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National Aeronautics and Space Administration

NASA TEERM Project

Corn Based Alternative to Plastic Media Blasting for Aerospace Applications *(formerly Corn Based Blasting Media)*

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Brian Greene	ITB Inc.	NASA TEERM Office Manager
Jahn Dussich	ITB Inc.	NASA TEERM Engineer/Project Manager
Wade Olsen	ITB Inc.	NASA TEERM Sr. Engineer/Assistant Project Manager

What is NASA TEERM?

- The Technology Evaluation for Environmental Risk Mitigation Principal Center (TEERM) – (*formerly AP2*)
- Identifies and validates sustainable pollution prevention technologies through joint activities
- Reduces risk while minimizing duplication and associated costs.
- Commonly involves two or more NASA stakeholders and contractors
- Collaborative approach benefits project members in multiple ways:
  - ✓Resources are shared
  - ✓Increases technical confidence
  - ✓Improves the overall technical quality
  - ✓Accelerates implementation

TEERM Partners

NASA:

- Shuttle Program
- Constellation Program
- KSC Corrosion Laboratory
- Regulatory Risk Analysis and Communication (RRAC) Principal Center
- Recycling and Affirmative Procurement (RAP) Principal Center

DoD:

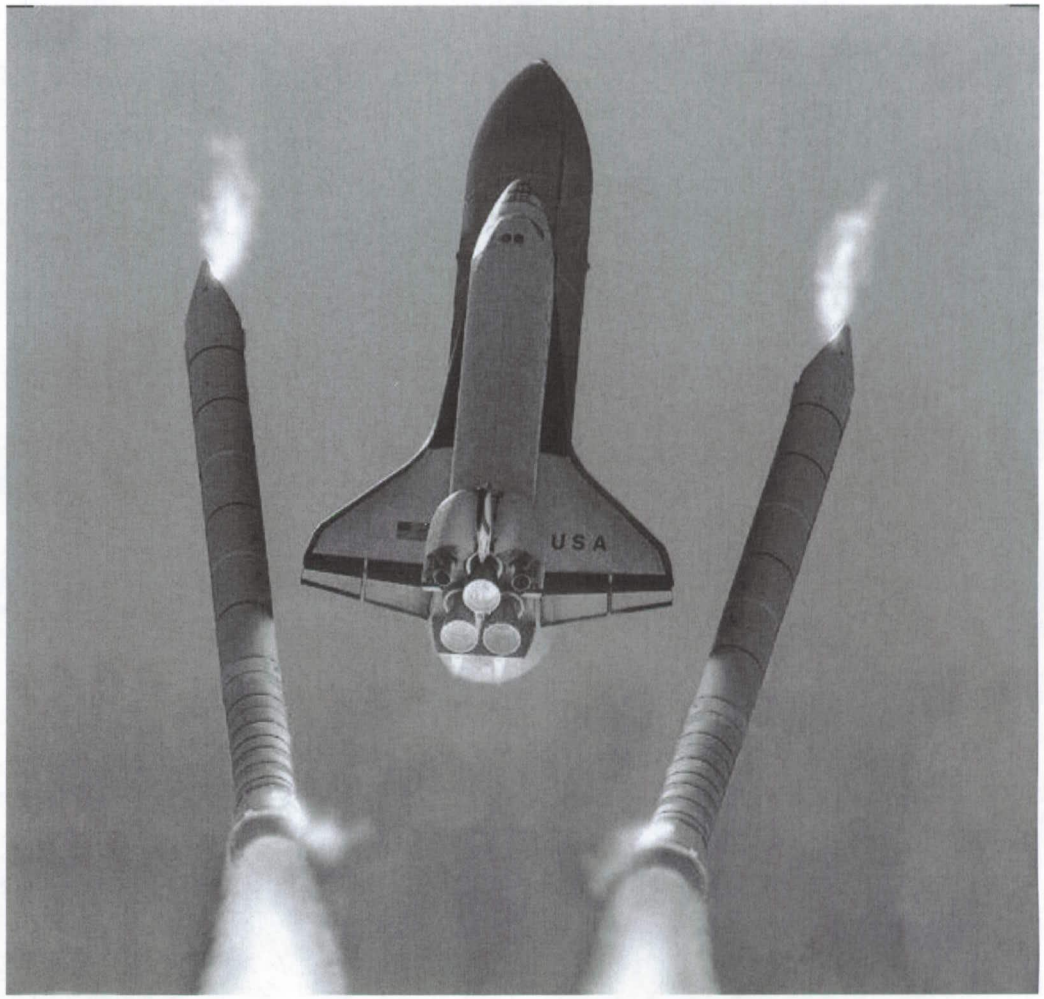
- Joint Group on Pollution Prevention (JG-PP)
- Air Force Space Command (AFSC)

International:

- Centro Para Prevenção da Poluição (Portuguese Center for Pollution Prevention) (C3P)
- European Space Agency (ESA)

