

Table 5.2 Corrosion Data for Zinc and Zinc Coatings with Inorganic Chemicals

Some references that occur frequently (and are mainly tabular summaries) are referred to in this table by letter code:

- A = Helwig and Bird (1973)
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Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	µm/year			
Acids							
All with pH <5		All			d	Including aqueous solutions	
Alkalies							
≤ pH 12.5		Room			b	See specific alkalies	
≤ pH 12.5		Heated			c	See specific alkalies	
> pH 12.5		All			c-d	See specific alkalies	
Aluminum chloride							
Molten					b	As soldering flux	Imperial Smelting Co. (1969)
26% solution	21	10	510,000	71,400	d		D, I, Tödt (1961)
Aluminum hydroxide					b		D
Aluminum nitrate					d	In polishing solutions	D
Ammonia							
Pure, dry, vapor	240	20	33	5	a	Chloride increases corrosion	Jones and Wilde (1977)
pH 12.5					b		

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			g/m ² /year	µm/year			
Ammonium acetate							
Solution					d		D, Kloetz (1965)
0.2% solution		60			d		
Ammonium acid fluoride							
5% NH ₄ F · HF	1	20	6,900	965	d	Corrosion products not removed	B
10% NH ₄ F · HF	1	20	13,900	1,950	d		
20% NH ₄ F · HF	14	20	15,330	2,150	d		
Ammonium bisulfate					d		D, Kloetz (1965)
Ammonium bromide					b	Inhibitor in acids	Miskidch'jan (1970)
Ammonium carbamate					b		
Ammonium carbonate					b		D, Roebeck (1972)
Ammonium chloride							
0.1 N	2	35			c		I
10%		20	694	97	b-c		B
Zn-1% Cd		20	1,390	195	c		B
Zn-1% Pb		20	621	87	b-c		B
Technical grade 10%		20	621-1,715	87-240	b-c		D

Ammonium dichloride					d		D
Ammonium dichromate					b	Dissolves phosphate films	Kaysser (1972)
Ammonium dihydrogen phosphate	bp				d		Roebeck (1972)
Ammonium fluoroborate					b	In solders	Alcoa (1968)
Ammonium fluoride							
5%			6,900	960	d		
20%	20		1,600	220	c		Köhler (1955)
Ammonium hydrogen phosphate							
5%		100	6,900	960	d		Köhler (1955), D
10%		100	6,600	920	c		Köhler (1955), D
20%		100	1,600	220	c		Köhler (1955), D
Ammonium hydrogen sulfite					d		D
Ammonium hydroxide							
Vapor	30						
Reagent	2	30	1,680	235	c		I
Reagent	2	30	2,750	385	c		I
3.5% solution (1 N)	2	30	2,120	295	c		A
3.5% solution (1 N), aerated	2	30	5,150	715	d		A
pH 7.3		20	980	135	c		Markovic et al. (1958)
pH 10.6,		20	2,630	365	c		Markovic et al. (1958)
Anodized					b		Benninghof (1970)
Cr in surface film							
zero	30	RT	226	31	b	Attack may increase	A
0.2 $\mu\text{g}/\text{dm}^2$	30	RT	15	2	a	when Cr is depleted	A
1.3 $\mu\text{g}/\text{dm}^2$	30	RT	4	0.6	a		A
2.2 $\mu\text{g}/\text{dm}^2$	30	RT	4	0.6	a		A
Ammonium molybdate	60-70				a		D
Ammonium nitrate	bp				b-d	Zn-coated steel used in explosives industry	D, Huber (1968)
Ammonium sulfamate							
7-40% solution		RT	1,500	210	b		
Ammonium sulfate			1,780	250	c		Marshall and Neubauer (1955)
10% + free NH_3			2,225	310	c		I

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Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	µm/year			
Ammonium thiocyanate					b	Anodic dissolution of Ni/Cr from zinc	Dillenberg (1968)
Antimony chloride 90%		20			b		C
Antimony oxide						Used to strip zinc from steel	BS 729 (1971)
Antimony trichloride							
Araldite					b		Draugelates et al. (1966)
Argon					a		D
Arsenic pentoxide							
Moist					d		D
Pure					a		D
Arsenious acid							
0.2% in 2% H ₂ SO ₄						For stripping zinc from steel	DIN 51 213
Barium chloride pH 7.1-7.3		106	4,850	675	c		D

