

Innovative Laser Paint Stripping Technology for Reducing VOC's, Toxics and Particulates

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Institute for Research and Technical Assistance (IRTA)

- Small technical nonprofit organization established in 1989
- Identifies, develops, tests, demonstrates safer alternatives and technologies
- Major focus is industrial and consumer product solvent applications
 - Cleaning, paint stripping, dry cleaning, printing, coating, adhesives
- Projects sponsored by federal, state and local government agencies
- Worked with hundreds of California facilities

Background

- California Air Resources Board (CARB) grant
 - ICAT program
- Partners
 - IRTA
 - Southern California Edison
 - Laser Strip
- Project aim
 - Test, demonstrate and evaluate portable hand-held laser prototype

Advantages of Laser Stripping

- Chemical stripping
 - VOC and toxic solvent emissions, high waste generation, water contamination
 - Can't strip certain substrates
- Media blasting
 - PM 2.5 and PM 10 emissions, hazardous emissions, high waste generation, expensive controls
 - Can't strip certain substrates
- Manual, thermal
 - Expensive
- Laser stripping relies on light
 - Low emissions, waste generation and can do all substrates

Description of Laser Technology

- Laser generates pulses in 10.6 micron frequency range of infrared spectrum
- Light is absorbed by paints and other contaminants
- High peak power causes small explosion of organic materials which are vaporized
 - Called ablation
- Particulates routed to filter
- Substrate does not absorb light
- Can be tuned to remove contaminants one at a time

Description of Laser Prototype

- Carbon dioxide laser
 - 10.6 micron frequency range
 - HEPA filtration system
 - Can be tuned
- Portable
 - Fits in pickup truck
- Hand-held
 - Arm allows easy movement
- 100 watts
- Used prototype to demonstrate concept



Potential Applications of Laser Stripping

- Aircraft
- Ground vehicles
- Ship internal tanks, hulls
- Oil platforms
- Bridges

Description of Demonstrations

- Aircraft parts stripping at Aero Pro
- Water storage tank stripping at San Bernardino Airport
- Ground vehicle stripping at Barstow Marine Base
- Ship parts and panel stripping at San Diego Navy corrosion control facility

Project Demonstrations

- Aircraft parts stripping
 - Aero Pro
 - Aircraft maintenance facility at San Bernardino Airport
 - Epoxy primer, polyurethane topcoat, CARC
 - Parts included engine cowling (aluminum,) Kreuger flap (magnesium,) aileron (aluminum)
 - Prototype laser stripped coatings 2 to 14 millimeters thick and sealant
 - Laser could not strip graphite on aileron

Project Demonstrations Cont'd



Project Demonstrations Cont'd



Demonstrations Cont'd

- Water storage tank stripping
 - San Bernardino airport
 - Meant to represent steel substrates of all kinds
 - Epoxy primer, polysiloxane topcoat
 - Removed primer and topcoat, topcoat only, rust
 - Coating average thickness of 3.5 millimeters