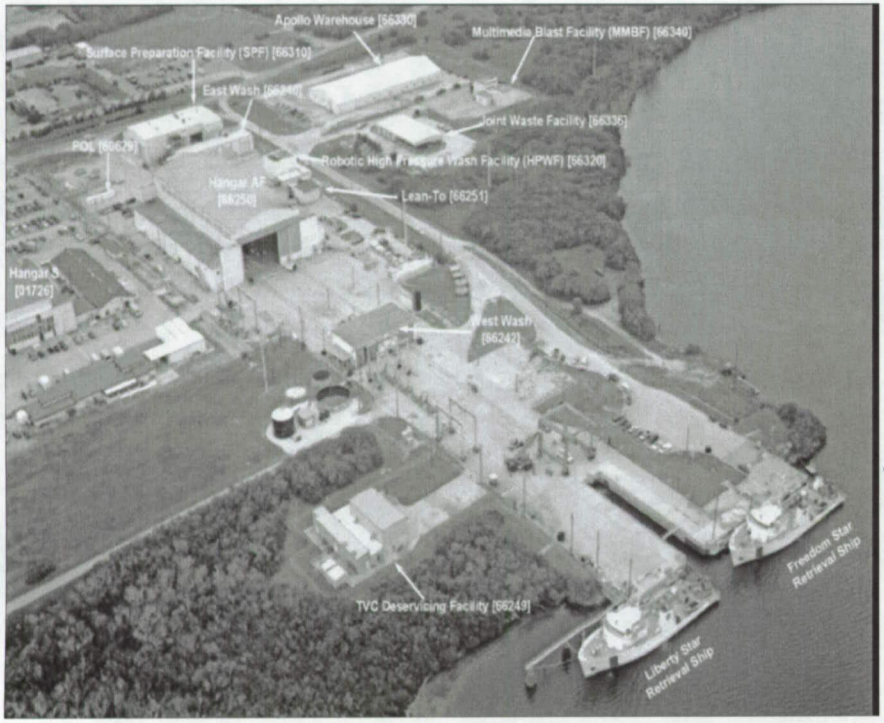
Solid Rocket Boosters

- Commonly called "The SRBs", are retrieved in the Atlantic, refurbished at KSC in Florida and at ATK in Utah
- Space Shuttle SRBs
  - Located on either side of the orange external propellant tank. The pair of large solid rockets used during the first two minutes of powered flight.
- The Ares I
  - First stage is a single, five-segment reusable SRB(NASA, (1))
- Ares V
  - First stage includes two SRB-derived rockets, which will have five and a half segments instead of the four currently used on the Space Shuttle(NASA, (1)).



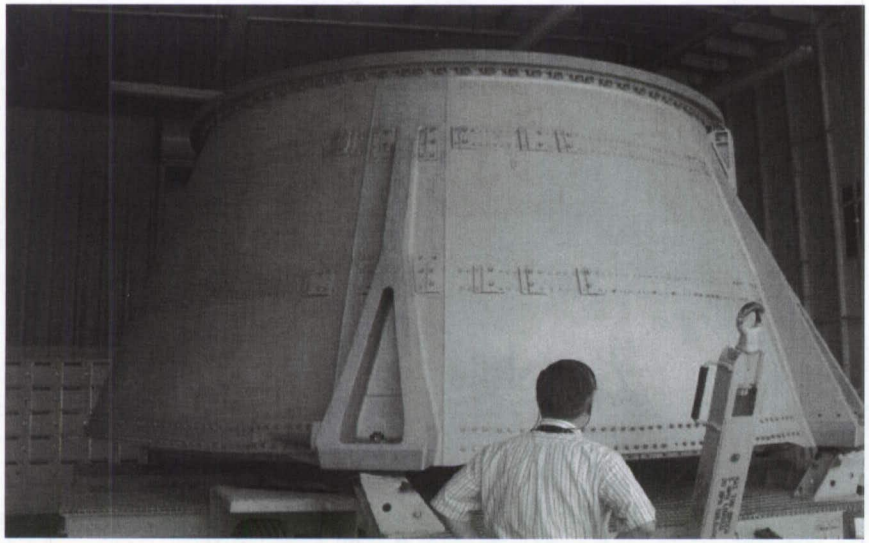
Solid Rocket Booster refurbishment

- SRBs (with aft skirts attached), frustums, and parachutes are recovered by the *Liberty Star & Freedom Star* *(NASA Facts On Line (2))*



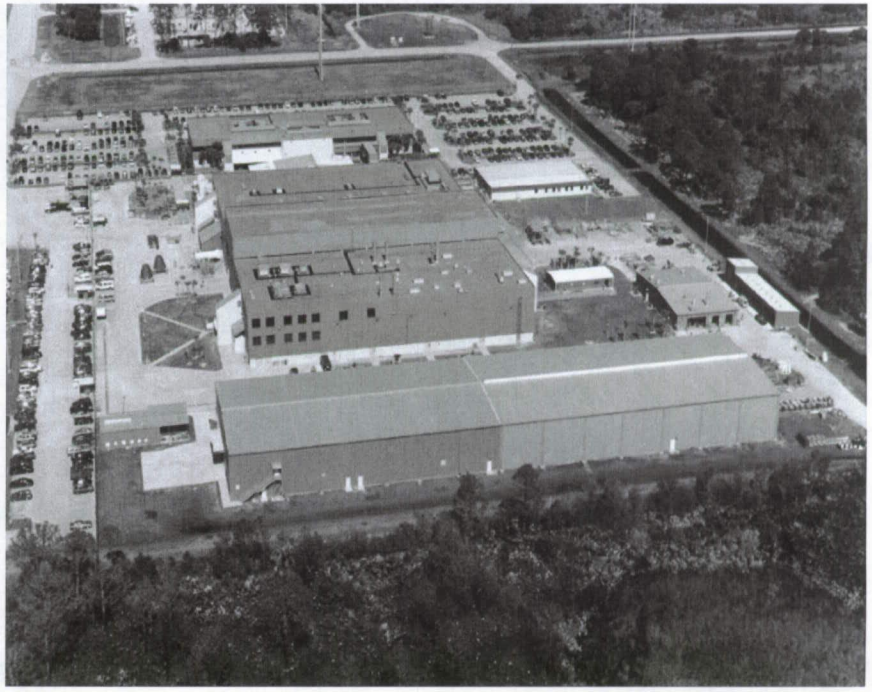
After arriving at the Hanger AF wharf the refurbishment process begins.

KSC CCF and the ARF



The frustum, aft skirt, forward skirt, and the ETA ring are stripped to bare metal at the KSC Corrosion Control Facility (KSC CCF). An SRB Aft Skirt (at right) after plastic media blasting at the Corrosion Control Facility.