Saturated solution		80				d		C
Molten						c		Kokorin (1969)
Barium hydroxide Solution						c-d	Similar to NaOH	B, D, F, Rodionova (1957, 1960)
Barium nitrate Solution			415	58		b	Aftertreatment of chromate films	Underwood et al. (1971)
Barium sulfate Solution						b		D
Beeswax						c		D
Borates								
5-15%						b	Used in prefluxes	Thiem Corp. (1971)
Borax						b	Used in prefluxes	Thiem Corp. (1971)
Bromides						c	Less corrosive than Cl ⁻	
Bromine								
Pure dry		100				b		D, E
Moist						d	Hygroscopic	D
Cadmium chloride Solution						d		D
Cadmium nitrate Solution						b		Czakow (1967)
Cadmium sulfate Solution						d		D
Calcium chlorate 1.57%	10	20	511	71		b		I, Hercules (1966)
Calcium chloride 1.1%	2	35	1,180	164		c	Partial immersion	I
20%: sheet	30	-5	438	61		b	Based on immersed area	I
20%: galvanized	30	-5	>562	>78		b	Based on immersed area	I
20%: sheet	10	33	126	18		a		I
20%: galvanized	10	33	82	11		a		I
20%: with silicate: sheet	10	35	92	13		a		I
20% + 0.05% Ca(OH) ₂	10	35	95	13		a		I
20% + 0.17% Na ₂ Cr ₂ O ₇	10	80	80	11		a		I
Saturated solution		60				d		C

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Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	μm/year			
Calcium hydroxide		RT			b	Transport in galvanized containers	D
Pure, dry		80			d		D
saturated solution			365	50	b	Maximum	D, E, Tödt (1961)
20% solution							
Calcium sulfate		80			d		C
Saturated solution					b	Chromating protects	B, D
Moist, 23% H ₂ O							
Cesium acetate					b		D
Pure, neutral							
Cesium hydroxide					d		D, Gmelin (1956)
Solution					a	Porous anode in amalgamating zinc	Mallory (1968)
Chlorates		20	475	66	b		B
1.57%							

Chloric acid 20%	40				d	Explosive reaction	E
Chlorine Pure, dry					a		B, D, F
Chlorine water 100%	80				d		C
Chromates Solution					a		G (many)
Chromium chloride	20				d		D, King and Mayer (1953)
Chromium oxide Dry solution					b		D
Chromium sulfate Solution					d		D
Copper chloride Solution					d		D
Copper ions					d	Accelerates attack	
Fluorides					b	In fluxes, wood preservatives, surface treatment solutions	G (many)
Fluorine Pure, dry	20				a		E
Fruit juices					d	Acidity/product contamination	Grillo (1973)
Halogens Dry					b		Grigorev (1967)
Moist					d		
Hydrochloric acid Still	2	30	273,750	38,000	d		J
Aerated	2	30	237,250	32,950	d		J
Gas					d		Barton (1968)
Hydrogen peroxide 30%	20				b		Gmelin (1956), B
Hydrogen sulfide Gas						ZnS protective layer	D, E
Hyperchlorites Solution					a-d	Depends on purity	Metal Progress (1973)

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Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	µm/year			
Iodides							
Solution						With sulfate	Radovici and Kovacs (1968)
Iodine							
Molten, dry					b		D
Moist					d		D
Gas							Ginzburg (1969/71)
Iron chloride							
10% solution		60			d		B, D
60% solution		80			d		C
					b	For dissolving metal coatings from cast zinc	Rüegg (1970), C
Iron sulfate							
100% solution		80			d		B, D
Lead nitrate							
Moist		100			d	Forms NO ₂ and O ₂	D, Huber (1968)
100% solution		80			d		C

