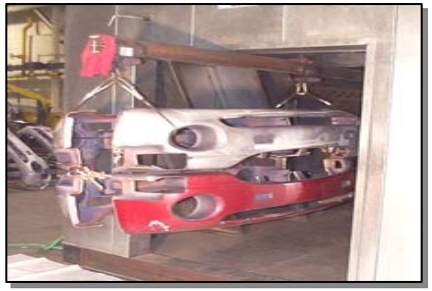
NOWOCOR Ltd
THERMAL TECHNOLOGIES

PYROLYTIC COATING REMOVAL TECHNOLOGY




It's all about containment !

Pyrolytic Coating Removal Technology

Paint Finishing Industry Breakthrough !

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PYROLYTIC COATING REMOVAL TECHNOLOGY

Overview

- **Patented low temperature humidity injection process**
  - ✓ Increases life of fixtures / tools
  - ✓ Minimizes dirt defects
  - ✓ Optimizes prop tool surface conductivity
  - ✓ Multiple materials: Steel, Aluminum, Alloy Steel, finished products
- **Patented Containment**
  - ✓ Eliminates fugitive emissions
  - ✓ Eliminates thermal migration
- **Field proven over 10 years**
- **Reduced enviromnental impact**

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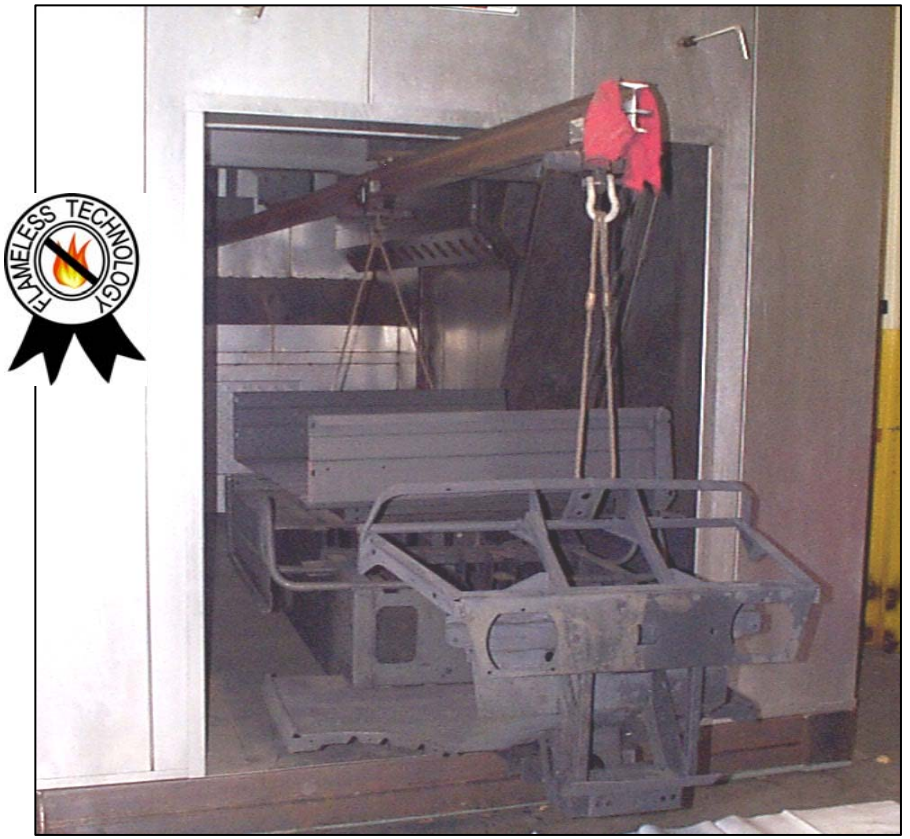
Features & Benefits

- Open Silhouette utilizing the Air Barrier Air Seal design allows either batch or continuous flow systems.
- No open flame, lower operating temperatures
- Low oxygen process limits rusting of ferrous products
- Does not generate fly-ash
- Environmentally superior to conventional burn-off ovens



Features & Benefits

- Forced Air Circulation with atmosphere control provides a consistent temperature profile allowing light gauge materials to be processed.