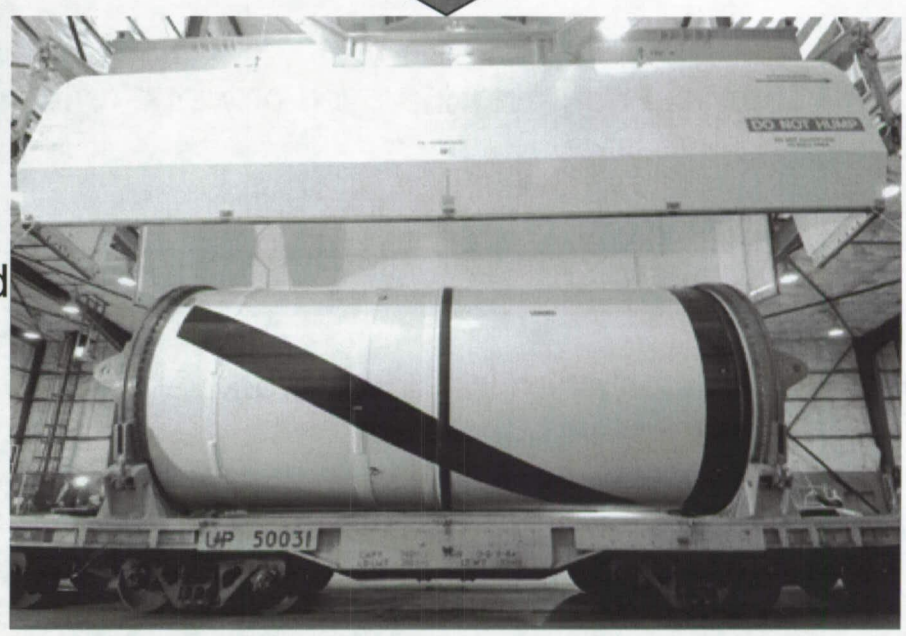
At the Assembly and Refurbishment Facility (ARF), SRB components including aft and forward skirts, frustums, nose caps, recovery systems, electronics and instrumentation as well as elements of the thrust vector control system, are refurbished, assembled and tested here (NASA Facts (3)).



ATK Launch Systems, Clearfield Refurbishment Center

In Hanger AF workers prepare the separated segments of one of the retrieved SRBs for their transport to the NASA railway. The segments will be sent to ATK in Utah for refurbishment and processing and returned to KSC.

A solid rocket segment is loaded onto a railcar at it's processing facility in Utah for NASA's Ares I crew launch vehicle. The hardware will undergo final processing and preparations before being stacked with the other portions of the Ares I-X test rocket.



SRB Refurbishment Methods, the Evolution

- Pneumatic (hand sanding): Uses abrasive substrates to scratch coatings off
  - Time consuming (767 rudder = 81 hour strip sanding job)
  - Damaging to delicate substrates (rounds off rivets, screws, leading edges, etc)
  - Dangerous (Dust hazards, flammability, etc)
  - Injurious to workers (Work-related musculoskeletal disorders (WMSDs), HAVS, etc)

- Chemical Stripping: Sprayed or wiped onto coatings, coatings are liquefied
  - Time consuming
  - Dangerous, may release Volatile Organic Chemicals (VOC) or Hazardous Air Pollutants (HAP)
  - "Safer" chemicals don't work very well
  - Contributes to waste stream

Current SRB Refurbishment Method

- Plastic Media Blasting (PMB): used to perform coatings removal as part of maintenance, repair, and overhaul activities. PMB is used on various SRB sensitive components (alloys, composites, etc).
  - Historically inexpensive media (*tied to petroleum prices)*
  - Fast stripping rate
  - Dry process, eliminates wastewater
  - Reusable, (6 – 8 times depending on the job),
  - 100% recyclable –
    - (*if spent media contains haz waste/toxics*) – sent to TSDF, grinded up and added to construction material
  - When properly used, PMB is relatively safe on delicate/sensitive substrates
  - If no post-blast chemical wipe-down is performed, PMB generates no Volatile Organic Chemicals (VOC) or Hazardous Air Pollutants (HAP)

Plastic Media Blasting (PMB)

- Risks:
  - End product liability
  - Derived from virgin, non renewable resources (*no recycled content*)
  - Petroleum based is tied to the price of oil
  - Petroleum based

SECTION IV – FIRE AND EXPLOSION HAZARD DATA

FLASH POINT ____ °F ____ °C N.A.	**FLAMMABLE:** N.A.	**LEL:** N.A.	**UEL:** N.A.
EXTINGUISHING MEDIA: Carbon dioxide, dry chemicals or water fog.			
SPECIAL FIRE FIGHTING PROCEDURES: Wear respirator (MSHA/NIOSH approved) and full protective gear. Do not use high-pressure water stream. Fog nozzles are preferable.			
UNUSUAL FIRE AND EXPLOSION HAZARDS: Product is a combustible thermoplastic resin. Burns vigorously with heat. High dust concentration could form explosive mixture with air.			

  - Urea/ Formaldehyde

SECTION VI – REACTIVITY DATA

STABILITY: ☑ **STABLE** ☐ **UNSTABLE**	**CONDITIONS TO AVOID:**
INCOMPATIBILITY (Materials to avoid): No specific incompatibility	
HAZARDOUS DECOMPOSITION or BYPRODUCTS: Smoke, carbon dioxide, carbon monoxide, formaldehyde, hydrogen cyanide at +500°F.	
HAZARDOUS POLYMERIZATION: ☑ **MAY NOT OCCUR** ☐ **MAY OCCUR**	**CONDITIONS TO AVOID:**

Plastic Media Blasting (PMB)

- Risks:
  - Unnecessary post blast procedures (leaves behind acrylic residue)
  - Petroleum based media increases risk to visual (NDE) inspection
  - Risk of damage to substrate (hardness, fracturability, material deflection)
    - Type II PMB (Urea/Formaldehyde based)= 3.5 Mohs
    - Type V PMB (petroleum based)= 3.5 Mohs
    - Type III PMB (Melamine/Formaldehyde based)= 4.0 Mohs
  - Quality risk
  - USDA BioPreferred Program

ATK, Clearfield Refurbishment Center

The nozzles and spent case segments are transported to ATK Launch Systems at Clearfield for refurbishment(NASA Facts (3))

- Currently:
  - Use varying amounts of Type III PMB for certain SRB refurbishment processes.
  - Used only once
  - Disposed of in landfill or open pit burning with mixed spent media and coatings debris.
- Concerns:
  - Use of a product containing formaldehyde and melamine
  - Recent EPA ruling puts pressure on ATK to reduce the amount of airborne particulates emitted during open burning of hazardous wastes(Air Quality Standard Designation Promontory Operations Implications (6)).
  - Future requirements under BioPreferred Program may require ATK to give preference to CHP over PMB

ISC operations at KSC Corrosion Control Facility

Refurbishment of SRB frustum, aft skirt, forward skirt, and ETA ring are performed by ISC at the Corrosion Control Facility at KSC.