Demonstrations Cont'd



Demonstrations Cont'd



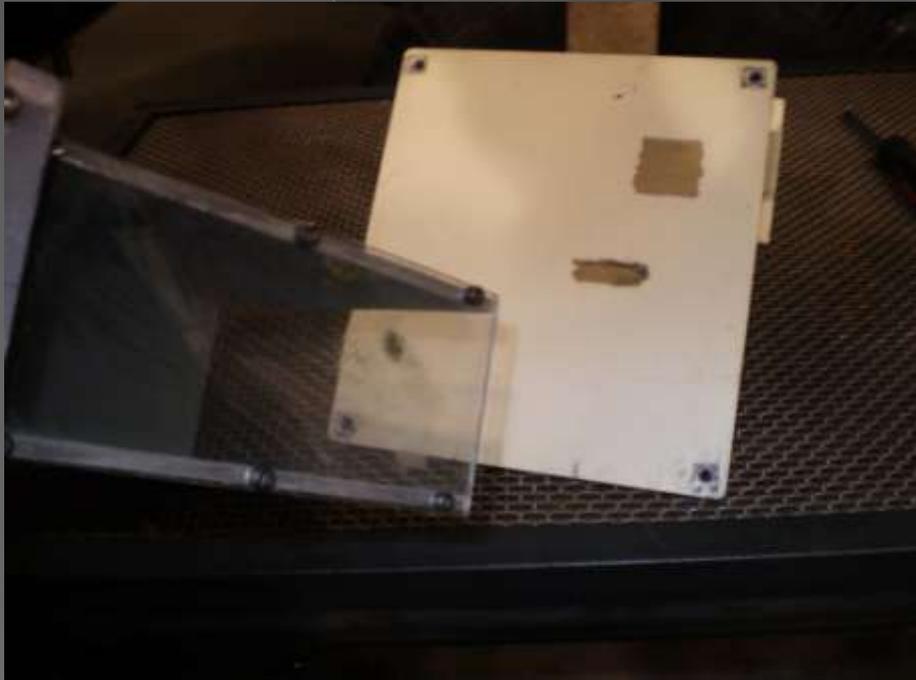
Demonstrations Cont'd

- Ground vehicle stripping
 - Barstow Marine Base
 - Maintenance of ground vehicles
 - Must strip variety of paints on range of substrates
 - CARC, epoxy, latex, polyurethane
 - Aluminum, iron, steel, fiberglass, composite
 - Stripped coatings 1 to 30 millimeters thick
 - Corrosion, sealant

Demonstrations Cont'd



Demonstrations Cont'd



Demonstrations Cont'd



Demonstrations Cont'd

- Navy parts / panel stripping
 - Navy Southwest Regional Maintenance Center
 - Powder coatings, marine coatings
 - Parts included stanchions, high metal content, silicon / epoxy
 - Coating thickness ranged from 7 to 27 millimeters

Demonstrations Cont'd



Feasibility and Cost Analysis for Demonstrations

- Aircraft parts
 - Compared to methylene chloride stripping
- Water storage tank
 - Compared to sand blasting
- Ground vehicle stripping
 - Compared to garnet blasting
- Navy stanchions
 - Compared to burn-off oven
- Assumed larger lasers with higher strip rates
 - 3,000 vs 100 watts
 - 6,000 vs 100 watts

Cost Analysis for Demonstrations

– Aircraft Stripping

- Chemical Stripping Procedure
 - Mask off aircraft and put tarp on floor of hanger
 - Apply methylene chloride stripper to aircraft
 - Agitate surface with brushes
 - Apply second coat of stripper
 - Remove stripper / coating residue onto tarp
 - Shovel waste material into drums
 - Rinse aircraft with high pressure low volume water
 - Collect water for disposal

