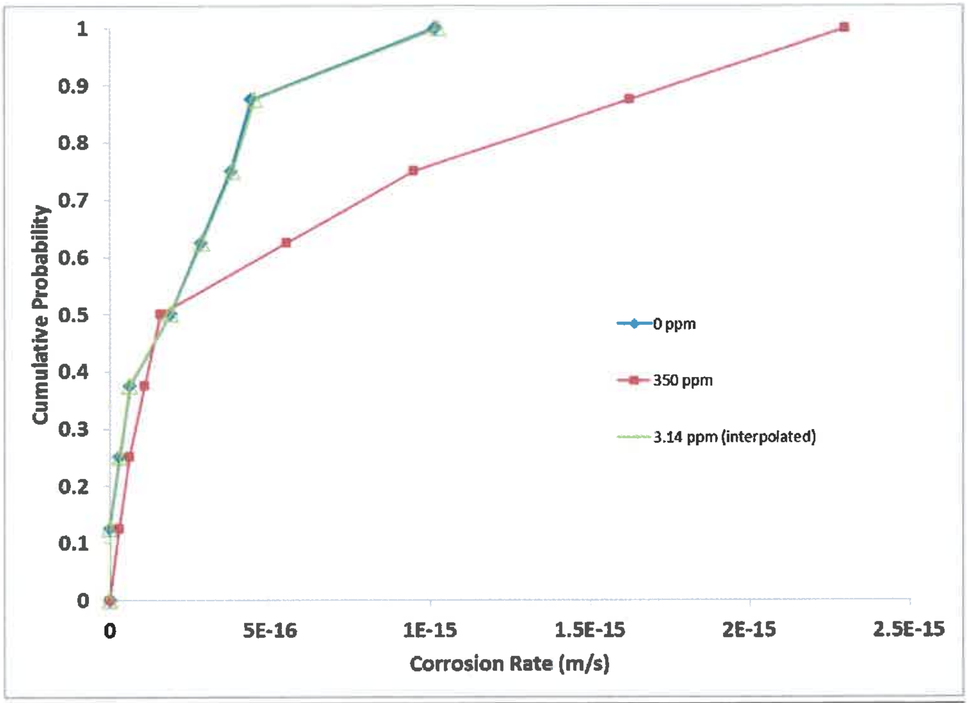

Figure 1. CDFs for the 0 ppm and 350 ppm CO_2 data sets, as well as the final interpolated CDF for 3.14 ppm.

Table 1. CDF data for the STEEL:HUMCORR parameter that describes iron corrosion rates.

Value	Cumulative Probability
0	0
2.83E-19	0.125
3.20E-17	0.25
6.39E-17	0.375
1.90E-16	0.5
2.88E-16	0.625
3.86E-16	0.75
4.55E-16	0.875
1.03E-15	1

Table 2. Statistics for the CDF of STEEL:HUMCORR.

Mean	2.71E-16
Median	1.90E-16
St. Dev.	3.30E-16
Min.	0.00E+00
Max.	1.03E-15

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References:

Brush, L.H. and P.S. Domski. 2013. Prediction of Baseline Actinide Solubilities for the WIPP CRA-2014 PA. Sandia National Laboratories, ERMS 559138.

Roselle, G.T. 2013. "Determination of Corrosion Rates of Gas Generation Rates from Iron/Lead Corrosion Experiments, AP 159, Rev. 1" Analysis Report, January 23, 2013. Carlsbad, NM: Sandia National Laboratories. ERMS 559077.

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