- Currently:
  - Use varying amounts of Type II PMB for certain SRB refurbishment processes
  - The media is typically used 6-10 times depending on the process
  - Spent media is recycled off-site and remanufactured into SEALTECH™ Block(8)
- Concerns:
  - Use of the recycled end product below grade(8)
  - Formaldehyde is a toxic substance
  - Potential changes in procurement requirements under BioPreferred Program may require preference to CHP over PMB

USA refurbishment operations at KSC

United Space Alliance

Refurbishment of SRB components are performed by USA at Hanger AF, and Hanger N, located on the Cape Canaveral Air Force Station.

- Currently assumed:
  - USA uses varying amounts of Type ? PMB
  - 100% is recycled, spent media is reconstituted into SEALTECH™ Block(8)
- Concerns:
  - Unknown amounts, users, etc.
  - Potential procurement requirements under federal BioPreferred Program may require USA to give preference to bio-based media over petroleum based media

Proposed Alternative Blast Media

- Corn Hybrid Polymer blast media (CHP): "Starch Abrasive", which is a 100% renewable, organic, "engineered bio-based plastic" abrasive made from crystallized corn starch grown and manufactured in the U.S.
- Approved and implemented across commercial, military and aerospace. Meets MILSPEC 85891
- More stable pricing
- Compatible with existing equipment
- Reduces our reliance on fossil fuels and toxic chemicals
- Reusable, (10 - 12 times depending on the job)
- BioPreferred Program approved product (source: R.Buckhalt, USDA)
- 100% recyclable
  - (*if it contains haz waste/toxics*) – remanufactured into toxic waste absorbent, incinerated, and ash is added as an ingredient to cement.
- Less risk of damage to certain delicate/sensitive substrates than current methods (2.0 Mohs)
- CHP generates no Volatile Organic Chemicals (VOC) or Hazardous Air Pollutants (HAP), post blast wipe-down can be performed with water.

Media Blasting Comparison Origins

CHP

- 100% renewable, organic
- American farm made, biobased product
- Reduces reliance on petroleum.
- BioPreferred approved product
- Product is 100% biodegradable
- Ingredient: Corn

PMB

- Non-renewable, virgin petroleum/chemicals
- Safety concerns
- Oil based furthers our reliance on petroleum.
- Not USDA BioPreferred Program approved
- Not biodegradable
- Ingredients: Acrylate Polymer, Methyl Methacrylate, Anti-Static Agent, Formaldehyde, Melamine, additives, ...

Media Blasting Comparison Safety

CHP

- Product is non hazardous(source: Envirostrip XL MSDS)
- Leaves no residue, requires no post blast chemical wipe down
- Detectable under UV light aids in visual inspection
- Recycling:-"spent" media is remanufactured into a toxic waste absorbent which is subsequently high temp incinerated, ash is added to cement clinker.
- No restrictions on end product use

PMB

- Type V: combustible thermoplastic resin which burns vigorously with heat(source: Poly V MSDS).
- Type II contains formaldehyde (REACH SIN)
- Type III contains melamine (REACH SIN)
- Acrylic residue requires post-blast removal by additional chemical wipe-down or other methods
- PMB has propensity to liquefy and fill small cracks – concern for NDE inspection
- Recycling- "spent" media is ground up and added to construction materials. Above grade use only

Media Blasting Comparison Performance

CHP

- Designed to meet MIL-P-85891(A)
- Uses same equipment and same basic techniques as PMB
- As Starch media breaks down it fractures along its crystalline structure creating new cutting edges. The more it is cycled the more aggressive this material becomes.
- Starch is an extremely sharp material that cuts coatings very effectively, yet is as soft as your fingernail. (Hardness 2.0Mohs)
- Unlike prior bio-based blast media CHP has no moisture concerns and upon drying will return to it's granular state

PMB

- Designed to meet MIL-P-85891(A)
- Product "rounds" the more it's used, leading operator to have to either increase pressure or proximity to the substrate to maintain consistent removal rates.
- Plastic is an "impact" media that fractures coatings through repeated "high energy" impacts. (Hardness 3.5 – 4 Mohs) This process may cause heat, and the potential for substrate deflection and damage.
- Plastic media leaves behind an oily residue which must be removed before subsequent work can continue.