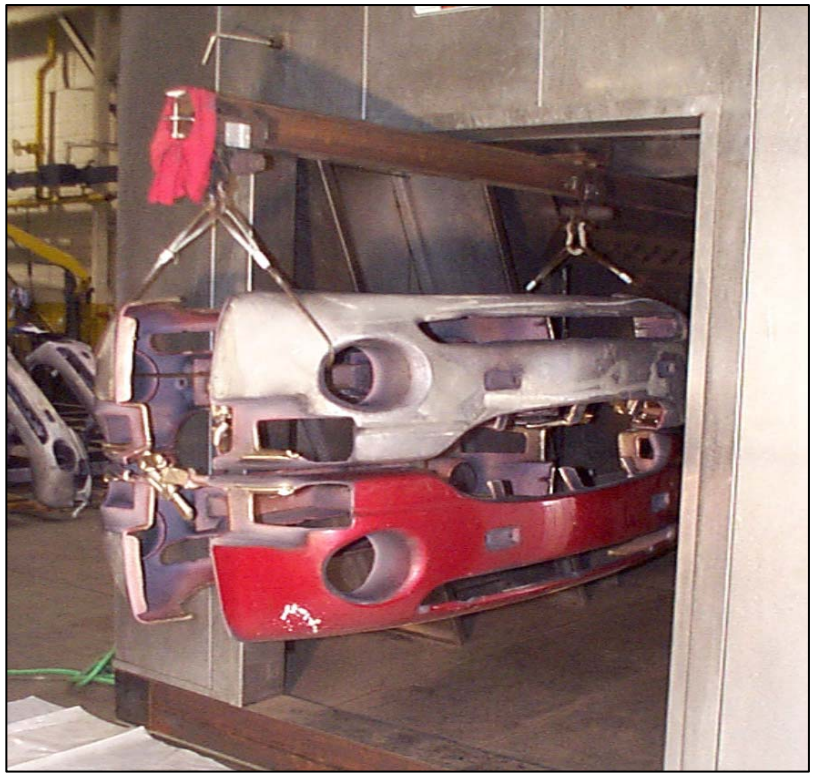
Features & Benefits

- **Flameless**

  means lower temperature on the product surfaces allowing materials like aluminum to be process in our pyrolytic oven.

Applications

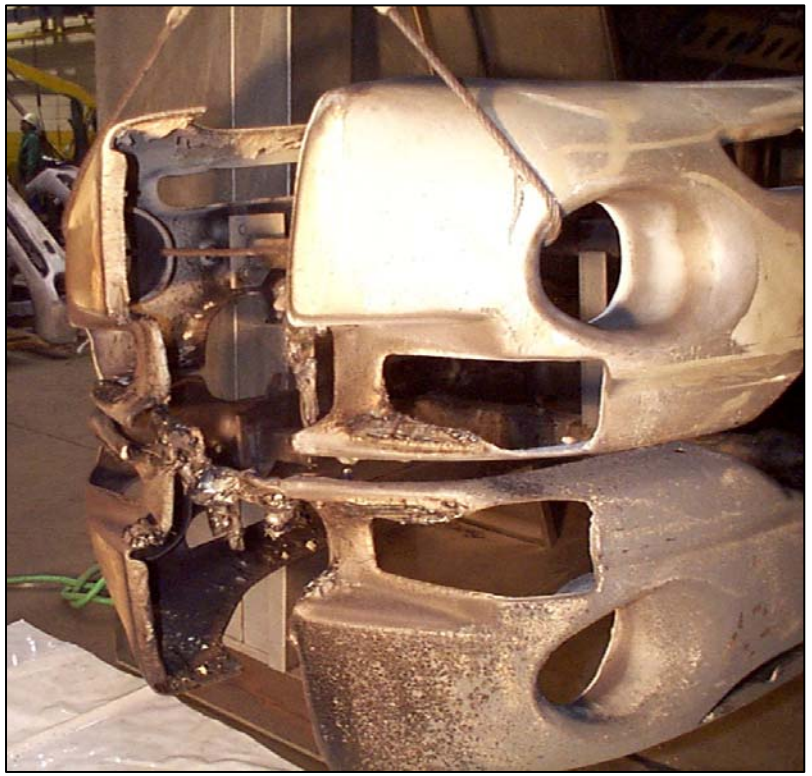
- The Pyrolytic Oven can be utilized for:
  - ✓ Hook and Jig Cleaning
  - ✓ Skid Carriers
  - ✓ Aluminum Bucks
  - ✓ Product recovery on bad paint jobs
  - ✓ Grating Cleaning



Specifications

- Ovens are sized for:
  - ✓ the products processed
  - ✓ production requirements
  - ✓ coating status and thickness

  providing the most economical oven for the application.



