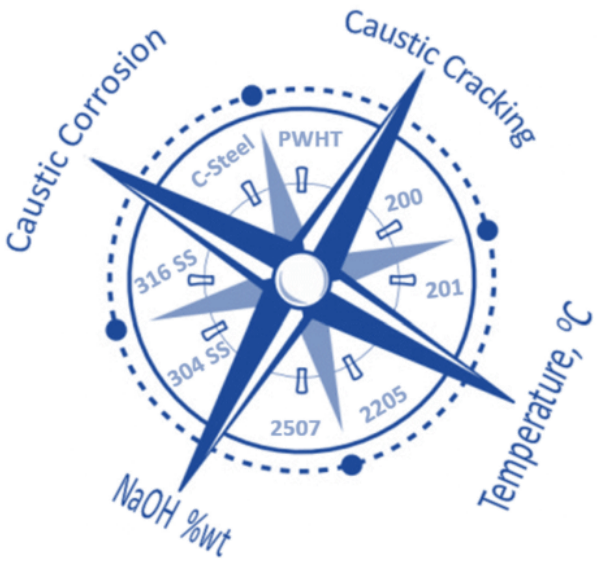


Corrosion Modeling and Corrosion Prediction Software

CCC-Compass®: Modeling and Life Prediction of Caustic Corrosion and Caustic Stress Corrosion Cracking

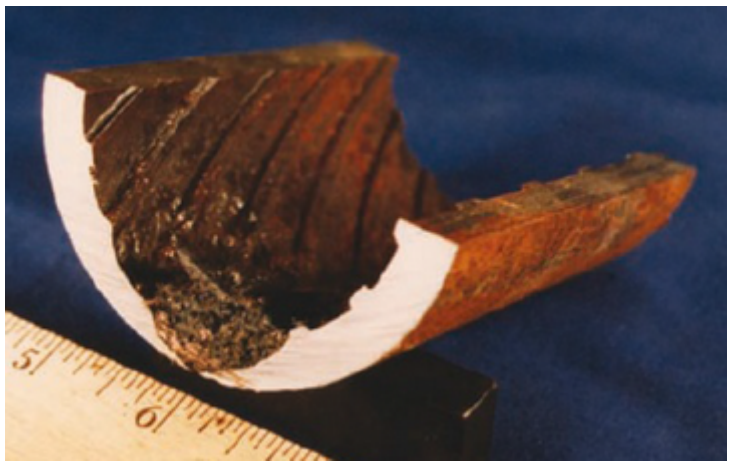
Version 9.20

☆ **Performance** ☆ **Functionality** ☆ **Usability**

Anytime Anywhere Any Device Any OS

No USB dongles No installation No Browser Plug-ins

Overview and Application Examples of CCC-Compass



Caustic corrosion refers to localized corrosion due to the concentration of caustic (alkaline) solutions such as NaOH and KOH, and/or corrosive salts from those solutions, that usually occurs under evaporative or high heat transfer conditions (commonly called caustic gouging). Also, corrosion resulting in general thinning can occur at elevated temperatures, depending on alkali or caustic solution strength. Primarily carbon steel, low-alloy steels, and 400 series SS. Carbon steel is the material most commonly used in situations where caustic corrosion is a concern. 300 series SS is generally resistant to caustic corrosion until passivity is damaged. Caustic SCC is characterized by surface-initiated cracks that occur in piping and equipment exposed to caustic (alkaline hydroxide solutions) at elevated temperature, primarily adjacent to non-PWHT'd welds. It is a form of ASCC. The temperature above which caustic SCC occurs depends on the concentration of the caustic solution. Carbon steel, low-alloy steels, and 300 series SS are susceptible. Duplex stainless steels are also susceptible but have shown improved resistance compared to the 300 series SS. Nickel-based alloys are more resistant.

CCC-Compass is the only device and OS independent software tool on the market for the modeling and life prediction of caustic corrosion and caustic stress corrosion cracking of carbon steels, stainless steels and nickel alloys. Designers, OEM engineers, consultants, operation personnel, maintenance and inspection engineers can quickly and accurately determine: (1) the caustic corrosion rate under the prevailing operating temperature and caustic concentration; (2) the susceptibility to caustic stress corrosion cracking; (3) the requirement of post-weld heat treatment (PWHT) on carbon steels with and without steam tracing; (4) the remaining life of the equipment or piping in caustic services.

CCC-Compass®: Modeling and Prediction of Caustic Corrosion and Caustic Cracking

Equipment	Crude Transfer Piping		Material	Carbon Steel	
Wall Thickness	mm	6.000	Steam Tracing	No	
Caustic Concentration	wt%	50.000	Temperature	°C	65.000
Boiling Point	°C	142.362	Freezing Point	°C	11.292
Corrosion Rate	mm/y	0.127	Remaining Life	years	47.068

Susceptibility to Caustic Stress Corrosion Cracking

Caustic SCC was reported under the prevailing conditions.

PWHT Requirement on Carbon Steel

PWHT is required for welds and bends. Nickel alloy trim for valves is required.

