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Effect of Chloride Droplet Size on Pitting Corrosion of Type 304 Stainless Steel

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Pitting is a common form of corrosion in austenitic stainless steels, often initiating from surface heterogeneities such as surface roughness, manganese sulfide inclusions, or delta ferrite secondary phases. Previous studies pertaining to pit initiation, growth, and morphology have demonstrated the effects that chloride concentration, relative humidity, time elapsed, surface roughness, microstructure, and temperature can have on corrosion within a water droplet. However, most studies reported in the literature were conducted in larger droplets ranging from 2mm to 5mm in diameter. Deposition and deliquescence from atmospheric contaminants have been observed to occur at a much smaller size range approximately two orders of magnitude less than current studies on the subject. As droplet size decreases the metallic surface area covered also decreases, resulting in a decreased probability of covering an inclusion and possible pit initiation. The available cathodic area under the droplet can also be greatly reduced making it more difficult to sustain pit growth, especially growth in all directions that leads to the formation of hemispherical pits. These factors can lead to smaller pit size and fewer instances of initiation. It could hypothetically result in changes in the pit morphology, though little research has been done in this area. This study aims to determine the effects of parameters controlling corrosion governed by a reduction in droplet size more pertinent to real world atmospheric exposures. Saturated magnesium chloride droplets will be deposited onto stainless steel 304 coupons and exposed for various time periods under constant temperature and relative humidity. The droplet morphology and corrosion progress will be monitored for the duration of the exposure. Post exposure analysis of corrosion damage will enable correlation of initial droplet conditions with pitting susceptibility. Experiments will be conducted pertaining to the effect of droplet size on the corrosion of austenitic stainless steels and will identify potential correlation of droplet size and pit initiation.

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