A Precision Wire Drawing System: Development and Results

UIA Symposium: Industrial Session

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Outline

- Project Objectives
- Prior Work
- Stack Design & Construction
- Wire Drawing Experiments
- Experimental Results
  - Reduced draw forces
  - Cleaning
  - Improved smoothness
- Summary
Project Objectives

The objectives of this project were to:
- Design and build a special purpose ultrasonic wire drawing unit
- Carry out ultrasonic wire drawing tests on a high alloy wire

The intent was to improve the surface finish of the wire.
- Wire was Carpenter MP35N (Ni-Co-Cr-Mo)
  - Not primarily an electrical wire
  - Nominal diameter ~0.005”

Literature review was Step 1.
Testing apparatus from prior work

Fig. 1. A scheme of apparatus for wire drawing with superimposed ultrasonic vibrations: (1) ultrasonic generator, (2) ultrasonic transducer, (3) ultrasonic horn, (4) die, (5) pusher-type furnace, (6) dynamometer, (7) wire, (8, 9) spools.

From past work...

Photo on left shows wire drawn without ultrasonic energy; photo on right shows drawn with ultrasonic energy.

Recent work...

Superconducting composite and fine wire (~0.005” / 36AWG).
Stack Design

Shrink-fit collet
Wire Drawing Bench
Wire Drawing Experiments

Converting Voltage from Polytec HSV2001 Laser Vibrometer to Amplitude

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Draw marks on as-received wire

Performance data of stack
Post-draw diameter could not be measured while ultrasonic energy applied.

ultrasonics off  ultrasonics on
Experimental Results

**Expected results:**
- Friction reduction, meaning:
  - Faster draw speed
  - Less draw force
  - Reduction in breakage

**Also observed increased smoothness:**

Drawn without ultrasonics

![Image of drawn material without ultrasonics]

Drawn with ultrasonics

![Image of drawn material with ultrasonics]
Experimental Results

- **Unexpected results:**
  - Wire resonance – could not measure post-draw diameter
  - But, this “cleaned” the wire
  - Also affected use of lubricant applied

Cleaning >>>>
Summary

- Ultrasonic-assisted wire drawing has been researched and equipment developed, by EWI and others.

- Data has been reported that shows improvement in:
  - smoother surface finish
  - faster draw speeds possible
  - lower draw force - ~30%
  - reduction or elimination of draw lubricant

- Questions?
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