Corrosion

Randy Beals
Of All The Issues That Influence Mg Use Corrosion, And Bimetallic Corrosion Associated With Fastening, Are The Least Friendly
General Corrosion is Not the Problem

• ASTM B117 salt spray tests
• Magnesium alloys: AZ91D, AM60B, AM50A, AE42 and AS21 showed lower corrosion rates than aluminum alloy A380
• Magnesium alloy AM20 showed higher corrosion rates than A380.
Galvanic Corrosion is the Issue

\[ E_{pk} - E_{pa} = \frac{I}{R_e + R_m} \]

Ref: Hydro Magnesium
There are few low-cost green fasteners...chromate coated steel bolts are no longer allowable.

“Friendly” designs to isolate moisture and Fe ions from interfaces are expensive and clumsy.... but possible.

Fastening Mg parts to a vehicle’s steel structure requires high loads (>90 Nm) in the US and Al fasteners are not strong enough. In EU lower loads (~ 40 N) are allowed and thus Al bolts can be commonly used.
- Eliminate electrolyte
- Break electric circuit
  - Plastic washers
  - Non-conductive coatings
- Reduce electropotential
  - 5000/6000 series Al washers

Good designs can eliminate corrosion
Coatings

Delamination/deadhesion
Better mechanical property databases are required for FEA deformation/crash modeling.

CAE filling models for HPDC do not describe how to modify gate designs and filling profiles (shot speed & pressure) and how to control porosity throughout all cross-sections in all locations.... unlike LP/G DC
Test bar databases are widely available, but are not statistically related to HPDC component processing conditions, nor actual component mechanical properties at different locations.

Component mechanical property databases (such as for FEA) are closely held within individual companies and not widely available.
Magnesium HPDC structures are inhomogeneous. Are their properties inhomogeneous too?