Lead arsenate										
3.8 g/L			90		12	b				N
Lead sulfate						d				D
Lead sulfite						b	Reduces electrode gassing			ESB (1968)
Lithium chloride										
Gas		RT				b	Air conditioning equipment			I
30% solution vapor	40	115	18,250		2,535	d	Solution is worse			I
30% solution	40					d	Very heavy attack			I
40% solution						d				D
40% solution						b	With 1% Na ₂ CrO ₄ Fe/Zn alloys OK			D
In alcohol + 0.01% HCl						b				Heitz et al. (1970)
Molten						b				
Lithium hydroxide										
0.1–1 N solution						d				Rodionova (1957)
Lithium silicate						a	Paint binder			Du Pont (1965), Kohnen (1968)
Lithopone										
Pure, dry						a	Drying equipment made in galvanized steel			D
Moist						b				D
Magnesium carbonate						b				D
Magnesium chloride										
42.5% solution	30	–5	320–560		45–78	c	Pitting			I
1.2% solution	14	20	767		110	b				B; also Schikorr (1960)
Magnesium fluoride						a				D
Magnesium hydroxide										
Saturated solution		20	730		100	b	Stored in galvanized steel			D
Magnesium oxide										
Dry, pure						b	Stored in galvanized steel			D
Magnesium oxychloride						d				D
Magnesium sulfate										
0.004%		95	730		100	b				D
2%		20	77		11	b				Steinrath (1960)
10%		40				d				C

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			g/m ² /year	μm/year			
Manganese dioxide Dry, pure					a		D
Manganese phosphate Solution					a	Phosphating solution	Dettner and Elze (1964-1969), Neuhaus and Gebhardt (1966)
Mercury 100%		60			d	Forms amalgams	D
Mercury salts Electrolyte					b		Sony (1966), Mallory (1967)
Milk of Magnesia					b	Stored in glass	G (many)
Molybdenum chloride Wet		"High"			b	Equipment uses, Mn/Zn alloy	Heumann and Venker (1968)
Molybdate ions					b	Protective layer forms	
Nickel acetate					d		D

Nickel ammonium sulfate		d		D
Nickel chloride		d		D
Nickel ions				
In solution with $\text{NH}_4\text{Cl} \cdot \text{ZnCl}_2$			Accelerates corrosion	Era et al. (1967)
Nickel sulfate				
Electroless plating		b	With additives	Gavranek and Levchenko (1967)
Niobium chloride				
Vapor	“High”	b		Heumann and Venker (1968)
Nitrates				
Pure, dry		b		G (many)
Solution		d		B, D
Nitric acid		d		Halliday and Horton (1967),
		b	For brightening, etching	Petrov (1968)
Nitrites				
Pure, dry		b		Bukowiecki (1968)
Moist		d		Bukowiecki (1968)
Nitrogen				
Pure, dry	20	a		B, D, G
Nitrogen oxides				
Pure, dry		b		E
	300	c	More than in oxygen	E
Oxygen				
Pure, dry		a		
Moist		c		
	300-400		May form protective layer; parabolic time law	Lucas (1971)
Ozone				
Pure, dry	20		Similar to oxygen	D, E
Perborates				
Solution		d		D

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Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	µm/year			
Perchlorate Solution						Mechanism studies	Schwabe (1957), Gaspar and Soriano (1971)
Perchloric acid Solution					b	In polishing solutions	Dettner and Elze (1964–1969)
Permanganate Solution					b	In dye solutions	<i>ILZRO Digest</i> (1970)
Peroxide Pure, dry					b		Gmelin (1956)
Moist					d		Gmelin (1956)
Persulfate Solution					d		B
Phosphates						Wood preservatives, polishes, laundry powders, surface coatings	G (many)

Phosphor (red)					b				
Pure, dry					b				
Moist					d				
Phosphor (white)									
Molten									
Phosphor chloride							D		
Pure, dry		20			b		D		
Trace water		20			d				
Phosphoric acid									
0.3-3% solution					a	With 0.5-3% chromic or 0.1-0.4% sodium nitrite	D		
					b	Electroplating, lithography	G (many)		
Phosphorus pentoxide									
Pure, dry					b		D		
Moist					d		D		
Potassium acid fluoride									
5-20% KF-HF	28	20	540-810	75-110	c	Corrosion product left	Köhler (1955), Dirkse and Hampson (1972)		
5-20% KF-HF	1	80			d				
Potassium bicarbonate					b	With 0.1 M KCl	Krochmal and Puacz (1965)		
Potassium carbonate									
10% solution		80			d		C		
>50% solution		20			d		D		
Potassium chloride									
0.07%	30	25	1,300	180	d	} Partial immersion: 2-30 days test without aeration or agitation: 35°C tests on galvanized sheet; rest on zinc sheet; approximately linear with time	Borgmann and Evans (1934) except 35°C tests Borgmann (1937)		
0.75% (1 N)	4	25	2,565	355	d				
0.75%	2	35	3,525	490	d				
1.86%	2	35	4,235	590	d				
3.64%	30	25	3,700	520	d				
7.13%	4	25	3,880	540	d				
13.7%	30	25	4,170	580	d				
19.8%	4	25	5,275	730	d				
5-30%	65	12	664-430	92-61	c			Immersion 65 days	H
10%		40			d				C