Testing - Pgs 8 thru 14

Testing performed:

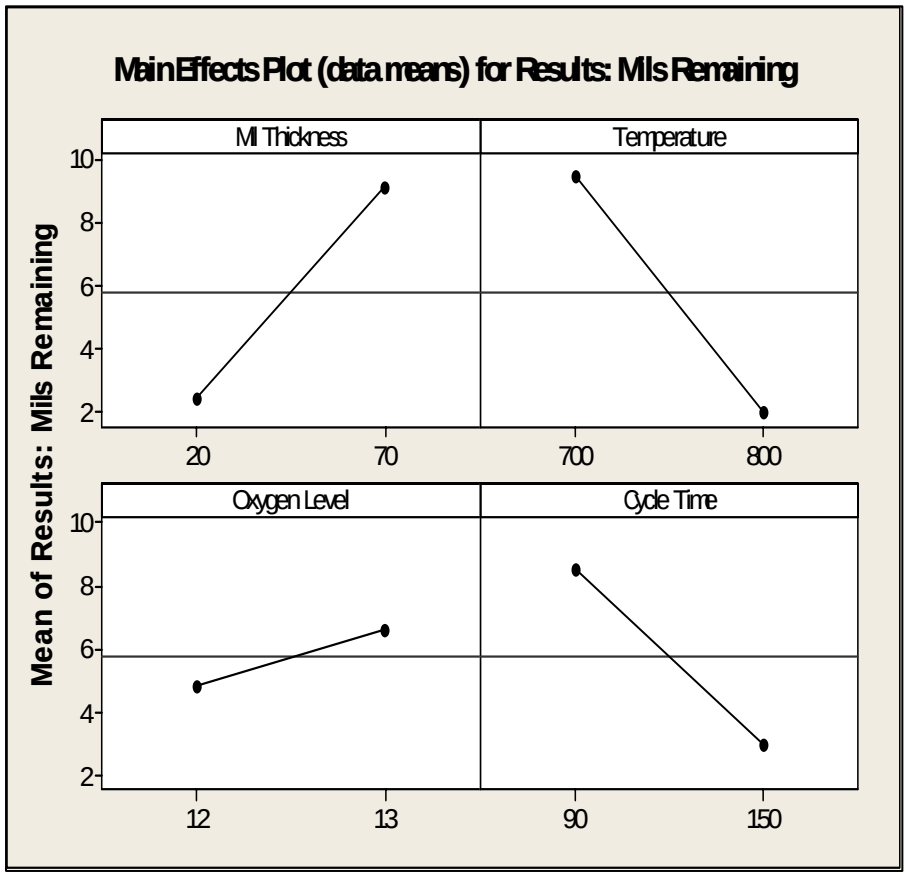
- Process Testing for process optimization
- Metallurgical Testing for type of metal that can be processed
- Thermographic scanning for evaluation of metal temperatures during processing
- Post Cleaning for evaluation of processing methods
- Operational Costing
- Maintenance and Fault Log for system improvements

