Thermomechanical Processing of AA5083 and the Resulting Impact on Corrosion Resistance

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Objective

Correlation of grain size of AA5083 with corrosion resistance and yield strength in order to develop an added thermomechanical processing step to mitigate the deleterious effects of \( \beta\text{-Al}_3\text{Mg}_2 \) formation while keeping yield strength above the required threshold for hull plating in naval vessels.

Approach:

Used EBSD scans to measure grain size at 0 %, 5 %, 10 %, 15 % and 20 % thickness reductions followed by ASTM G67 NAMLT testing to determine the material corrosion resistance based on mass loss. Additional tensile samples at 0 %, 5 %, 30 % and 60 % thickness reductions tested in-situ using an SEM tensile stage. Prior to tensile testing, the samples were scanned using EBSD to determine their respective grain size.

Impact:

- **Grain size relation to \( \beta\text{-Al}_3\text{Mg}_2 \) formation:** The overall relation between grain size and corrosion resistance has shown a steady correlation between larger grain size and improved corrosion resistance.
  - Increase from 47.2 μm to 63.90 μm, mass loss decreased ~50 %

- **Grain size relation to yield strength:** Preliminary tensile tests showed a decreasing trend in yield strength as grain size increased.
  - 35.84 μm grain size, Y.S. = 238 MPa
  - 73.28 μm grain size, Y.S. = 176 MPa

AA5083-H116 standard calls for a yield strength of ~228 MPa so any added thermomechanical step needs to reach this level.

**Reduced Maintenance Cost:** If a thermomechanical processing step can be added that increases the hull plating corrosion resistance without substantially decreasing yield strength, the lifetime of the hull plating will be increased, thereby reducing maintenance and replacement costs.

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