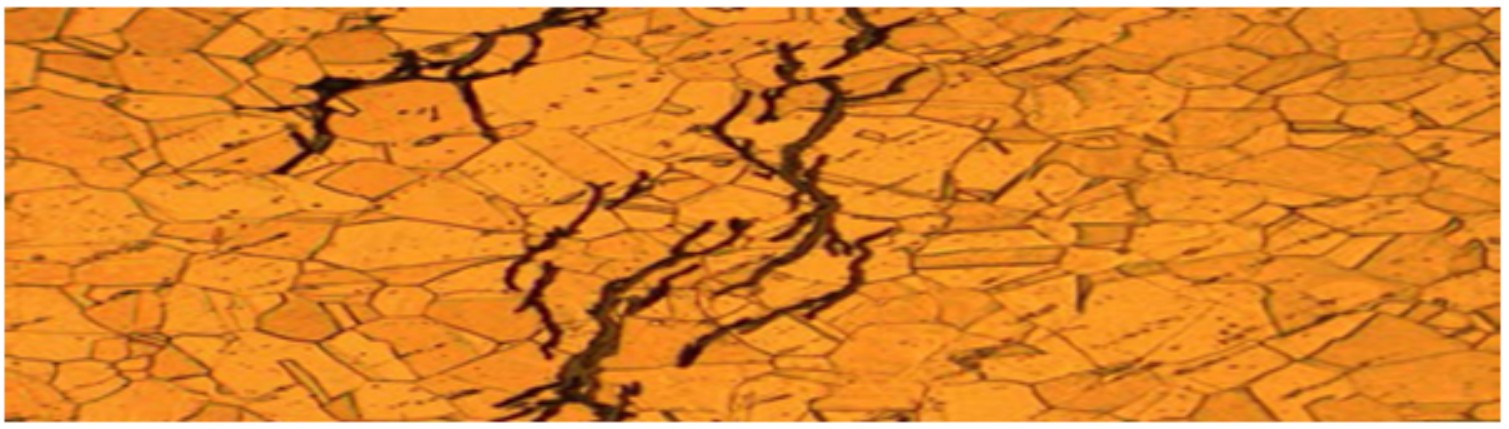


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Figure 1 CCC-Compass for modeling and prediction of caustic corrosion and caustic stress corrosion cracking.

Under the prevailing operating conditions shown in Figure 1 above, the predicted caustic corrosion rate for carbon steel is 0.127 mm/y, the predicted remaining life (based on caustic corrosion rate) is 42 years. The predicted boiling point is 142.36^{o}C and the freezing point (solidifying point) is 11.29^{o}C. Under the prevailing operating conditions, CCC-Compass predicts that the carbon steel piping is expected to experience caustic stress corrosion cracking. Post-weld heat treatment is required for welds and bends and nickel alloy trim for valves is required for preventing caustic SCC.

CCC-Compass is a cloud-based software that works on any device running any OS without the need for users to install or download anything. Experience the industry's first cross-platform and device-independent caustic corrosion and caustic SCC modeling and prediction app on your iPads, tablets, smart phones, notebooks and desktops, at any time and anywhere, in the office or in the field. No installation files to download, no browser plug-ins required, no USB dongles to carry around, and no license keys to transfer from one PC to another. CCC-Compass simply works on any device running any OS. All you need is an internet browser.

CCC-Compass®: Modeling and Prediction of Caustic Corrosion and Caustic Cracking

Equipment	Crude Transfer Piping		Material	Carbon Steel	
Wall Thickness	mm	6.000	Steam Tracing		
Caustic Concentration	wt%	50.000	Temperature		
Boiling Point	°C	142.362	Freezing Point		
Corrosion Rate	mm/y	0.127	Remaining Life		

Carbon Steel
Cast Iron
Low Alloy Steel
304 SS
316 SS
Alloy 200
Alloy 201
2304 DSS
2205 DSS
2507 DSS

Susceptibility to Caustic Stress Corrosion Cracking

Caustic SCC was reported under the prevailing condition.

PWHT Requirement on Carbon Steel

PWHT is required for welds and bends. Nickel alloy trim for valves is required.

