

ENGINEERING BULLETIN #119

Corrosion of Common Alloys in Dry Chlorine

In a couple earlier Engineering Bulletins we showed how [Chloride / Chlorine Levels](#) in aqueous environments affect alloy selection and how [PREN](#) (Pitting Resistance Equivalent Number) is used to determine pitting corrosion resistance in the face of chloride attack.

Here, we consider another dimension in chlorine piping systems. Dry chlorine is defined as chlorine with its water content dissolved in solution. It could be a liquid or a gas. If the water exceeds its solubility and forms a second aqueous liquid phase, the chlorine is defined as wet chlorine, and becomes extremely corrosive.

The Chlorine Institute's Pamphlet 6 details how moisture most commonly enters a dry chlorine system.

- Start-up and shutdown
- Wet pad purge gases
- Exposure to atmosphere

Dry chlorine is not corrosive to steels at ambient temperatures and is commonly shipped and handled in carbon steel equipment, with higher-alloy materials such as Monel 400 and Hastelloy C-276 used for critical parts.

However, temperature and pressure changes can affect the moisture content of the solution, ushering the change from dry to wet chlorine. For this reason, it's important to monitor these operating conditions.

Corrosion rates of different alloys in dry chlorine and temperature (°C) at which given rates are exceeded are presented in the table below. Keep in mind that moisture will greatly accelerate the attack of any of these materials with the additional danger of SCC (Stress Corrosion Cracking) of stainless steel.

CORROSION OF SOME COMMON ALLOYS IN DRY CHLORINE

Penetration Rates, [inches/year] and °C at Which Given Rate is Exceeded					
Alloy	0.005"	0.01"	0.05"	0.10"	0.50"
Inconel 600	489	504	540	556	596
Inconel 625	484	500	534	545	589
Hastelloy C-276	473	488	522	538	579
Inconel 825	388	407	451	472	527
SS Alloy 310	362	383	434	465	536
SS Alloy 316	339	358	407	431	492
SS Alloy 309		354	390	406	448
SS Alloy 304		341	375	393	434
SS Alloy 321		341	375	393	434

If you have any questions or comments, please [contact us](#).