VENETIAN 747



VENETIAN 747



VENETIAN 747



VENETIAN 747



VENETIAN 747



DESAULT FALCON 2000



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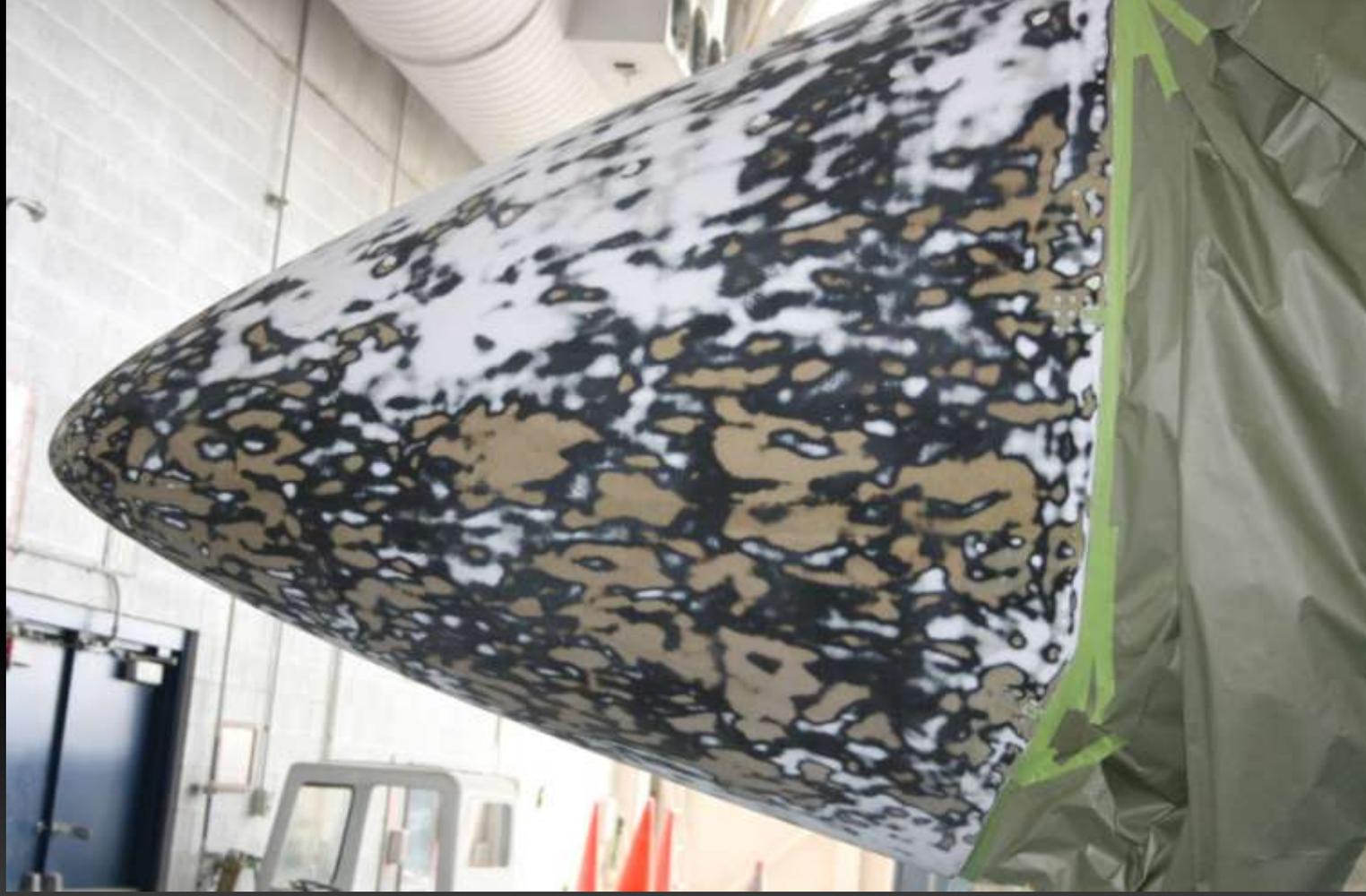
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Aircraft Stripping Cont'd

- Case study
 - 727 – 200 fuselage and vertical stabilizers
 - 5,400 square feet of surface area
 - Six drums of methylene chloride stripper
 - Six workers performing stripping
 - 415 labor hours in 36 elapsed hours
 - Generates four drums of waste
 - Generates 1,200 gallons of water waste
 - Use fan for ventilation
 - Total stripping cost of \$36,235

Aircraft Stripping Cont'd

- Laser Stripping
 - Assumed strip rate of 500 square feet per hour per mil of coating
 - Laser leasing service cost of \$500 per hour
 - Stripping cost of \$1 per square foot per mil of coating
 - 5,400 square feet and 4.5 mil thickness
 - Total stripping cost of Laser Stripping is \$25,920

Cost Analysis for Demonstrations

– Water Storage Tank Stripping

- Sand blast stripping procedure
 - Shroud tank in shrink wrap
 - Leave work zone between tank and shroud
 - Erect three foot wide scaffolding around tank
 - Outside perimeter for shrink wrap
 - Don't know if waste hazards before stripping
 - Build secondary containment plastic sheeting structure under shrink wrap
 - Haul off waste daily
 - Operate sand blaster