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			g/m ² /year	µm/year			
Potassium chlorate							
Neutral solution					b	Protective layer forms	D
10% solution		80			d		C
With 0.1 M KCl						Activates chloride	Krochmal and Puacz (1965)
Potassium dichromate							
14.7% (1 N)	2	30	27	4	a	15 g/m ² /year with aeration	J
1 N		20	73	10	a		D
20%		45			b	With 5–6 cm ³ /L H ₂ SO ₄	D
Potassium disulfate							
0.5 mol Solution					b	With 1 mol NaCl	Bianchi (1958)
					b	With 1 mol KCl	Kronshorst (1972)
Potassium fluoride							
5–20%	28	20	157–gain	22–gain	a	Corrosion product left	Köhler (1955), Dirske and Hampson (1972)
5–20%	1	80	gain	gain	a		

Potassium hydroxide Solution		20			d	Gmelin (1956), B, C, Huber (1968), Vorkapit et al. (1974)
Potassium hypochlorite Neutral solution		20	2-55	0.3-8	b	B, D
Potassium nitrate 5-10% solution	189	20	44-110	6-15	b	H
Unaerated			310-415	43-58	c	D, G
Aerated			415-625	58-87	c	D, G
Potassium peroxide					d	D
Potassium persulfate 10%		40			d	C, D
Potassium phosphate					c	D
Potassium silicate					b	Depends on alkalinity D
Potassium sulfate 0.5-10%	57	12	400-182	55-25	b	B, D, H
100%		80			d	C
Potassium sulfate pH <12					b	D
Potassium sulfite Solution					d	D
Potassium zincate					b	Plating electrolyte
Selenium chloride Pure, dry		20			b	Gmelin (1956)
Silver bromide Pure, dry					b	Becomes black
Silver chloride Pure, dry		20			b	
Moist, wet					d	Gmelin (1956)
Silver nitrate Solution					d	Summerville (1970)
Silicates					b	G

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			g/m ² /year	µm/year			
Silica Solution					b	With 0.01 N KOH	Lovreček and Petric (1971), Petric (1972)
Sodium acetate					b		Konnik (1969)
Sodium aluminate					d		D
Sodium aluminum fluoride					d		D
Sodium aluminum sulfate					d		D
Sodium arsenate 10% solution (pH 10)		20	1,970	275	d		D
Sodium arsenite 60 g/L			1,970	275	c		D
Sodium benzoate 2% solution		20			b	Steel anodic to zinc	D
Sodium bicarbonate Saturated solution		80			d		C
5%		20			c		B

Sodium bifluoride					d		D
Sodium bisulfate					d		D
Sodium bisulfite		42,000	5,830		d		B
Sodium borate							
Solution					a		D
Solution with NaOH					b	pH 9–12.3; zinc passivates	Davies and Lotlikar (1966)
Sodium bromate							
1% solution	10	45	12,630	1,750	d		B
2% solution	10	45	5,000	700	d		B
3% solution	10	45	15,695	2,180	d		B
Sodium bromide							
Vapor	365	24	650	90	c	30–45% RH	I
100%		80			d		A, C
Sodium carbonate							
0.5%	5 h	66	1,400	195	c		I
Saturated solution		80			d		C
3.7–7%		RT	36–255	5–35	b	In degreasers, dyes	E
Sodium chloracetate							
Pure, neutral					d		D
Sodium chlorate							
1.57%	10	RT	475	66	b		B, D
10%		40			b		C
100%		80			b		C
Sodium chloride							
0.5–3%	64	12	660–372	92–52	c	Depends on aeration	H
0.5% solution		20	657	91	c		D
1.5% solution		20	511	71	c		D
6.0% solution		20	256	35	b		D
Saturated solution		20	110	15	b		D
pH 8.5	90	–8	4,625	650	d	Halved if only sprayed	I
3.5%		30	694–1,643	97–230	c	5 m/min speed: pits	I
5.6% (1 N)	31	35	339	47	c	300 m/min speed pH 7.85	Union Carbide (direct data)
5.6%	30	35	1,350	148	c	300 m/min speed pH 8	I
5.6%	2	30	910–2,390	25–390	c	Highest with aeration	J