Media Blasting Comparison Costs

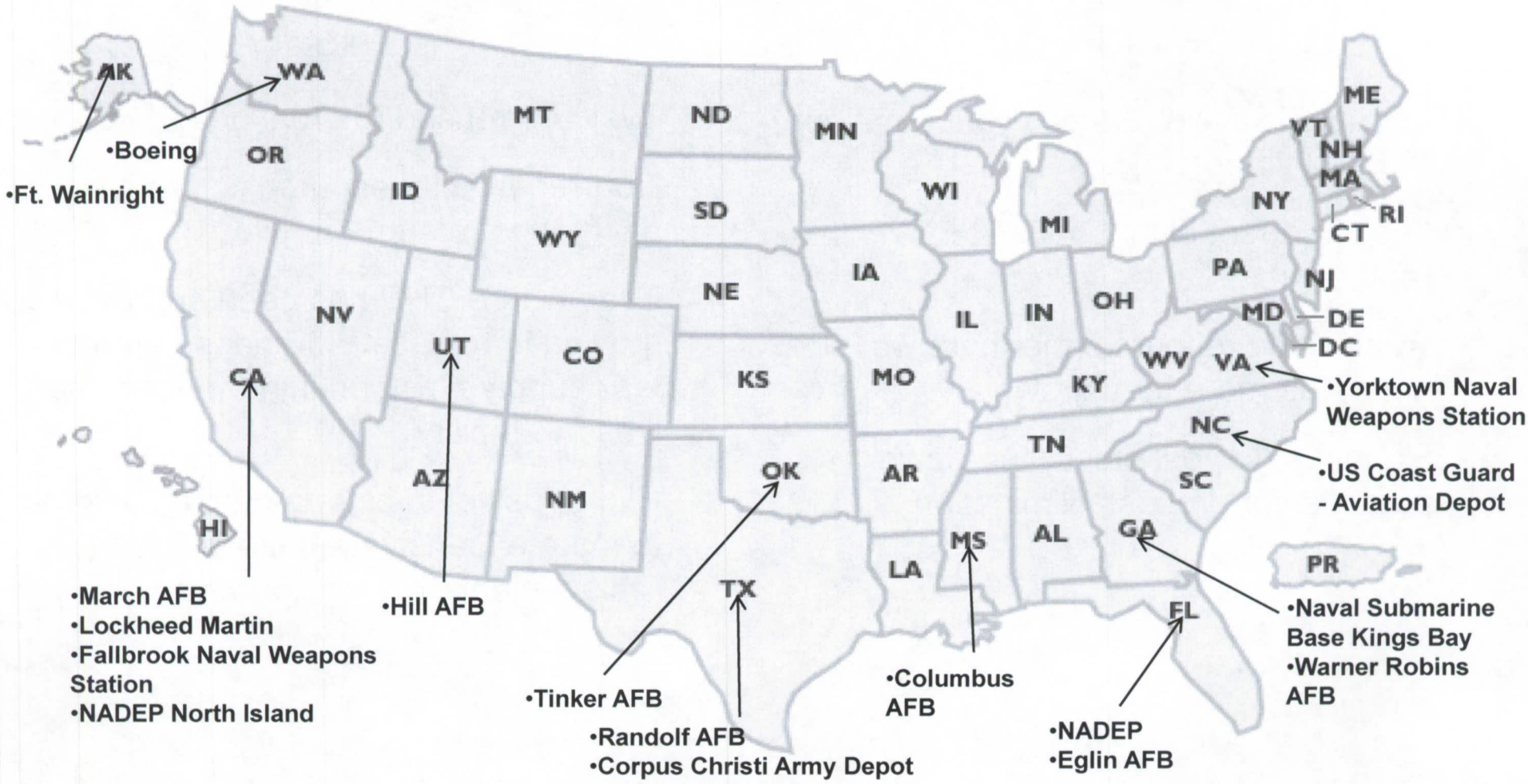
CHP

- Longer life cycle reduces consumption (10 - 12 times)
- Less frequent blast booth filter replacements
- Renewable resource, the more we need, the more they grow
- Requires no post blast wipe-down, potential for process elimination

PMB

- Typically reused (8 -10 times)
- Non-renewable resource tied to the price of petroleum
- Everywhere CHP has been approved is moving to replace PMB, less demand = less supply = risk of higher prices and less availability
- Higher risk of substrate damage leads to more expensive repairs or replacements.

Corn Based Blast Media Usage



A Need within NASA

- To simultaneously be on the forefront of new, and novel technologies, while making sure these technologies meet NASA's exacting requirements
- To use environmentally preferred, best-management practices where possible which help generators meet regulatory requirements such the USDA BioPreferred Program's procurement process for federal agencies and their contractors
- For a potential process improvement in visual inspection and elimination of costly, time consuming, dangerous procedures.
- To implement processes which last longer, work better, and don't require extensive new training or equipment changes thereby saving money

Project Justification

- Potentially reduces risks associated with environmental, safety, and health concerns
- Potentially reduces overall operating costs
- Potentially provides more stable pricing forecasts
- Potentially reduces risk of technology obsolescence
- Project is a continuation of previous successful DoD studies conducted by NASA TEERM and JG-PP thus reducing duplication of effort and costs.

Project Goals

- Evaluate corn-based blasting media for removing coatings from delicate substrates
- Evaluate overall coatings removal efficacy and cost feasibility
- Determine if the process meets stakeholder requirements
- Identify approval authorities and implementation paths for corn-based blasting media at NASA facilities
- Determine feasibility and help facilitate implementation

Description

- **Stakeholders:**

- NASA (Kennedy Space Center, Marshall Space Flight Center), Portuguese Center for Pollution Prevention (C3P), United Space Alliance (USA), ATK Thiokol (ATK), Archer Daniel Midland (ADM), Midvale Technologies, Institutional Service Contract (URS, Yang, EG&G, Dynamac, etc.)

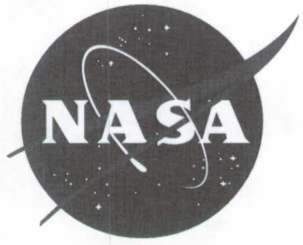
- **Project Set-up (example):**

  - Field Testing
    - ➢ Coatings removal at existing facilities
    - ➢ Timed strip-rate trials
    - ➢ Testing against current specifications
    - ➢ Laboratory testing if required.

Special thanks to:

Questions?

Thank you!



