

# Chemical Engineering Thesis Defense

3D Printing of stainless steel 316L for corrosive  
and low-pressure environments

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## Abstract

Corrosion is one of the key failure modes for stainless steel (SS) piping assets handling water resources managed by utility companies. During downtime, the costs start to incur as the field engineer procures its replacement parts. The parts may or may not be in stock depending on how old, complex, and common the part model is. As a result, water utility companies and its resilience to operate amid part failure are a strong function of the supply chain for replacement piping.

Metal additive manufacturing (AM) has been widely recognized for its ability to (a) deliver small production scales, (b) address complex part geometries, (c) offer large elemental metal and alloy selections, (d) provide superior material properties. The key motive is to harvest the short lead time of metal AM to explore its use for replacement parts for legacy piping assets in utility-scale water management facilities. In this paper, the goal was to demonstrate 3D printing of stainless-steel (SS) 316L parts using selective laser melting (SLM) technology. The corrosion resistance of 3D printed SS 316L was investigated using (a) Chronoamperometry (b) Cyclic Potentiodynamic Polarization (CPP) and Electrochemical Impedance spectroscopy (EIS) and its improved resistance from wrought (conventional) part was also studied. Then the weldability of 3D printed SS 316L to wrought SS 316L was illustrated and finally the mechanical strength of the weld and the effect of corrosion on weld strength was investigated using uniaxial tensile testing.

The results show that 3D printed part compared to the wrought part has a) lower mass loss before and after corrosion, (b)% higher pitting potential and (c) higher charge transfer resistance. The tensile testing of welded dog bone specimens indicates that the 3D printed parts despite being less ductile were observed to have higher weld strength compared to the wrought part. On this basis, metal AM holds great value to be explored further for replacement piping parts owing to their better corrosion resistance and mechanical performance.



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Zoom Link: <https://asu.zoom.us/j/2086788579>