

Behaalde innovatie successen

ENCONSOL / VEOLIA



13-04-2023



Gerard Fuite



Mark Gerritsjans



Introductie

Enconsol / Veolia

- Gerard Fuite - ENCONSOL

gfuite@enconsol.nl - +31 (0)6 17749821



- Mark Gerritsjans - Business Development Manager VEOLIA

mark.gerritsjans@veolia.com - +31 (0)6 48507863



- Scaling



- Biofouling



- Corrosie



Uitdaging Corrosie



The gradual destruction of materials by chemical and/or electrochemical reaction with their environment

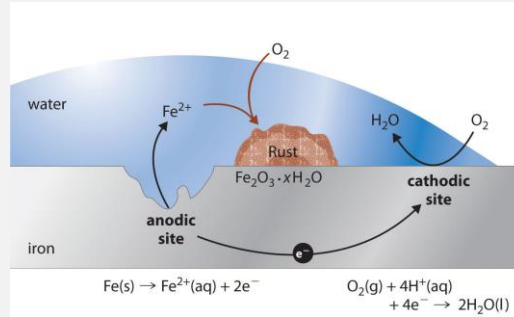


TABLE 11.1 Standard Reduction Potentials at 25°C (298 K) for Many Common Half-Reactions

Half-reaction	E° (V)	Half-reaction	E° (V)
$\text{F}_2 + 2\text{e}^{-} \rightarrow 2\text{F}^{-}$	2.87	$\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^{-} \rightarrow 4\text{OH}^{-}$	0.40
$\text{Ag}^{+} + \text{e}^{-} \rightarrow \text{Ag}$	1.99	$\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$	0.34
$\text{Ce}^{4+} + \text{e}^{-} \rightarrow \text{Ce}^{3+}$	1.82	$\text{Hg}_2\text{Cl}_2 + 2\text{e}^{-} \rightarrow 2\text{Hg} + 2\text{Cl}^{-}$	0.27
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightarrow 2\text{H}_2\text{O}$	1.78	$\text{AgCl} + \text{e}^{-} \rightarrow \text{Ag} + \text{Cl}^{-}$	0.22
$\text{Cl}_2 + \text{e}^{-} \rightarrow \text{Cl}^{-}$	1.70	$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$	0.20
$\text{PbO}_2 + 4\text{H}^{+} + \text{SO}_4^{2-} + 2\text{e}^{-} \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O}$	1.69	$\text{Ca}^{2+} + 2\text{e}^{-} \rightarrow \text{Ca}$	0.16
$\text{MnO}_4^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightarrow \text{MnO}_2 + 2\text{H}_2\text{O}$	1.68	$2\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{H}_2$	0.00
$\text{IO}_3^{-} + 2\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{IO}_2 + \text{H}_2\text{O}$	1.60	$\text{Fe}^{3+} + \text{e}^{-} \rightarrow \text{Fe}^{2+}$	-0.036
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O}$	1.51	$\text{Pb}^{2+} + 2\text{e}^{-} \rightarrow \text{Pb}$	-0.13
$\text{Au}^{3+} + 3\text{e}^{-} \rightarrow \text{Au}$	1.50	$\text{Sn}^{2+} + 2\text{e}^{-} \rightarrow \text{Sn}$	-0.14
$\text{PbO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{Pb}^{2+} + 2\text{H}_2\text{O}$	1.46	$\text{Ni}^{2+} + 2\text{e}^{-} \rightarrow \text{Ni}$	-0.23
$\text{Cl}_2 + 2\text{e}^{-} \rightarrow 2\text{Cl}^{-}$	1.36	$\text{PbSO}_4 + 2\text{e}^{-} \rightarrow \text{Pb} + \text{SO}_4^{2-}$	-0.35
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	1.33	$\text{Cd}^{2+} + 2\text{e}^{-} \rightarrow \text{Cd}$	-0.40
$\text{O}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightarrow 2\text{H}_2\text{O}$	1.23	$\text{Fe}^{3+} + \text{e}^{-} \rightarrow \text{Fe}^{2+}$	-0.44
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$	1.21	$\text{Cr}^{3+} + \text{e}^{-} \rightarrow \text{Cr}^{2+}$	-0.50
$\text{IO}_3^{-} + 6\text{H}^{+} + 5\text{e}^{-} \rightarrow \frac{1}{2}\text{I}_2 + 3\text{H}_2\text{O}$	1.20	$\text{Cr}^{2+} + \text{e}^{-} \rightarrow \text{Cr}$	-0.73
$\text{Br}_2 + 2\text{e}^{-} \rightarrow 2\text{Br}^{-}$	1.09	$\text{Zn}^{2+} + 2\text{e}^{-} \rightarrow \text{Zn}$	-0.76
$\text{VO}_2^{+} + 2\text{H}^{+} + \text{e}^{-} \rightarrow \text{VO}^{2+} + \text{H}_2\text{O}$	1.00	$2\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{H}_2$	-0.83
$\text{AuCl}_4^{-} + 3\text{e}^{-} \rightarrow \text{Au} + 4\text{Cl}^{-}$	0.99	$\text{Mn}^{3+} + 2\text{e}^{-} \rightarrow \text{Mn}^{2+}$	-1.18
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightarrow \text{NO} + 2\text{H}_2\text{O}$	0.96	$\text{Al}^{3+} + 3\text{e}^{-} \rightarrow \text{Al}$	-1.66
$\text{ClO}_2 + \text{e}^{-} \rightarrow \text{ClO}_2^{-}$	0.94	$\text{H}_2 + 2\text{e}^{-} \rightarrow 2\text{H}^{-}$	-2.23
$2\text{Hg}^{2+} + 2\text{e}^{-} \rightarrow 2\text{Hg}$	0.91	$\text{Mg}^{2+} + 2\text{e}^{-} \rightarrow \text{Mg}$	-2.37
$\text{Ag}^{+} + \text{e}^{-} \rightarrow \text{Ag}$	0.80	$\text{Li}^{+} + \text{e}^{-} \rightarrow \text{Li}$	-2.37
$\text{Hg}_2^{2+} + 2\text{e}^{-} \rightarrow 2\text{Hg}$	0.80	$\text{Na}^{+} + \text{e}^{-} \rightarrow \text{Na}$	-2.71
$\text{Fe}^{3+} + \text{e}^{-} \rightarrow \text{Fe}^{2+}$	0.77	$\text{Ca}^{2+} + 2\text{e}^{-} \rightarrow \text{Ca}$	-2.76
$\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{H}_2\text{O}_2$	0.68	$\text{Ba}^{2+} + 2\text{e}^{-} \rightarrow \text{Ba}$	-2.90
$\text{MnO}_4^{-} + \text{e}^{-} \rightarrow \text{MnO}_4^{2-}$	0.56	$\text{K}^{+} + \text{e}^{-} \rightarrow \text{K}$	-2.92
$\text{I}_2 + 2\text{e}^{-} \rightarrow 2\text{I}^{-}$	0.54	$\text{Li}^{+} + \text{e}^{-} \rightarrow \text{Li}$	-3.05
$\text{Cu}^{+} + \text{e}^{-} \rightarrow \text{Cu}$	0.52		

