Electronic Supplementary Information

Exact calculation of corrosion rates by the weight-loss method

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Dissolution profile of regular n-gonal prism

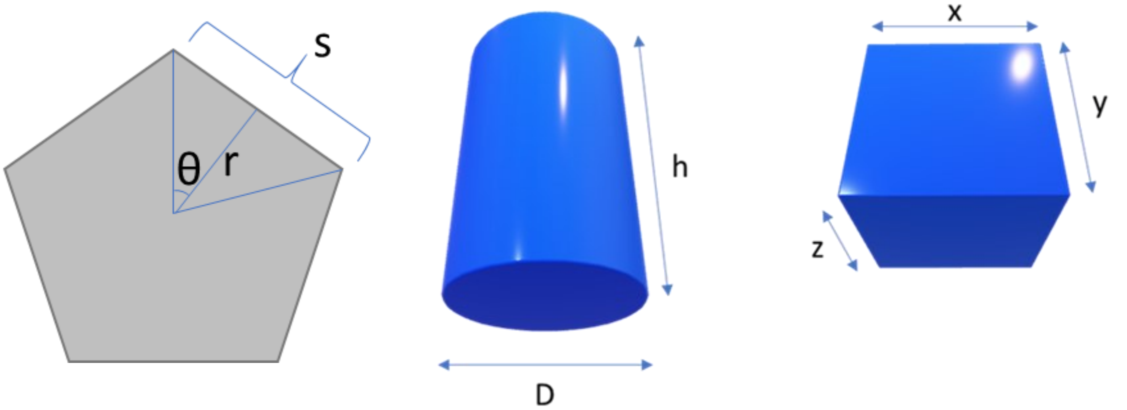

Figure S1. Symbol nomenclature for cylindrical and rectangular objects and cross-section of a regular n-gonal prism.

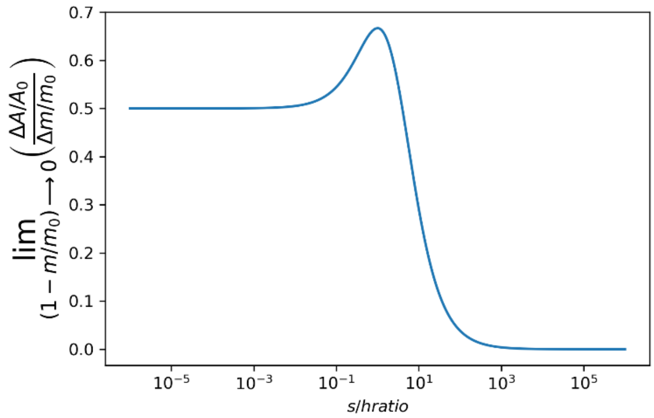

Figure S2. Initial gradients $(\Delta A/A_0)/(\Delta m/m_0)$ as a function of the s/h ratio for dissolving square prisms calculated with arbitrary values: initial area of 1 cm^2, ρ = 7.05 g/cm^3, CR of 0.1 cm/y. Nota bene: initial surface area, density and CR do not affect the results, as the values in the plot are relatives.

Table S1. Partial List of Standardized Immersion Tests (Kutz 2005).

Designation	Title
ASTM G31	Standard Practice for Laboratory Immersion Corrosion Testing of Metals
ASTM G48	Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution
ASTM G36	Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution
ASTM G49	Standard Practice for Preparation and Use of Direct Tension Stress-Corrosion Test Specimens
ASTM G30	Standard Practice for Making and Using U-Bend Stress-Corrosion Test Specimens
ASTM G38	Standard Practice for Making and Using C-Ring Stress-Corrosion Test Specimens
ASTM G41	Standard Practice for Determining Cracking Susceptibility of Metals Exposed Under Stress to a Hot Salt Environment
ASTM G44	Standard Practice for Exposure of Metals and Alloys by Alternate Immersion in Neutral 3.5% Sodium Chloride Solution
ASTM G78	Standard Guide for Crevice Corrosion Testing of Iron-Base and Nickel-Base Stainless Alloys in Seawater and Other Chloride-Containing Aqueous Environments
ASTM G35	Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids
NACE MR0174-95	Recommendations for Selecting Inhibitors for Use as Sucker-Rod Thread Lubricants
NACE TM0198-98	Slow strain rate test method for screening corrosion-resistant alloys for stress corrosion cracking in sour oilfield service
NACE TM0169	Laboratory Corrosion Testing of Metals
NACE TM0171	Autoclave corrosion testing in high-temperature water
USFS 5100	Standard Test Procedures For the Evaluation of Wildland Fire Chemical Products
NACE TM0177	Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids

Table S2. Relative errors in the corrosion rate as a function of the mass loss fraction if Eq. 1 is used (constant area), calculated with arbitrary values: initial area of 1 cm2, ρ = 7.05 g/cm3, CR of 0.1 cm/y. Nota bene: initial surface area, density and CR do not affect the results, as the values in the plot are relatives.