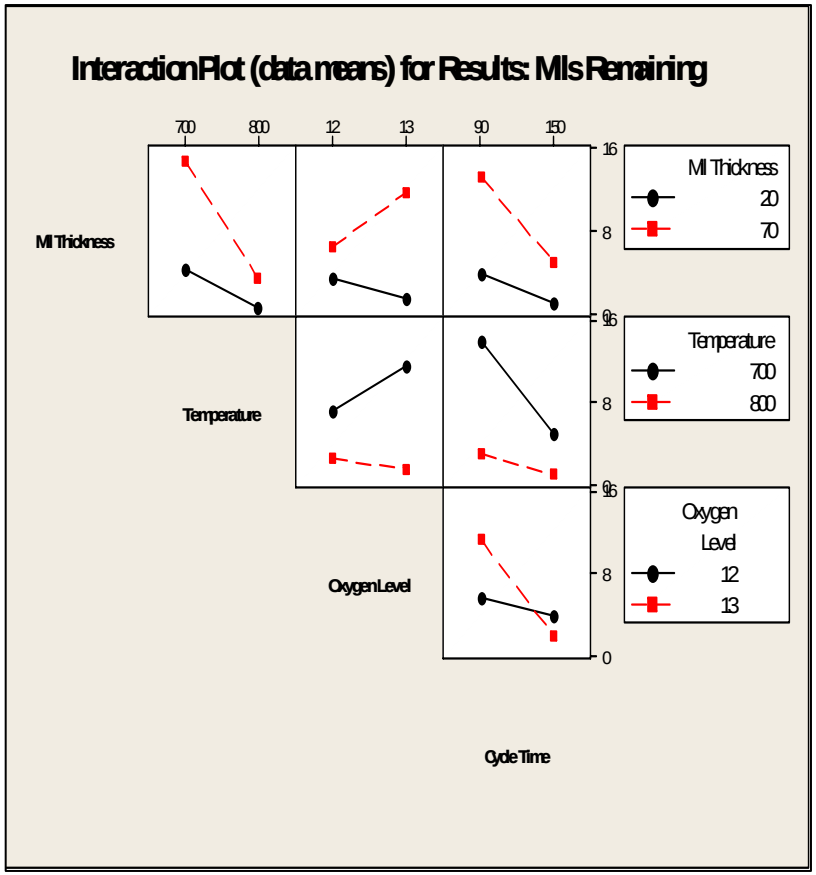
Process Testing

- Process Testing utilized factorial design of experiments to determine optimization of operational parameters considering Time, Temperature, Oxygen Level, and mil thickness of Paint
- Testing compared amount of paint remaining after burn off in measurement of weight and mil thickness
- Factorial Design Analysis was used to determine main effects, and interaction effects within the process
- Major effects show temperature follow by time to be the main effects

Testing

Factorial Results Graphs





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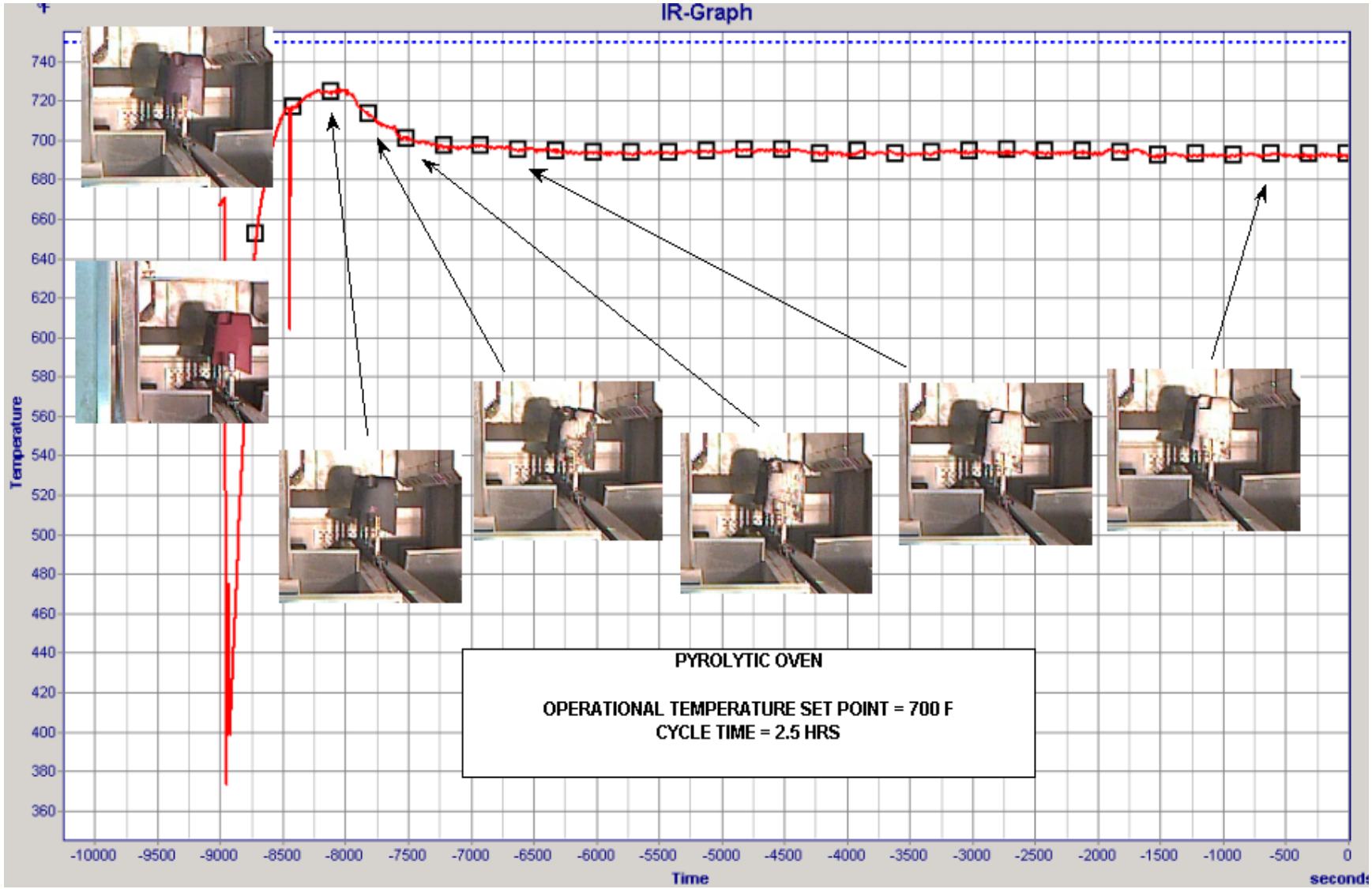

