GREAT DESIGNS IN STEEL

LASER HEAT TREATING OF AUTOMOTIVE DIES

Aravind Jonnalagadda (A.J.)
Synergy Additive Manufacturing LLC
22792 Macomb Industrial Dr,
Clinton Township, MI 48036
info@synergyadditive.com

Brian Timmer
Autodie LLC
44 Coldbrook St NW
Grand Rapids, MI 49503
Brian.Timmer@autodie-llc.com
CONTENTS

- Fundamentals of Laser Heat Treating
- Process benefits
- Cost savings
- Advancements in Laser Heat Treating
  - Hot Stamping dies
  - Trim Dies
- Additive Manufacturing for tool and die
- Future work
LASER HEAT TREATING

Process:
Laser beam illuminates the surface of metal raising the temperature:
Stage 1: Austenite formation from pearlite-cementite (hypereutectoid steels) or from pearlite-ferrite (hypoeutectoid steels)
Stage 2: Martensite transformation from Austenite

- Cooling rates (~100°C/sec) > Critical cooling rates for martensite formation
PROCESS VIDEO
LASER HEAT TREATING

Heat Treatable Materials
+ Any material with 0.2% or higher C
  • D6510
  • 0050A
  • A2
  • D2
  • S7
  • G3500
  • 4140 and others

Typical Hardness reaches the theoretical hardness of the material

Hardness Depth: 1-1.5 mm (0.040-0.060”)
DISTORTION DATA

• 3D scans of the die before and after laser heat treating show negligible distortion
A Comparison of the Die Construction Process Before & After Laser Hardening

Time to Market (TTM) : 5 days Reduction
Die Machining delivery time shortened from 18 to 13 days
COST SAVINGS, 11-MONTH RESULTS

• Over 100 applicable draw die castings (post, binders and cavities) have been completed on the 3 programs.

• While the heat treating and non-perimeter shipping cost increased, this was offset by total process cost savings.

• Kaizen savings had a benefit to cost average of **28.6** over 11-months.

• Critical resource savings; **37%** reduction in machine time in our CNC Machine department.

• Cutter cost reduction of $17,850 as the castings are now finished by 3D machining while in soft condition, no hard cut process is required.

• Analyzing the results from these 100 castings **TTM averaged a 7-day improvement.**

• This resulted in a **40%** reduction in a draw die machining process.
NEW ADVANCEMENTS

HOT STAMPING DIES

- Hot stamping dies consists of several sections joined together
- Conventional process – Induction/flame/oven
- Conventional heat treating requires complete dis-assembly prior to heat treating
- No dis-assembly is required for laser heat treated dies
- Net process speed up of approximately 5 days
NEW ADVANCEMENTS – TRIM DIES

Laser Heat Treating on Trim dies and Inserts

Current challenges:
- Hardness consistency
- Insert base warpage
- Rolled joint lines using either flame or induction hand applied methods

Benefits of using Laser Heat Treating:
- Eliminate machining joints after heat treat
- Reduce / eliminate finish profile hard cut
- One assembly process - laser heat treating after the trim inserts are fully assembled
- Eliminate requalifying of insert base flatness
NEW ADVANCEMENTS
ADDITIVE MANUFACTURING

- Die reconfiguration
- Die buildup
SUMMARY

- Laser heat treating results in minimal to no distortion in large automotive dies
- The process has Kaizen savings had a benefit to cost average of 28.6 over 11-months.
- Critical resource savings; 37% reduction in machine time in our CNC Machine department.
- Cutter cost reduction of $17,850 as the castings are now finished by 3D machining while in soft condition, no hard cut process is required.
- Analyzing the results from these 100 castings TTM averaged a 7-day improvement.
- This resulted in a 40% reduction in a draw die machining process.
FOR MORE INFORMATION

Aravind Jonnalagadda (A.J.)
Synergy Additive Manufacturing LLC
Aravind@synergyadditive.com

Brian Timmer
Autodie LLC
Brian.Timmer@autodie-llc.com