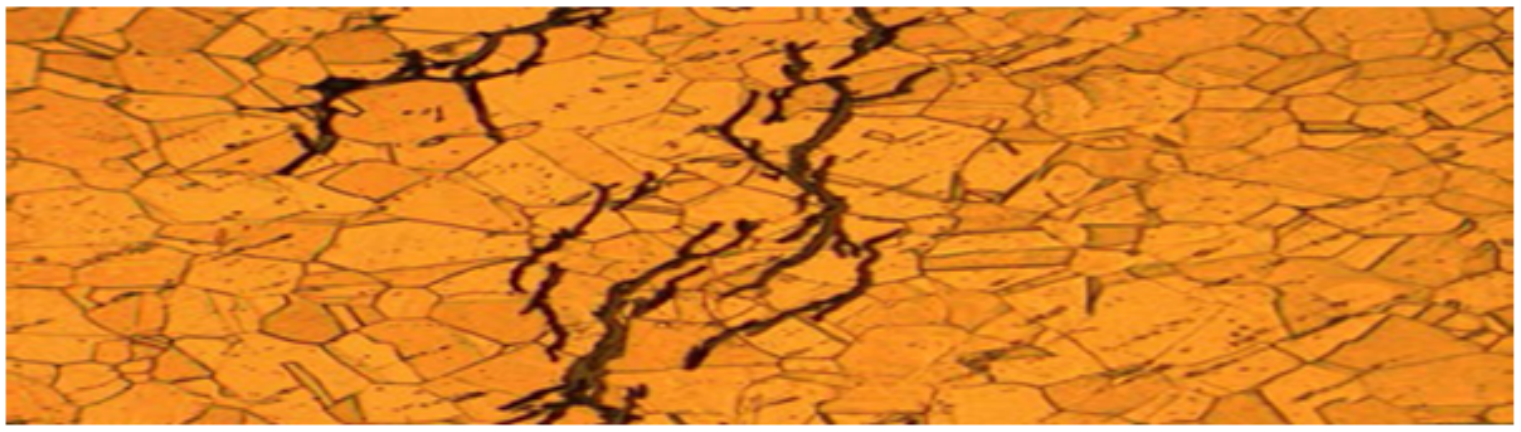

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Figure 2 CCC-Compass can be used as a powerful software tool for material selection and process optimization.

CCC-Compass®: Modeling and Prediction of Caustic Corrosion and Caustic Cracking

Equipment	Crude Transfer Piping		Material	Carbon Steel	
Wall Thickness	mm	6.000	Steam Tracing	No	
Caustic Concentration	wt%	50.000	Temperature		
Boiling Point	°C	142.362	Freezing Point	°C	11.292
Corrosion Rate	mm/y	0.127	Remaining Life	years	47.068

No
Yes

Susceptibility to Caustic Stress Corrosion Cracking

Caustic SCC was reported under the prevailing conditions.

PWHT Requirement on Carbon Steel

PWHT is required for welds and bends. Nickel alloy trim for valves is required.

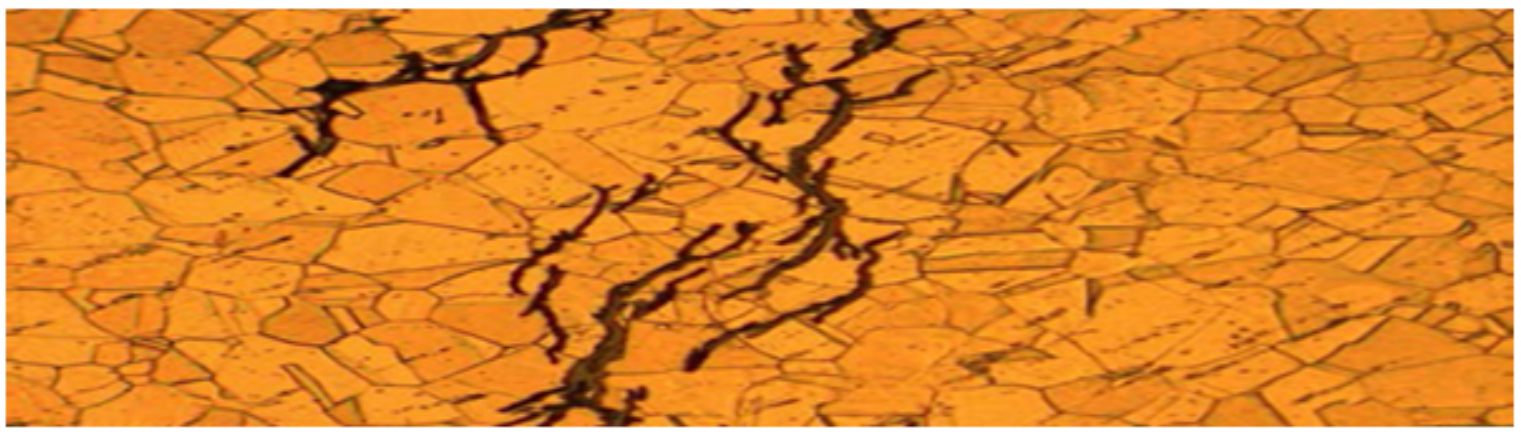

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Figure 3 CCC-Compass models the effects of flow velocity and steam tracing on caustic corrosion and caustic SCC.

CCC-Compass models the effects of critical factors such as caustic concentration, temperature, flow velocity, PWHT, and steam tracing on the caustic corrosion rate and caustic stress corrosion cracking (SCC). By varying the selected material and the operating parameters, CCC-Compass can be used as a powerful software tool for material selection and process optimization. Integrity operating windows (IOWs) can also be easily established for the selected material.

The powerful applications of CCC-Compass are truly unlimited in engineering design, materials selection, process operation, inspection and maintenance, corrosion risk assessment, modeling and prediction of caustic corrosion and caustic stress corrosion cracking (SCC) of equipment and piping in caustic services.
Click here to contact us for licensing details and experience the power of CCC-Compass.

CCC-Compass, giving you the right directions in the Modeling and Prediction of Caustic Corrosion and Caustic SCC.