Bepaling van opgeloste Metalen met ICP-OES

Calcium, filtered, as Ca	6590	ppm	0.2
Cadmium, filtered, as Cd	0.001	ppm	0.001
Cobalt, filtered, as Co	<0.01	ppm	0.01
Chromium, filtered, as Cr	<0.03	ppm	0.03
Copper, filtered, as Cu	<0.005	ppm	0.005
Iron, filtered, as Fe	5.70	ppm	0.005
Potassium, filtered, as K	358	ppm	1.0
Lithium, filtered, as Li	2.92	ppm	0.1
Magnesium, filtered, as Mg	950	ppm	0.1
Manganese, filtered, as Mn	0.20	ppm	0.01
Molybdenum, filtered, as Mo	<0.05	ppm	0.05
Sodium, filtered, as Na	42800	ppm	5.0
Nickel, filtered, as Ni	<0.01	ppm	0.01
Phosphorus, filtered, as P	<0.2	ppm	0.2
Lead, filtered, as Pb	<0.05	ppm	0.05
Antimony, filtered, as Sb	<1.0	ppm	1.0
Selenium, filtered, as Se	<0.2	ppm	0.2
Ta, filtered, as Sn	<0.05	ppm	0.05
Strontium, filtered, as Sr	431	ppm	0.05
Titanium, filtered, as Ti	<0.01	ppm	0.01
Vanadium, filtered, as V	<0.005	ppm	0.005
Zinc, filtered, as Zn	0.02	ppm	0.01