References

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2. http://www-pao.ksc.nasa.gov/kscpao/nasafact/ships.htm.
3. NASA Facts, FS-2004-07-012-KSC (Rev. 2006)
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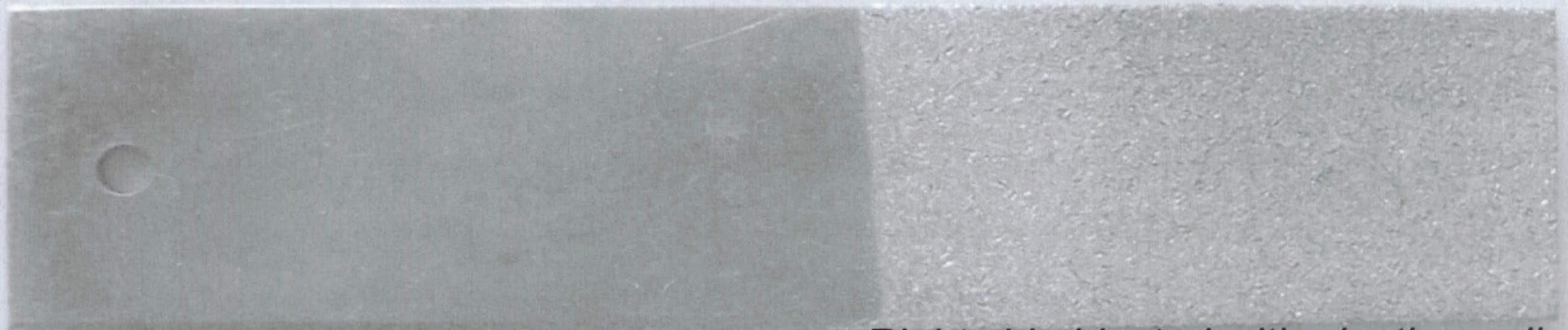
5. http://www.sealtechblock.com/
6. Gosen, Dave, power point presentation on Air Quality Standard Designation Promontory Operations Implications, ATK Launch Systems, April 23rd, 2009, slides 2-3
7. U.S.Technology Corp. Poly V Material Safety Data Sheet
8. Archer Daniels Midland Company Envirostrip XL Material Safety Data Sheet
9. Pratt & Whitney approval for removal of Magnesium from delicate surfaces ADM Newsletter 2008.pdf

Supporting Documents

4340 steel, cadmium plated, blasted for 5 seconds



Left side blasted with XL—cadmium remains intact.

Right side blasted with plastic media-- cadmium removed.

Supporting Documents

Corn Hybrid Polymer (CHP) Media (eStripTMGPX)

- Polycrystalline cornstarch material
- 100% organic, non-toxic, and biodegradable
- Operating pressures range from 20-35psi
- Used in standard light abrasive blast equipment
- Considered a “drop-in” replacement for many plastic media blasting (PMB) systems
- Meets MIL-P-85891
- Generates minimal waste
- Low dust, non-hazardous
- Manufactured by Archer Daniels Midland (ADM)
- Sole Government distributor is Midvale Environmental Technologies

Supporting Documents

SECTION I

PRODUCT NAME OR NUMBER (as it appears on label) Polyplus® Plastic Blast Abrasive (Type Two)	
MANUFACTURER'S NAME U.S. Technology Corporation	**EMERGENCY TELEPHONE NO.** (330) 455-1181
ADDRESS (Number, Street, City and Zip Code) 1446 W. Tuscarawas St., Canton OH 44702	**DATE PREPARED/REVISED – NO.** September 29, 2008-6
MATERIAL DESCRIPTION, PROPER SHIPPING NAME Plastic Abrasive, Polyplus	
HAZARD CLASSES (as applicable): N.A.	
CHEMICAL FAMILY: Amino Thermoset Plastic	**FORMULA:** N.A.

SECTION II – INGREDIENTS
(list all ingredients)

CAS REGISTRY NO.	Approx. %W	Chemical Name(s)	OSHA PEL	ACGIH TLV	Other Limits Recommended
9004-34-6 9011-05-6	>1%	Polymerized Urea Formaldehyde Compound w/ Alpha Cellulose Filler			
2764-13-8	<1%	Anti-Static Agent – Cal Stat 600			
5280-80-8 13463-67-7 12769-96-9	<1%	Pigments and Additives			

SECTION III – PHYSICAL DATA

BOILING POINT___°F ___ °C N.A.	**SPECIFIC GRAVITY (H_2O=1):** 1.47-1.52	
MELTING POINT___°F ___°C N.A.	**PERCENT VOLATILE BY VOLUME (%)** N.A.	**PERCENT SOLID BY WEIGHT (%)** 100
VAPOR DENSITY (AIR=1) N.A.	**EVAPORATION RATE (=1)** N.A.	
SOLUBILITY IN WATER - Not	**pH=** 4-8	
APPEARANCE AND ODOR: Multi-colored granules with slight plastic odor		**MATERIAL FORM:** Solid

SECTION IV – FIRE AND EXPLOSION HAZARD DATA

FLASH POINT ____ °F ___ °C: N.A.	**FLAMMABLE:** N.A.	**LEL:** N.A.	**UEL:** N.A.
EXTINGUISHING MEDIA: Carbon dioxide, dry chemicals or water fog			
SPECIAL FIRE FIGHTING PROCEDURES: Do not use high-pressure water stream. Fog nozzles are preferable.			
UNUSUAL FIRE AND EXPLOSION HAZARDS: Maintain normal good housekeeping for control of dust.			

Supporting Documents

SECTION V – HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE – Conditions to avoid: Mechanical injury to eyes and/or skin can occur. Excessive dust inhalation may be harmful.	**THRESHOLD LIMIT VALUE:** _____ **PERMISSIBLE EXPOSURE LIMIT:**_____
PRIMARY ROUTES OF ENTRY: ☑ **Inhalation** ☑ **Skin Contact** ☐ **Other (specify)**	
EMERGENCY AND FIRST AID PROCEDURES: Inhalation: Remove to fresh air. **Skin:** Wash affected area with soap and water. **Eye:** Flush immediately with large amounts of lukewarm water. Call physician if necessary.	

SECTION VI – REACTIVITY DATA

STABILITY: ☑ **STABLE** ☐ **UNSTABLE**	**CONDITIONS TO AVOID:** Temperatures over 260C (500°F)
INCOMPATIBILITY (Materials to avoid): Strong acids, bases, oxidizing agents.	
HAZARDOUS DECOMPOSITION or BYPRODUCTS: Acrylic monomers	
HAZARDOUS POLYMERIZATION: ☑ **MAY NOT OCCUR** ☐ **MAY OCCUR**	**CONDITIONS TO AVOID:** N.A.