Table 5.2 Continued

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A	=	Helwig and Bird (1973)
B	=	Ritter (1958)
C	=	Ried (1964)
D	=	Dechema (1953)
E	=	Bauer and Schikorr (1934)
F	=	Zinkberatung (1959)
G	=	Wiederholt (1976)
H	=	Friend and Tidmus (1924)
I	=	International Nickel Co. (direct data)
J	=	Fuller (1927)
N	=	New Jersey Zinc Co. (direct data)
R	=	Clarke and Longhurst (1961)

Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	μm/year			
Molten					d		Imperial Smelting Co. (1969), Ishutin (1971)
3% solution	2-14		3,470-5,140	485-720	d		B
0.58%	2	35	3,336	470	d		I
1.45% 0.25 N	2	35	4,245	595	d		I
2.9% 0.5 N	8.5	25	2,376	330	c		I
20% immersed	24	RT	59	8	b		I
20% spray	21	35	2,628	370	c	Zinc sheet: the erratic results are not explained	I
	63	35	1,168	164	c		I
	119	35	2,957	415	c		I
	21	35	2,701	380	c	Galvanized steel: it would appear that corrosion	I
	63	35	730	102	c	products slow reaction with time; pitting up to 500 μm in 119 days	I
	119	35	803	112	c		I

24% immersed	30	-5	73-318	10-45	b	Pitting	I
60-400 g/L	64	12	274-91	38-13	b		H
3% solution + 10 g/L NaSO ₄ · 10 H ₂ O	2-14		4745-8213	660-1,140	a		B
3% solution + 12 g/L MgCl ₂ · 6H ₂ O	2-14		110-183	15-25	b		B
Sodium chlorite							
Saturated solution		80			b	Transported in galvanized containers pH 4 Black coating with ac	C, D
0.5% solution		80	17,155	2,383	d		Petrow et al. (1970)
0.5-1%		70			b		
Sodium chromate							
Saturated solution		80			d		C
4%		20			b		D
Sodium dichromate Solution					c	Attack increases with temperature	D
Sodium fluoride Solution						Increases attack	D
Sodium hydride In NaOH melt					d		D
Sodium hydroxide							
0.5% solution	5	21	172-438	24-61	c		I
0.5% solution	5 h	66	3,250-7,450	450-1,035	d		I
3.9% solution	2	30	3,200-6,400	445-890	d		J
50% solution	1	30	156,000- 217,000	21,670- 30,140	d	Galvanized iron only 13,834 g/m ² in the 1-day test	J
			2,790	390	d		G
Solution pH 7.3			2,520	350	d		G
Solution pH 10.6 Molten					d		Zarubitsky and Salabai (1969)
Sodium hypochlorite Solution			766	106	c	0.24 g/L active chlorine: increases with pH and time	D
10%		20			d		C
Sodium iodide					d		D
Sodium nitrate							
1%		20	310	43	b	Un-aerated: attack increases with aeration and temperature	D

Table 5.2 Continued

Some references that occur frequently (and are mainly tabular summaries) are referred to in this table by letter code:

A	=	Helwig and Bird (1973)
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C	=	Ried (1964)
D	=	Dechema (1953)
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F	=	Zinkberatung (1959)
G	=	Wiederholt (1976)
H	=	Friend and Tidmus (1924)
I	=	International Nickel Co. (direct data)
J	=	Fuller (1927)
N	=	New Jersey Zinc Co. (direct data)
R	=	Clarke and Longhurst (1961)

Corrosive media	Time (days)	Temperature (°C)	Corrosion rates		General suitability ^{a-c}	Remarks	Ref.
			g/m ² /year	µm/year			
Sodium nitrite					b		D
Sodium oxide							
Pure, dry					b	Galvanized containers	D
Moist					d		D
Sodium perborate							
0.064%		20	285	40	b	pH 9.75	D
Sodium perchlorate							
pH 3.4-7					c		Gusev and Rakcheev (1968), Tanaka et al. (1969)
Sodium peroxide							
Dry, solid		20			b	Galvanized containers	D
Sodium silicate, SiO ₂ /Na ₂ O							
1:1, 1%		20	150	20	b		D
2:1, 1%		60	150	20	b		D
2:1, 5%		60	1,200	170	c		D

