The Largest Cost Reduction Opportunity for Titanium in a Quarter Century: Electrochemical Conditioning and Finishing

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Changing the Paradigm About Titanium Conditioning

- Alpha case and micro/macro cracks form with every thermo mechanical process
  - Forging
  - Rolling
  - Extrusion

- If cracks not removed, even greater negative impact with next hot working

- Conventional conditioning = grinding, machining or chemical milling away all surfaces to the bottom of the deepest cooling cracks
  - Conditioning step yield is routinely 94 – 97% (3% to 6% of the material is lost)

- Four to six conditioning steps from ingot to saleable product
  - 14% to >30% of starting material becomes waste
  - Intermediate conditioning is among largest contributors to Ti’s low yield, and therefore, high cost
Traditional Conditioning is Fully Subtractive

- MetCon’s electrochemistry is a patented novel alternative to:

  - Grinding
  - Bar Peeling
  - HF-HNO₃ Pickling
  - Wet Sheet Grinding

Source: International Titanium Corp.
Source: TSI Titanium
Source: Amsax Technologies
Source: Specialty Metal Processing
MetCon’s Electrochemistry Retains the Bulk Metal, While Focusing on the Cracks

Textbook Says Electrochemistry Concentrates on High Points

- Non traditional rectification:
  - Smoothes crack edges
  - Feathers/ blends cracks
  - Blunts crack tips
  - Flattens crack bottoms
  - Retains majority of surface metal
- Cracks heal on subsequent hot working
- Surface sufficiently smooth for immersion ultrasonic inspection

Current Concentrates at High Points

After Smoothing
Driver of the Yield/ Cost Benefit

Conventional

Grinding/ machining entire surface until deepest crack tip removed

MetCon

Feathering + crack tip modulation; 2/3 of typically removed metal, retained

Ready to Process
(No sharp crack)
Cooling Cracks Are Blended and Smoothed

As Received 13” RCS

Post MetCon Process

Electrochemical: 98% Step Yield
vs:
Midwest Grind: 93% Step Yield
4% Yield & 5% Cost Improvement for Each Electrochemical Conditioning Step vs. Conventional

MetCon Yield Savings Effect on Finished Product Cost and Ingot Weight
(Assuming Constant 7,000 lbs. of Finished Product and Constant Manufacturing Costs)

Increment of Reduced Total Finished Cost and Reduced Input Weight with Each MetCon Conditioning Step
Dramatic Yield & Total Cost Improvement

Remarkable Throughput Gains

No Hydrogen Increase

Improved Product Performance

As Received (Masked)

Electrochemical Smoothing

9” RCS, Ti-6Al-4V