Thermographic Test Results

- Testing shows thermal spikes at peak pyrolysis
- At 700^{O}F the spike was 30 degrees and elongated
- At 800^{O}F the spike was as much as 150 degrees greater, revealing a shorter but much steeper thermal burst.
- Operating at 750^{O}F or less, reliably offers a controllable spike

Operational Parameters - Results

- With the consideration of Factorial and Thermographic Testing, the optimal design parameters of 750^{O}F, 12% Oxygen for 150 minutes to handle up to 70 mil thickness.
- Sizing systems proven by site-specific testing & field verified by over 10 years of commercial application.

Metallurgical Testing

- Testing carried out was designed to determine the effects the process has on various metals to determine what can be processed in the Pyrolytic Oven
- 5 Types of metal were tested
  - ✓ Cast Aluminum
  - ✓ 6061 T6511 Heat Treated Aluminum
  - ✓ 1018 Cold Roll Steel
  - ✓ 1045 Hot Rolled Steel
  - ✓ A519 Hot Rolled Steel

- Testing was performed at a range of different operating temperatures and repeated with consistent results
- Metallurgical Analysis was performed to determine suitability
  - ✓ Chemical Analysis
  - ✓ Mechanical Properties
  - ✓ Micro-Grain Structure
  - ✓ Rockwell Hardness
- Long Term Cycling to over 50,000 cycles has been recorded at a number of locations proving consistent & reliable results

Metallurgical Test Results

Metallurgical tests showed predictable results, generally annealing

- No impact on high and mid grade alloy steels
- Negligible loss of mechanical properties (softening) of unquenched carbon steels, generally at work-hardened points.
- Noticeable loss of hardness on quench hardened steels.
- Slight loss of mechanical properties on basic aluminum.
- Considerable loss of mechanical properties on heat treated aluminum due to significant grain growth.
- Little evidence of nitrogen microcracking of steels was observed at pyrolysis temperatures with spikes kept generally below 900^{O}F.
- As there is no direct exposure to flame, no other heat caused anomalies were encountered in repeat-heat fixtures or single-heat components.

Metallurgical Results - Conclusions

- Pyrolytic ovens can reliably process high and mid grade alloy steels
- Pyrolytic ovens can reliably process aluminum and low grade steels provided there are no mechanical or hardness property requirements.
- Because of the dwell time required for the Pyrolytic process to remove coatings effectively, ovens operating over 550^{O}C with predictable spikes exceeding 650^{O}C should not be used to process Heat Treated (quench hardened) steels or aluminum.

Post Cleaning

- Methods Tested:
  - ✓ Spray impingement,
  - ✓ high pressure washing
  - ✓ immersion dip
- All have been successful
- Spray Impingement is only successful on line-of-sight surfaces
- High pressure washing is laborious
- Immersion dip with phosphoric acid is preferred –
  - ✓ Ash / rust / smut removal
  - ✓ Oxidation inhibitive

NOTES:

- Generally post cleaning is required to remove a thin layer of dust that may remain after process.
- Some profiles may be suitably post-cleaned by ultrasonic bath.
- Not all profiles require post cleaning.
- Not all processes require post cleaned product.

Economical

- Pyrolytic ovens operate cost effectively.
- Continuous flow allows on-line system reducing:
  - ✓ Material Handling
  - ✓ Damage to Product
  - ✓ Inventory of Carriers and fixtures
- Post cleaning allows cleaner fixtures, reducing product rejects and repairs
- Pyrolytic ovens are environmentally friendly… operate cleanly with no fly ash or fugitive emissions, with reduced environmental and regulatory risk.