2:1, 10%		60	3,300	460	c		D
2.4:1, 1%		60	400	55	b		D
2.4:1, 5%		60	550	75	b		D
2.4:1, 10%		60	1,460	200	c		D
Sodium silicofluoride					d		D
Sodium stannate					d		D
Sodium sulfate							
5–300 g/L	60	12	475–473	65–10	b	60-day test	H
10 g/L	14		584	80	b	14-day test	B
Sodium sulfide		bp	2,860	400	c	Galvanized apparatus for concentrating	D
Sodium sulfite					d		D
Sodium thiosulfate							
Saturated solution		150	13,320	1850	d	pH 7.8	G
Sulfides							
Pure, dry		20				Discolored surface	Gmelin (1956)
Sulfur dioxide							
Liquid	14	20	1,095	152	c	+ 1% H ₂ O + 0.21% O ₂	D, Bollinger (1952)
0.6% vapor	7	40	672	93		89% RH	Sanyal and Bhadwar (1959)
Zinc chloride					d		G
Molten		500–700			d		Kerridge and Tariq (1967)
Zinc chromate					b		Parker Co. (1967)
Zinc sulfate					b		G
Zinc sulfides					b	In 5 N NaOH	Merkulov and Flerov (1968–1969)
Zirconium oxide		800				Zn with 10% Mg reduces ZrO to Zr	Garg (1970)

*Most dry materials have no significant corrosion reaction with zinc: those that do are specifically mentioned. This general classification usually covers either chemical solution or moist materials. Where specific corrosion rates are not given, there is a general classification.

^bRatings: d = definitely not suitable (>3000 μm/year); c = corrosive (100–3000 μm/year); b = borderline for zinc; bad for coatings (10–100 μm/year); a = acceptable usually (<10 μm/year).

^cIt should be noted that these ratings are not always aligned with results of short-term tests; often the zinc corrosion products formed initially slow down corrosion subsequently.

Table 5.3 Corrosion Data for Zinc and Zinc Coatings with Agricultural Chemicals (Inorganic and organic) and Pesticides

Letter code for references cited in this table:

D	=	Dechema (1953)
I	=	International Nickel Co. (direct data)
N	=	New Jersey Zinc (direct data)
O	=	Cook and Dickinson (1950)
S	=	Marshall and Neubauer (1955)
T	=	Consolidated Mining and Smelting Co. of Canada Ltd. (direct data)

Materials	Time (days, except as otherwise indicated)	Temperature (°C)	Corrosion rates		Remarks	Ref.
			g/m ² /year	μm/year		
Agricultural Chemicals						
Ammonium sulfamate	98	15–40	548	76		I
Blue Amate Brush Killer	112	15–40	172	25		I
Esteron Brush Killer (2-4D + 2,4,5-T) L/100 L water	119	15–32	675	95		I
Ammonium sulfate	121		Zinc stripped	7250		S
						S
						S
						S
						S
Nitrolime	121		Zinc stripped	300	Alternate humidity, weekly cycle forced air circulation 24 h, 100% RH (1), 24 h dry air (2); repeat (1) and (2) then 8 h 100% RH, 64 h dry air	S
300 g/L CuSO ₄ · 5H ₂ O	121		Zinc partly stripped	75		S
280 g/L CoSO ₄ · 5H ₂ O	121		Pits			S
Potassium chloride (com)	121		Zinc partly stripped	95		S
Superphosphate	121					
Supercompound	121					
Supercompound + small amount of copper sulfate	121		Pits			S
Supercompound + small amount of cobalt sulfate	121					S

Agricultural lime	121
Burnt lime	121
Basic slag	121
Bone meal	121
Phosphorized Pollard	121