Bepaling van Conductiviteit

Conductivity at 25°C

165000

µS/cm

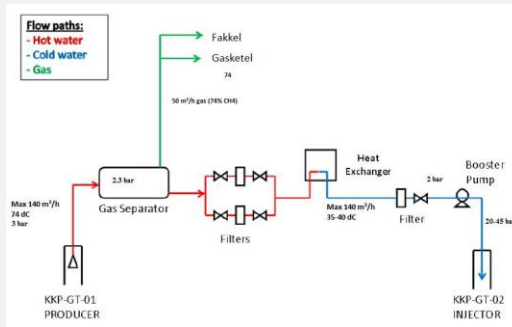
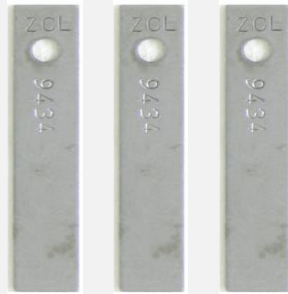
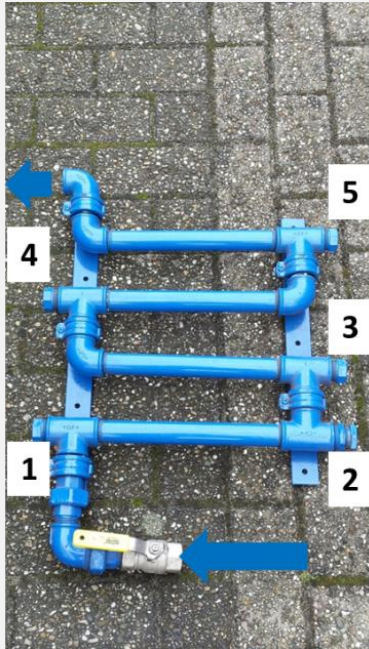
Corrosie snelheid

MPY : Mils Per Year → /40 = mm/jaar

Description	Carbon Steel
Excellent	Less than or equal to 1
Very Good	1 to 3
Good	3 to 5
Moderate to Fair	5 to 8
Poor	8 to 10
Very Poor to Severe	> 10



Uitdaging Corrosie



Uitdaging Corrosie



Monitoring:

- Corrosion online and coupon (MPY)
- Temperature ($^{\circ}\text{C}$)
- pH
- ORP (mV)

Uitdaging Corrosie

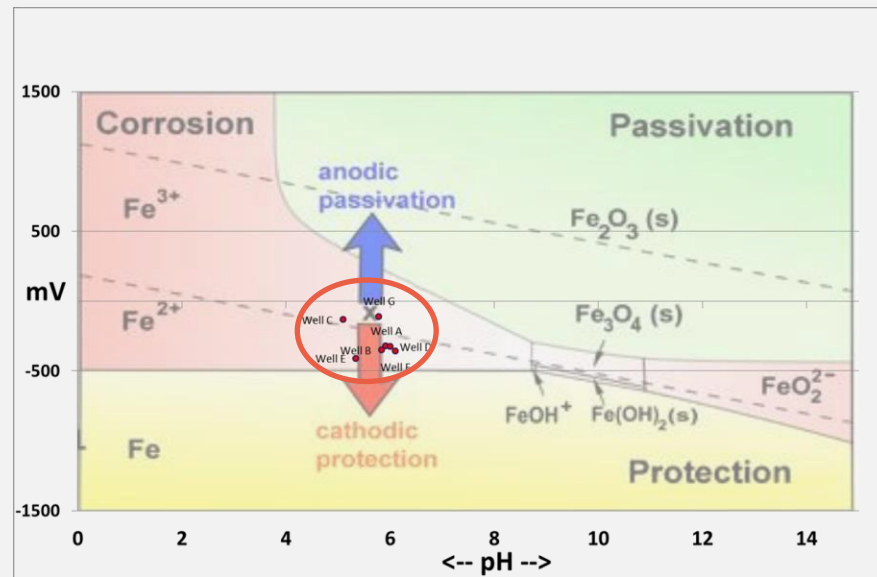


- Mechanical
- Operational
- Chemical

Well	pH	ORP (mV)
Well A	5,92	-323
Well B	5,84	-352
Well C	5,1	-132
Well D	6	-325
Well E	5,34	-410
Well F	6,1	-360
Well G	5,79	-110

Monitoring:

- Corrosion online and coupon (MPY)
- Temperature (°C)
- pH
- ORP (mV)



Uitdagingen Materialen

