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Castrol Industrial

# TECHNICAL BULLETIN

## Understanding Chlorides

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## Introduction

Chlorides are negatively charged chlorine ions that are commonly found in water and metalworking fluid dilutions. These ions are introduced into a metalworking fluid system in several ways. Chlorides often occur naturally in water due to salts such as sodium chloride and potassium chloride that dissolve into their constituent ions (Na+ & Cl- for example). Many well-water sources for manufacturing plants contain high levels of chlorides due to direct contact with ground salts and metals. Chlorides are also introduced into water systems by people. Chlorides can be introduced accidentally by dumping brine solutions, which are mainly sodium chloride, from water softeners into fluid systems. Some metalworking fluid concentrates contain chlorides. Oil-rejecting synthetics contain a polymeric quaternary ammonium compound that contains a bonded chloride ion that will be released by dissociation as the compound is introduced to the fluid system. This additive will raise the chloride level of the fluid.

Chloride concentrations build in metalworking fluid systems over time. As water evaporates the chloride level increases. Make up water (other than DI and RO waters) additions continue to introduce chlorides into the system. Without maintenance procedures, the chloride levels in a system will become problematic.

Chlorides interfere with the formation of a corrosion protective layer on the surfaces of metals. The chlorides then can concentrate in microscopic cracks on the metal and create small areas where the pH is very acidic (pH 2 to 3). This acid then attacks the metal surface, causing corrosion, pit rust. This is most common type of corrosion seen with chlorides in metalworking areas. Pit rust presents as small dimples on metal surfaces with corrosion in the center of each "pit." Stress and crack corrosion is also associated with elevated chloride levels.

Chloride corrosion is most prevalent in areas where there is poor water quality and high levels of system water evaporation. Tube mills have tremendous rates for evaporation due to high temperatures during the forming and welding processes. Tube mills are commonly affected by elevated chloride levels. Anywhere high levels of chlorides exist, there is potential for corrosion.

Although there is no practical method for removing chloride ions from metalworking fluids, there are ways to control the level in the system fluid. Using deionized or reverse-osmosis water for system additions will stop the increase of chloride concentration. DI and RO water filtration units not only remove hardness ions, but will also remove the chloride ions in the water. Limiting additions of chloride containing additives will also help control chloride levels in your fluid system.

As chloride levels rise, so does the potential for corrosion. The types of fluids that are most effective in counteracting chlorides will be from the soluble oil/semi-synthetic product lines. The high oil containing products provided the most corrosion protection against elevated levels of chlorides under controlled laboratory conditions. (100ppm, 300ppm and 500ppm chloride levels)
It should be noted that corrosion becomes increasingly likely above 300 ppm chlorides.
It is recommended that as chloride levels approach 250 ppm chlorides, a thorough evaluation of the metalworking fluid should take place. Corrosion may not occur, but the possibility for corrosion is increased.

Other possible factors that contribute to corrosion must be considered. For example, the type of metals being worked; cast iron is very susceptible to chloride corrosion while higher grade metals such as steels and stainless steels will be much more resistant.
Below are some things that should be considered when dealing with corrosion:

1. Is the metalworking fluid being maintained at an appropriate concentration?
2. What is the chloride level of the metalworking fluid?
3. What is the pH of the metalworking fluid?
4. Is there any contamination in the fluid? Such as dirt, metal fines, etc.?
5. Is there any microbiological activity in the fluid?
6. When is the corrosion appearing on the part? Describe the corrosion.
7. What happens to the parts after they have been worked?

It is most common to see corrosion caused by several factors, not just one. Low pH, low fluid concentration, high dirt and fines levels, high chloride concentration can all cause corrosion individually. The likelihood of corrosion increases dramatically as two or more of these factors are combined in a fluid.

**Containing Chloride Corrosion**

When chloride related corrosion does occur, it is recommended that SYNLUBE L4 be introduced to the system starting at a level of 0.75%. In a 1000 gallon system, this would mean the addition of 7.5 gallons of SYNLUBE L4. Castrol Balancer P3 demonstrated equivalent effectiveness in the prevention of chloride related corrosion, however, Castrol Balancer P3 is an amine compound which drastically increases the alkalinity and pH of a metalworking fluid. High alkalinity and pH can contribute to irritation of the skin. SYNLUBE L4 has little impact on the alkalinity and pH of the metalworking dilution and is preferred as the recommended containment treatment for chloride related corrosion in metalworking fluids.

Corrosion inhibitors are meant to be used as short-term fix to a corrosion problem caused by high chloride levels. The only way to reduce the chloride level in a metalworking fluid is through a partial fluid dump of the system. This will reduce the level of chlorides in the system, but not eliminate them. Elimination of the chloride ion source is the only way to eliminate chlorides from the metalworking fluid.