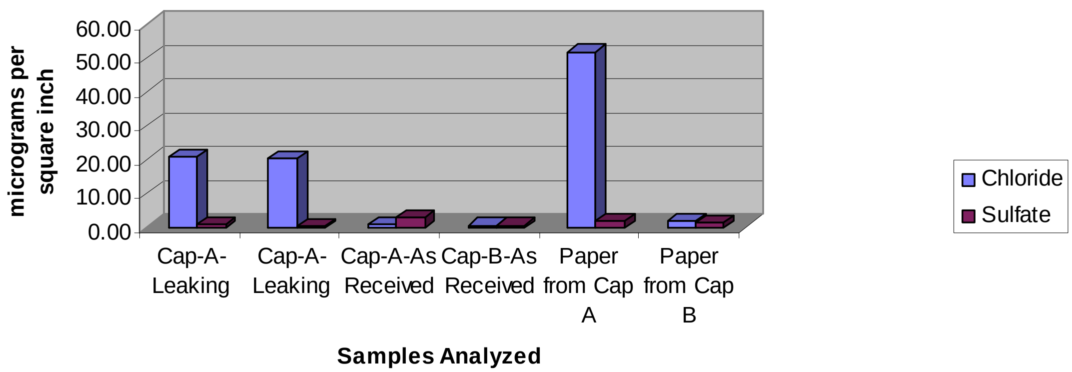
Talk About Being Canned...
Leaking Electrolytic Capacitors
Foresite Inc.

In this study, we were assisting an assembler track down the cause of extensive corrosion on a printed wiring assembly. The corrosion occurred after hot-cold thermal cycling (acceptance testing). The corrosion was always in one portion of the board, surrounding an electrolytic can capacitor, and was extensive enough to open-circuit the traces in that area. An analysis of all of the failures showed that failures correlated to Company A capacitors, but not on Company B capacitors. Both capacitors were nominally the same voltage and capacitance rating, and the same size.

Ion chromatography (IC) analysis was performed on capacitors. Extractions were done on several of the leaking capacitors that had failed the thermal cycling. These capacitors were also tested in the as-received condition. In addition, several of the capacitors from both suppliers were taken apart and examined visually for differences. IC was also done on samples of the dielectric paper used in the capacitors. These papers were charged with the electrolyte solution used in that capacitor.

The only visible difference between the two caps was the size of the elastomer gasket used to seal the capacitors at the leads. The leaking capacitor had a smaller gasket (thinner and smaller diameter) than the non-leaking caps. The leaking gasket also appeared to have a different composition than the non-leaking gasket, but this was not confirmed. Both used a crimp seal.

Chart 1 - Leaking Electrolytic Capacitors



The IC results are shown in Chart 1. The analysis showed both capacitors to have relatively low levels of chloride and sulfate (both corrosive materials) in the as-received condition. The chloride levels dramatically increased for the leaking capacitors, and with some elevation in sulfates. Looking at the samples of the dielectric paper, which was saturated with the capacitor electrolyte, you can see the cause. Capacitor brand A used an electrolyte that was highly charged with chloride and that had a significant sulfate constituent. Capacitor brand B also had chloride and sulfate, but in dramatically lower levels. High levels of chloride and sulfate, when mixed with water or water vapor, are highly corrosive and promote metal migration when an electrical potential is applied.

Most electrolytes in can capacitors have a polyglycol base, to which are added “proprietary” ingredients. Such ingredients are often jealously guarded secrets. The end result for capacitor A was a high chloride and sulfate content from these ingredients. Since capacitor B gave the same electrical performance, with a lower amount of chloride and sulfate, it was preferred.

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After additional analysis, we concluded that the elastomer seal was not sufficient for the thermal range of the test. If the elastomer had a dramatically different coefficient of thermal expansion (brand A vs. brand B), then the crimp connection may have been insufficient as a seal, allowing the corrosive electrolyte to escape. As a result of the analysis, the client changed to capacitor B due to the better sealing properties exhibited, and the lower corrosive risk represented by the electrolyte in capacitor B.

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