Mass loss fraction	Error [%]									
	s/h									
	0.001	**0.01**	**0.1**	**0.5**	**1**	**2**	**8**	**10**	**100**	**1000**
0.01	0.3	0.3	0.3	0.4	0.4	0.4	0.2	0.2	0.02	0.002
0.02	0.6	0.6	0.6	0.7	0.7	0.7	0.4	0.3	0.04	0.004
0.03	0.8	0.8	0.9	1.0	1.1	1.0	0.5	0.5	0.06	0.006
0.04	1.1	1.1	1.1	1.4	1.4	1.3	0.7	0.6	0.08	0.008
0.05	1.3	1.3	1.4	1.7	1.7	1.6	0.9	0.7	0.1	0.01
0.06	1.6	1.6	1.7	2.0	2.1	1.9	1.0	0.9	0.1	0.01
0.07	1.8	1.8	1.9	2.3	2.4	2.2	1.2	1.0	0.1	0.01
0.08	2.1	2.1	2.2	2.6	2.8	2.6	1.4	1.2	0.2	0.02
0.09	2.4	2.3	2.5	3.0	3.1	2.9	1.6	1.3	0.2	0.02
0.1	2.6	2.6	2.8	3.3	3.5	3.2	1.7	1.5	0.2	0.02
0.11	2.9	2.9	3.1	3.6	3.8	3.6	1.9	1.6	0.2	0.02
0.12	3.1	3.1	3.4	4.0	4.1	3.9	2.1	1.8	0.2	0.02
0.13	3.4	3.4	3.7	4.3	4.5	4.2	2.3	1.9	0.3	0.03
0.14	3.7	3.7	4.0	4.7	4.9	4.6	2.4	2.1	0.3	0.03
0.15	4.0	4.0	4.3	5.0	5.2	4.9	2.6	2.2	0.3	0.03
0.16	4.2	4.3	4.5	5.3	5.6	5.2	2.8	2.4	0.3	0.03
0.17	4.5	4.5	4.9	5.7	6.0	5.5	3.0	2.5	0.3	0.03
0.18	4.8	4.8	5.2	6.0	6.4	5.9	3.1	2.7	0.4	0.04
0.19	5.0	5.1	5.4	6.4	6.6	6.2	3.3	2.8	0.4	0.04
0.20	5.3	5.4	5.8	6.7	7.0	6.6	3.5	3.0	0.4	0.04
0.22	5.9	5.9	6.3	7.5	7.8	7.3	3.9	3.3	0.4	0.04
0.24	6.5	6.5	7.0	8.2	8.5	8.0	4.2	3.6	0.5	0.05
0.26	7.0	7.1	7.6	8.9	9.3	8.7	4.6	3.9	0.5	0.05
0.28	7.6	7.7	8.2	9.6	10.0	9.4	4.9	4.2	0.5	0.06
0.30	8.2	8.3	8.9	10.4	10.9	10.1	5.3	4.5	0.6	0.06
0.35	9.7	9.8	10.5	12.3	12.8	11.9	6.2	5.3	0.7	0.07
0.40	11.3	11.4	12.2	14.3	14.9	13.9	7.2	6.1	0.8	0.08
0.45	13.0	13.1	13.9	16.3	17.0	15.9	8.1	6.9	0.9	0.09
0.50	14.7	14.8	15.8	18.5	19.3	17.9	9.1	7.7	1.0	0.10
0.55	16.5	16.6	17.7	20.7	21.6	20.0	10.1	8.6	1.1	0.11
0.60	18.4	18.6	19.7	23.0	24.1	22.3	11.1	9.4	1.2	0.12
0.65	20.5	20.6	21.9	25.5	26.7	24.7	12.1	10.3	1.3	0.13
0.70	22.7	22.8	24.2	28.2	29.4	27.2	13.2	11.1	1.4	0.14
0.75	25.0	25.2	26.8	31.0	32.5	29.9	14.3	12.0	1.5	0.15
0.80	27.7	27.9	29.5	34.2	35.8	32.8	15.4	12.9	1.6	0.16
0.85	30.7	30.9	32.6	37.7	39.6	36.0	16.5	13.8	1.7	0.17
0.90	34.2	34.4	36.3	41.9	44.0	39.7	17.6	14.8	1.8	0.18
0.95	38.9	39.1	41.1	47.3	49.9	44.1	18.8	15.7	1.9	0.19

$$V = {}^{1}/_{4}\, n \cdot s^2 \cdot h \cdot \cot\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S1}$$

$$s = 2 \cdot r \cdot \tan\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S2}$$

$$\frac{\partial V}{\partial t} = \frac{\partial V}{\partial s} \cdot \frac{\partial s}{\partial r} \cdot \frac{\partial r}{\partial t} + \frac{\partial V}{\partial h} \cdot \frac{\partial h}{\partial t} \qquad \text{Eq. S3}$$

$$\frac{\partial r}{\partial t} = -CR \qquad \text{Eq. S4}$$

$$\frac{\partial h}{\partial t} = -2CR \qquad \text{Eq. S5}$$

$$\frac{\partial V}{\partial s} = \frac{\partial}{\partial s}\left({}^{1}/_{4}\, n \cdot s^2 \cdot h \cdot \cot\left({}^{\pi}/_{n}\right)\right) = {}^{1}/_{2}\, n \cdot s \cdot h \cdot \cot\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S6}$$