SECTION VII – SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Remove open flame, sparks, hot surfaces, and oxidizing agents. Sweep up and place waste in disposal container.
WASTE DISPOSAL METHOD: Sanitary landfill in accordance with Federal, State, and Local regulations.
CERCLA (Superfund) REPORTABLE QUANTITY (in lbs.): N.A.
RCRA HAZARDOUS WASTE NO. (40 CFR 261.33): N.A.
VOLATILE ORGANIC COMPOUND (VOC) (as packaged, minus water): N.A. ☐ **Theoretical** _____ **lbs. /gal.** ☐ **Analytical** _____ **lbs. /gal.**

SECTION VIII – SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify Type): Where required, use NIOSH/MSHA approved respiratory protection in compliance with OSHA regulations (i.e. 1910.134 et. al.).	
VENTILATION	**LOCAL EXHAUST (Specify Rate):** Where necessary to maintain exposure levels to OSHA permissible levels.
	MECHANICAL (General – Specify Rate): Acceptable
	SPECIAL: Explosion proof may be necessary if aerated or airveyed.
	OTHER:
PROTECTIVE GLOVES (Specify Type): Normal	**EYE PROTECTION (Specify Type):** Safety goggles
OTHER PROTECTION EQUIPMENT: Respirator hood, if necessary.	

SECTION IX – SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in closed, properly labeled containers in cool ventilated area. Keep away from heat, sparks, open flame and oxidizing agents. Do not transfer to unmarked containers.
OTHER PRECAUTIONS: None

Supporting Documents

SECTION I

PRODUCT NAME OR NUMBER (as it appears on label) Poly V® Plastic Blast Abrasive (Type V)	
MANUFACTURER'S NAME U.S. Technology Corporation	**EMERGENCY TELEPHONE NO.** 330) 455-1181
ADDRESS (Number, Street, City and Zip Code) 1446 W. Tuscarawas St., Canton OH 44702	**DATE PREPARED/REVISED NO.** September 29, 2008-4
MATERIAL DESCRIPTION, PROPER SHIPPING NAME Plastic Abrasive	
HAZARD CLASSES (as applicable): Non-regulated	
CHEMICAL FAMILY: Acrylic Polymer	**FORMULA:** N.A.

SECTION II – INGREDIENTS
(list all ingredients)

CAS REGISTRY NO.	Approx. %W	Chemical Name(s)	OSHA PEL	ACGIH TLV	Other Limits Recommended
25852-37-3	>1%	Acrylate Polymer (Non-Hazardous)	N.E.	N.E.	
80-62-6	Trace	Methyl Methacrylate Monomer	100	100 ppm	
2764-13-8	<1%	Anti-Static Agent – Cal Stat 600	N.A.	N.A.	

SECTION III – PHYSICAL DATA

BOILING POINT____°F ____ °C N.A.	**SPECIFIC GRAVITY (H_2O=1):** 1.10 -1.20	
MELTING POINT____°F 132 **°C**	**PERCENT VOLATILE BY VOLUME (%)** N.A.	**PERCENT SOLID BY WEIGHT (%)** 100
VAPOR DENSITY (AIR=1) N.A.	**EVAPORATION RATE (=1)** N.A.	
SOLUBILITY IN WATER Not	**pH=** 4-8	
APPEARANCE AND ODOR: Multi-colored or clear white granules with slight odor or methyl methacrylate		**MATERIAL FORM:** Solid

SECTION IV – FIRE AND EXPLOSION HAZARD DATA

FLASH POINT _____ °F _____ °C N.A.	**FLAMMABLE:** N.A.	**LEL:** N.A.	**UEL:** N.A.
EXTINGUISHING MEDIA: Carbon dioxide, dry chemicals or water fog.			
SPECIAL FIRE FIGHTING PROCEDURES: Wear respirator (MSHA/NIOSH approved) and full protective gear. Do not use high-pressure water stream. Fog nozzles are preferable.			
UNUSUAL FIRE AND EXPLOSION HAZARDS: Product is a combustible thermoplastic resin. Burns vigorously with heat. High dust concentration could form explosive mixture with air.			

Supporting Documents

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EFFECTS OF OVEREXPOSURE – Conditions to avoid: Mechanical injury to eyes and/or skin can occur. Excessive dust inhalation may be harmful.	**THRESHOLD LIMIT VALUE:** _____ **PERMISSIBLE EXPOSURE LIMIT:**_____
PRIMARY ROUTES OF ENTRY: ☑ **Inhalation** ☑ **Skin Contact** ☐ **Other (specify)**	
EMERGENCY AND FIRST AID PROCEDURES: Inhalation: Remove to fresh air. **Skin:** Wash affected area with soap and water. **Eye:** Flush immediately with large amounts of lukewarm water. Call physician if necessary.	

SECTION VI – REACTIVITY DATA

STABILITY: ☑ **STABLE** ☐ **UNSTABLE**	**CONDITIONS TO AVOID:** Temperatures over 260C (500°F)
INCOMPATIBILITY (Materials to avoid): Strong acids, bases, oxidizing agents.	
HAZARDOUS DECOMPOSITION or BYPRODUCTS: Acrylic monomers	
HAZARDOUS POLYMERIZATION: ☑ **MAY NOT OCCUR** ☐ **MAY OCCUR**	**CONDITIONS TO AVOID:** N.A.

SECTION VII – SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Remove open flame, sparks, hot surfaces, and oxidizing agents. Sweep up and place waste in disposal container.
WASTE DISPOSAL METHOD: Sanitary landfill in accordance with Federal, State, and Local regulations.
CERCLA (Superfund) REPORTABLE QUANTITY (in lbs.): N.A.
RCRA HAZARDOUS WASTE NO. (40 CFR 261.33): N.A.
VOLATILE ORGANIC COMPOUND (VOC) (as packaged, minus water): N.A. ☐ **Theoretical** _____ **lbs. /gal.** ☐ **Analytical** _____ **lbs. /gal.**

SECTION VIII – SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify Type): Where required, use NIOSH/MSHA approved respiratory protection in compliance with OSHA regulations (i.e. 1910.134 et. al.).	
VENTILATION	**LOCAL EXHAUST (Specify Rate):** Where necessary to maintain exposure levels to OSHA permissible levels.
	MECHANICAL (General – Specify Rate): Acceptable
	SPECIAL: Explosion proof may be necessary if aerated or airveyed.
	OTHER:
PROTECTIVE GLOVES (Specify Type): Normal	**EYE PROTECTION (Specify Type):** Safety goggles
OTHER PROTECTION EQUIPMENT: Respirator hood, if necessary.	