Water Storage Tank Stripping Cont'd

- Case Study
 - 8,243 square feet of surface area
 - Requires five to seven days to strip
 - Use rule of thumb for cost of sand blasting -- \$2 per square foot
 - Shrouding company cost also based on square feet
 - Erect scaffolding
 - Provide shrink wrap containment
 - Waste hauling company
 - Build secondary containment
 - Profile, bag and dispose of waste
 - Total stripping cost of \$57,796 if waste is hazardous

Water Storage Tank Stripping Cont'd

- Laser stripping
 - Assumed strip rate and laser leasing service cost
 - \$1 per square foot per mil of coating
 - 8,243 square feet and 3.5 mil thickness
 - Cost of laser stripping is \$24,729

Cost Analysis for Demonstrations

– Ground Vehicle Stripping

- Barstow's current stripping process relies on blast media, primarily garnet blasting
 - Base has four large booths and airborne media / paint residue routed to control devices
 - Two shifts with six workers
 - Vehicles, parts placed on pallets and blasted
 - Auger, elevator motors and compressors operate during stripping
 - Drums used for disposal

Ground Vehicle Stripping Cont'd

- Case Study
 - Evaluated annual stripping costs
 - Strips about 270,000 square feet per year
 - Requires six workers in four booths
 - Used stripping service contractor labor rate
 - Included purchase and disposal costs of media
 - Included maintenance costs for equipment
 - Included energy costs from booth motors
 - Total cost of stripping amounts to \$927,917 per year

Ground Vehicle Stripping Cont'd

- Laser Stripping
 - Assumed same strip rate and laser leasing service cost
 - \$1 per square foot per mil of coating
 - 271,011 square feet of surface area and average of 10 mils thickness
 - Two scenarios
 - Small laser service cost would be \$2,710,110
 - Large laser purchase and operation cost would be \$509,389

Cost Analysis for Demonstrations

– Navy Parts Stripping

- Burn-off oven procedure
 - Parts originally coated with thermal spray aluminum paint and then a polyester powder coat
 - Parts placed in burn-off oven to remove powder coat
 - Parts then sand blasted prior to re-coating

Navy Parts Stripping Cont'd

- Case Study
 - 150 stanchions stripped per day
 - Based on stanchion dimensions, 413 square feet are stripped per day
 - Manager estimates cost of stripping stanchions at \$178 per hour
 - Excludes labor and overhead
 - Two workers conduct stripping
 - Added in labor
 - Stripping cost is \$2,289 per day

Navy Parts Stripping Cont'd

- Laser Stripping
 - Assumed same strip rate and laser leasing service cost
 - \$1 per square foot per mil of coating
 - 413 square feet of surface area and coating thickness of 7 mils
 - Cost of laser stripping \$2,891 per day

Summary of Results

Stripping Costs		
	Current Method	Laser Stripping
Aircraft	\$36,325	\$25,920(p)
Storage Tank	\$54,906 - \$57,796	\$24,729(p)
Ground Vehicles	\$927,917	\$509,389(f)
Navy Parts	\$2,289	\$2,891(p)

p is portable, f is fixed

Advantages of Laser Technology

- Can strip composite, fiberglass substrates
- Can strip sealant, rust and corrosion
- Has very little waste and air emissions
- Has lower energy requirements

Conclusions of Analysis

- Strip rate of prototype far too low to be practical
 - Laser Strip constructing two larger systems
 - 3,000 watt portable, hand-held system
 - 6,000 watt fixed system
 - Both systems can strip composite
- Laser stripping offers advantages
- Portable hand-held laser most suitable for stripping low square foot and thinner coating
- Fixed laser most suitable for stripping higher square footage and thick coating
- Report available from IRTA

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Laser Strip

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