Damp granular fertilizers

Type	Components	Water (%)
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11-48-0	NH ₄ H ₂ PO ₄ · (NH ₄) ₂ HPO ₄	5.41	33	60	2,920	400	Fresh water once a week; SHG	T
11-48-0	NH ₄ H ₂ PO ₄ · (NH ₄) ₂ HPO ₄	5.41	33	60	1,675	240	AG-40A	T
12-12-12	11-48-0 (NH ₄) ₂ SO ₄ · KCl	6.18	33	60	36,680	5,140	SHG	T
12-12-12	11-48-0 (NH ₄) ₂ SO ₄ · KCl	6.18	33	60	53,290	7,460	AG-40A	T
13-16-10	11-48-0 (NH ₄) ₂ SO ₄ · KCl	6.68	33	60	1,825	255	SHG	T
13-16-10	11-48-0 (NH ₄) ₂ SO ₄ · KCl	6.68	33	60	2,010	280	AG-40A	T
16-20-0	11-48-0 (NH ₄) ₂ SO ₄	4.10	33	60	1,280	180	SHG	T
16-20-0	11-48-0 (NH ₄) ₂ SO ₄	4.10	33	60	5,695	800	AG-40A	T
35.5-0-0	NH ₄ NO ₃	3.54	33	60	83,585	11,700	SHG	T
35.5-0-0	NH ₄ NO ₃	3.54	33	60	28,760	4,030	AG-40A	T
21-0-0	(NH ₄) ₂ SO ₄	2.50	33	60	800	112	SHG	T
21-0-0	(NH ₄) ₂ SO ₄	2.50	33	60	250	35	AG-40A	T
(a) 11-48-0		5.4	11	RT	1,370	190	SHG	T
(a) 11-48-0		5.4	11	RT	720	100	AG-40A	T
(a) 11-48-0		5.4	11	60	1,405	200	SHG	T
(a) 11-48-0		5.4	11	60	518	73	AG-40A	T
(b) 16-20-0		4.1	11	RT	600	84	SHG	T
(b) 16-20-0		4.1	11	RT	518	73	AG-40A	T
(b) 16-20-0		4.1	11	60	3,047	425	SHG	T
(b) 16-20-0		4.1	11	60	2,830	400	AG-40A	T
(c) 33.5-0-0		3.5	11	RT	9,125	1,280	SHG	T
(b) 33.5-0-0		3.5	11	RT	2,400	335	AG-40A	T
(b) 33.5-0-0		3.5	11	60	21,720	3,040	SHG	T
(b) 33.5-0-0		3.5	11	60	6,130	860	AG-40A	T
Damp granular fertilizers								
(d) 21-0-0		2.5	11	RT	1,350	190	SHG	T

Zinc not penetrated

Alternate humidity, weekly cycle forced air circulation 24 h, 100% RH (1), 24 h dry air (2); repeat (1) and (2) then 8 h 100% RH, 64 h dry air

Four changes of moist fertilizers in all tests

Table 5.3 Continued

Letter code for references cited in this table:

D	=	Dechema (1953)
I	=	International Nickel Co. (direct data)
N	=	New Jersey Zinc (direct data)
O	=	Cook and Dickinson (1950)
S	=	Marshall and Neubauer (1955)
T	=	Consolidated Mining and Smelting Co. of Canada Ltd. (direct data)

Materials	Time (days, except as otherwise indicated)	Temperature (°C)	Corrosion rates		Remarks	Ref.	
			mg/m ² /year	µm/year			
(d) 21-0-0	2.5	11	RT	720	100	AG-40A	T
(d) 21-0-0	2.5	11	60	3,085	430	SHG	T
(d) 21-0-0	2.5	11	60	1,725	240	AG-40A	T
(e) 27-14-0 (a), (b)	4.5	11	RT	3,360	470	SHG	T
(e) 27-14-0 (a), (b)	4.5	11	RT	1,090	152	AG-40A	T
(e) 27-14-0 (a), (b)	4.5	11	60	12,590	1,760	SHG	T
(e) 27-14-0 (a), (b)	4.5	11	60	2,210	310	AG-40A	T
(f) 8-32-16 (a), (d), KCl	5.0	11	RT	3,360	470	SHG	T
(f) 8-32-16 (a), (d), KCl	5.0	11	RT	1,185	166	AG-40A	T
(f) 8-32-16 (a), (d), KCl	5.0	11	60	4,745	665	SHG	T
(f) 8-32-16 (a), (d), KCl	5.0	11	60	3,650	510	AG-40A	T
(g) 6-24-24 (a), (d), KCl	5.2	11	RT	3,395	475	SHG	T
(g) 6-24-24	5.2	11	RT	1,640	230	AG-40A	T
(g) 6-24-24 (a), (d), KCl	5.2	11	60	4,930	690	SHG	T
(g) 6-24-24 (a), (d), KCl	5.2	11	60	2,460	345	AG 40A	T
Liquid fertilizers							
Type: 27-14-0, 25% solution	21		RT	1,240	174		T
Type: 27-14-0, 25% solution	14		RT	4,180	585	Oxygen added daily	T
Type: 27-14-0, 25% solution	21		60	1,625	227		T
Type: 27-14-0, 25% solution	14		60	3,830	540	Oxygen added daily	T
Type: 27-14-0, 25% solution	21		RT	237	33		T