$$\frac{\partial s}{\partial r} = \frac{\partial}{\partial r}\left(2 \cdot r \cdot \tan\left({}^{\pi}/_{n}\right)\right) = 2 \cdot \tan\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S7}$$

$$\frac{\partial V}{\partial h} = \frac{\partial}{\partial h}\left({}^{1}/_{4}\, n \cdot s^2 \cdot h \cdot \cot\left({}^{\pi}/_{n}\right)\right) = {}^{1}/_{4}\, n \cdot s^2 \cdot \cot\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S8}$$

$$\frac{\partial V}{\partial t} = {}^{1}/_{2}\, n \cdot s \cdot h \cdot \cot({}^{\pi}/_{n}) \cdot 2 \cdot \tan({}^{\pi}/_{n}) \cdot (-CR) + {}^{1}/_{4}\, n \cdot s^2 \cdot \cot\left({}^{\pi}/_{n}\right) \cdot (-2CR) \qquad \text{Eq. S9}$$

$$\frac{\partial V}{\partial t} = -CR \cdot n \cdot s \cdot h - {}^{1}/_{2} \cdot CR \cdot n \cdot s^2 \cdot \cot\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S10}$$

$$s(t) = s_0 - 2RC \cdot \tan\left({}^{\pi}/_{n}\right) \cdot t \qquad \text{Eq. S11}$$

$$h(t) = h_0 - 2RC \cdot t \qquad \text{Eq. S12}$$

$$\frac{\partial V}{\partial t} = -CR \cdot n \cdot (s_0 - 2RC \cdot t) \cdot (h_0 - 2RC \cdot t) - {}^{1}/_{2} \cdot CR \cdot n \cdot (s_0 - 2RC \cdot t)^2 \cdot \cot\left({}^{\pi}/_{n}\right) \qquad \text{Eq. S13}$$

$$\frac{\partial V}{\partial t} = (-6 \cdot CR^3 \cdot n \cdot \tan(\pi/n)) \cdot t^2 + (2 \cdot CR^2 \cdot n \cdot h_0 \cdot \tan(\pi/n) + 4 \cdot CR^2 \cdot n \cdot s_0) \cdot t - CR \cdot n \cdot h_0 \cdot s_0 - {}^1/_2 \cdot CR \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n) \qquad \text{Eq. S14}$$

$$\int_{V_{ini}}^{V_f} \partial V = \int_{t_{ini}=0}^{t} (-6 \cdot CR^3 \cdot n \cdot \tan(\pi/n)) \cdot t^2 + (2 \cdot CR^2 \cdot n \cdot h_0 \cdot \tan(\pi/n) + 4 \cdot CR^2 \cdot n \cdot s_0) \cdot t - CR \cdot n \cdot h_0 \cdot s_0 - {}^1/_2 \cdot CR \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n)\, \partial t \qquad \text{Eq. S15}$$

$$\int_{V_{ini}}^{V_f} \partial V = V_f - V_{ini} = \Delta V \qquad \text{Eq. S16}$$

$$\int_{t_{ini}=0}^{t} (-6 \cdot CR^3 \cdot n \cdot \tan(\pi/n)) \cdot t^2 + (2 \cdot CR^2 \cdot n \cdot h_0 \cdot \tan(\pi/n) + 4 \cdot CR^2 \cdot n \cdot s_0) \cdot t - CR \cdot n \cdot h_0 \cdot s_0 - {}^1/_2 \cdot CR \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n)\, \partial t = (-2 \cdot n \cdot \tan(\pi/n)) \cdot CR^3 \cdot t^3 + (n \cdot h_0 \cdot \tan(\pi/n) + 2 \cdot n \cdot s_0) \cdot CR^2 \cdot t^2 - (n \cdot h_0 \cdot s_0 + {}^1/_2 \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n)) \cdot CR \cdot t \qquad \text{Eq. S17}$$

$$\Delta \boldsymbol{V} = \frac{\Delta \boldsymbol{m}}{\boldsymbol{\rho}} = (-2 \cdot n \cdot \tan(\pi/n)) \cdot CR^3 \cdot t^3 + (n \cdot h_0 \cdot \tan(\pi/n) + 2 \cdot n \cdot s_0) \cdot CR^2 \cdot t^2 - (n \cdot h_0 \cdot s_0 + {}^1/_2 \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n)) \cdot CR \cdot t \qquad \text{Eq. S18}$$

$$(-2 \cdot n \cdot \tan(\pi/n)) \cdot CR^3 \cdot t^3 + (n \cdot h_0 \cdot \tan(\pi/n) + 2 \cdot n \cdot s_0) \cdot CR^2 \cdot t^2 - \left(n \cdot h_0 \cdot s_0 + {}^1/_2 \cdot n \cdot {s_0}^2 \cdot \cot(\pi/n)\right) \cdot CR \cdot t - \frac{\Delta \mathrm{m}}{\rho} = 0 \qquad \text{Eq. S19}$$