Four changes of
moist fertilizers
in all tests

Type: 27-14-0, 25% solution	14	RT	1,223	171	Oxygen added daily	T
Type: 27-14-0, 25% solution	21	60	310	43		T
Type: 27-14-0, 25% solution	14	60	1,645	230	Oxygen added daily	T
Type: 6-16-7 liquid fertilizer	16	RT	858	120		T
Type: 6-16-7 liquid fertilizer	8	60	2,755	385		T
Type: 6-16-7 liquid fertilizer	16	RT	1,480	207		T
Type: 6-16-7 liquid fertilizer	8	60	310	43		T
Type: 6-16-7 liquid fertilizer	14	RT	675	95		T
EB-32 fertilizer solution, contains S + 0.1% Na ₂ Cr ₂ O ₇		60	1,697,250	237,700		T
8-24-0 fertilizer solution	5h	RT	18,800	2,630		T
8-24-0 fertilizer solution	10h	RT	14,600	2,050		T
8-24-0 fertilizer solution	100h	RT	8,760	1,230		T
Herbicides						
7% zinc sulfamate	28	RT	237	33	Commercial zinc	T
7% zinc sulfamate	28	RT	237	33	Galvanized steel	T
40% zinc sulfamate	28	RT	110	15	Commercial zinc	T
40% zinc sulfamate	28	RT	237	33	Galvanized steel	T
7% ammonium sulfamate	28	RT	1,280	180	Commercial zinc	T
7% ammonium sulfamate	28	RT	2,375	330	Galvanized steel	T
40% ammonium sulfamate	28	RT	1,640	230	Commercial zinc	T
40% ammonium sulfamate	28	RT	2,740	380	Galvanized steel	T
7% guanidine sulfamate	28	RT	1,020	143	Commercial zinc	T
7% guanidine sulfamate	28	RT	875	123	Galvanized steel	T
40% guanidine sulfamate	28	RT	164	23	Commercial zinc	T
40% guanidine sulfamate	28	RT	164	23	Galvanized steel	T
7% Du Pont Ammate	28	RT	402	56	Commercial zinc	T
7% Du Pont Ammate	28	RT	1,515	210	Galvanized steel	T
40% Du Pont Ammate	28	RT	128	18	Commercial zinc	T
40% Du Pont Ammate	28	RT	2,245	315	Galvanized steel	T

Table 5.3 Continued

Letter code for references cited in this table:

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I	=	International Nickel Co. (direct data)
N	=	New Jersey Zinc (direct data)
O	=	Cook and Dickinson (1950)
S	=	Marshall and Neubauer (1955)
T	=	Consolidated Mining and Smelting Co. of Canada Ltd. (direct data)

Materials	Time (days, except as otherwise indicated)		Temperature (°C)	Corrosion rates		Remarks	Ref.
				g/m ² /year	µm/year		
Pesticides/fungicides							
Bordeaux mixture: 10 g/L copper sulfate + 10 g/L quicklime ^a	20		RT	5	<0.1		N
Calcium arsenate ^a	20		RT	Gained weight			N
Chlordane-water emulsion	56	weeks	25	2,628	368		O
Copper sulfate - 10 g/L ^a	20		RT	7,850	(1,100)		N
DDT, 5% in distilled water	56	weeks	25	840	117		O
DDT, 5% solution in saltwater			25	1500	210		D
DDT, 10% solution in kerosene			25	5	0.7	*Solutions prepared from commercial products, changed after 3 and 6 days, weight changes as removed from test	D
DDT emulsion, 95% water and 5% mixture of 25% DDT, 65% dry lime sulfur - 36 g/L ^a	20		RT	166	(23)		N
White hellebore - 2.5 g/L ^a	20		RT	Gained weight			N
Formalin ^a	20		RT	Gained weight			N
Lead arsenate: 4 g/L ^a	20		RT	88	(12)		N
Paris green ^a	20		RT	Gained weight			N
Pyrethrum ^a	20		RT	Gained weight			N
Xylol 5% Triton X 100			25	985	140		D
Urea							
20% solution	1	month	30		Trace	Solutions changed weekly	T
Saturated urea solution	1	month	30	37	5	Solutions changed weekly	T
Moist urea salts, 3% water	1	month	30	369	52	Slight pitting, kept moist daily	T