SECTION IX – SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in closed, properly labeled containers in cool ventilated area. Keep away from heat, sparks, open flame and oxidizing agents. Do not transfer to unmarked containers.
OTHER PRECAUTIONS: None

Supporting Documents

ADM

MATERIAL SAFETY DATA SHEET

(Complies with 29 CFR 1910.1200)

PRODUCT NAME: **eSTRIP GPX 16/40**
(Code): (1698-C)

Section I - Identification

Manufacturer's Name Archer Daniels Midland Company (ADM)	**Emergency Telephone Number** 450-659-1911
Address 155 Iberia Candiac, Quebec J5R 3H1	**Telephone Number for Information** 514-846-8516

Section II - Hazardous Ingredients / Identity Information

CHEMICAL IDENTITY (Common Name):

Corn Starch (Starch, Carbohydrate)	**CAS No.:**	9005-25-8
Poly (Methyl Methacrylate) *	**CAS No.:**	9011-14-7
Calcium Carbonate	**CAS No.:**	471-34-1

* Non-reactive - non-hazardous

DPT Classification: NIOSH 5mg/m^3

OSHA PEL: 15mg/m^3 over 8 hours
This product is not manufactured to contain a hazardous component as defined in the following regulations: 21CFR 173.340 PARA 3; 49CFR 172; 40CFR 117; 40CFR 261 and CFR 1910, Subpart Z.

ACGIH TLV: Nuisance particulate 15 mg/m^3 of total dust or 5 mg/m^3 respirable dust.

OZONE DEPLETING SUBSTANCES (ODS): No Class I or Class II material is used in the manufacture of this product or is contained in this product.

CONEG: Complies with the Conference of Northeast Governor's Model Toxic Legislation.

HAZARDOUS AIR POLLUTANT: This product does not contain any ingredient classified as a hazardous air pollutant in the Clean Air Act Amendment dated 11/15/90.

TSCA: Included on the TSCA inventory under the Chemical Abstracts number 9005-25-8
Product may be considered to be 100% of the material listed under this CAS number.

Section III - Physical / Chemical Characteristics

Boiling Point: N/A		**Specific Gravity (H2O = 1):** 1.45 ± 0.10
Vapor Pressure (mm Hg): N/A		**Melting Point:** N/A
Bulk Density (Loose): 44lb/ft^3 ± 4	**Bulk Density (Packed):** 48lb/ft^3 ± 4	**Solubility in Water:** Less than 1%
Appearance: Yellowish/ Off-white crystals		**Odour:** None

Supporting Documents

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used):	**Flammable Limits (LEL, UEL):**
Dust cloud ignition temp. = 430C	0.07-0.08 /g/l

Extinguishing Media:
Water, carbon dioxide, foam, dry chemical extinguishers.

Special Fire Fighting Procedures:
None

Unusual Fire and Explosion Hazards:
Product as sold is not hazardous.Severe physical degradation to a fine powder (smaller than 125 microns) may cause possibility of an explosion under specific conditions. Avoid accumulation of dust and handling in the presence of high temperature sources.

Section V - Reactivity Data

Stability:	**Conditions to Avoid:**
Stable under normal conditions.	Formation of a nuisance particulate dust cloud.

Incompatibility (Materials to Avoid):
None Known

Hazadous Decompositions or Byproducts:
None Known

Hazardous Polymerization:	**Conditions to Avoid:**
Not known to occur.	None Known

Section VI - Health Hazard Data

Routes of Entry:

Inhalation:	**Skin Absorption:**	**Ingestion:**	**Eyes:**
Nuisance Dust	No Hazard	Yes	Solids or dust may scratch surface of the eye, which can cause mechanical irritation.

Health Hazards (Acute and Chronic): None. The following limit values for working atmospheres of inert or nuisance dust will apply. Total dust - 15 mg/m^3; respirable fraction 5 mg/m^3.

Carcinogenicity:	**NTP:**	**IARC** Monographs:	**OSHA Regulated:**
No	No	No	No

Signs and Symptoms of Exposure:
Excessive concentrations of particulates in workroom air may seriously reduce visibility, may cause unpleasant deposits in eyes, ears and nasal passages, or may cause temporary injury to the skin or mucuous membranes by mechanical action.

Medical Conditions Generally Aggravated by Exposure: The American Conference of Governmental Industrial Hygienists (ACGIH) has reported that so called 'nuisance' dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control.

Emergency and First Air Procedures: **Eyes:** immediately flush with clean lukewarm water (low pressure) until irritation subsides. If irritation persists, get medical attention. **Ingestion**: Treat symptomatically. FDA considers corn starch a Generally Recognized as Safe (GRAS) substance. **Inhalation**: If exposed to excessive levels of dust, remove to fresh air. Get medical attention if persistent cough or other symptoms develop. **Skin**: Wash with soap and water.

Supporting Documents

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled:

Avoid open flames, smoking, friction sparks, static sparks, welding and cutting tools in dusty surroundings. Sweep up spilled material and place in suitable receptacles for disposal. Flush spill area with water to remove with water to remove residues. Do not flush to storm sewer or waterway.

Waste Disposal Method:

Conform to applicable federal, provincial, state, and municipal regulations. Is not hazardous waste as specified in 40CFR 261. Dispose in an approved landfill in accordance with provincial, state, and municipal regulations.

Precautions to Be Taken in Handling and Storing:

Best storage is under dry, cool, away from heat source. Do not expose to open flame or sparks. Practice good housekeeping.

Other Precautions:

Avoid situations creating dust.

Section VIII - Control Measures

Respiratory Protection (*Specify Type*):

Use appropriate NIOSH/MSHA-approved mask when necessary.

Ventilation:

Local exhaust (wired to protect against ignition hazards posed by dust) should be used to maintain air-born dust concentrations below applicable OEL standards.

Protective Gloves:	**Eye Protection:**
Impervious Gloves	CSA Approved Safety Glasses

Other Protective Clothing or Equipment:

Good industrial hygiene practice.

Section IX - Preparation Information

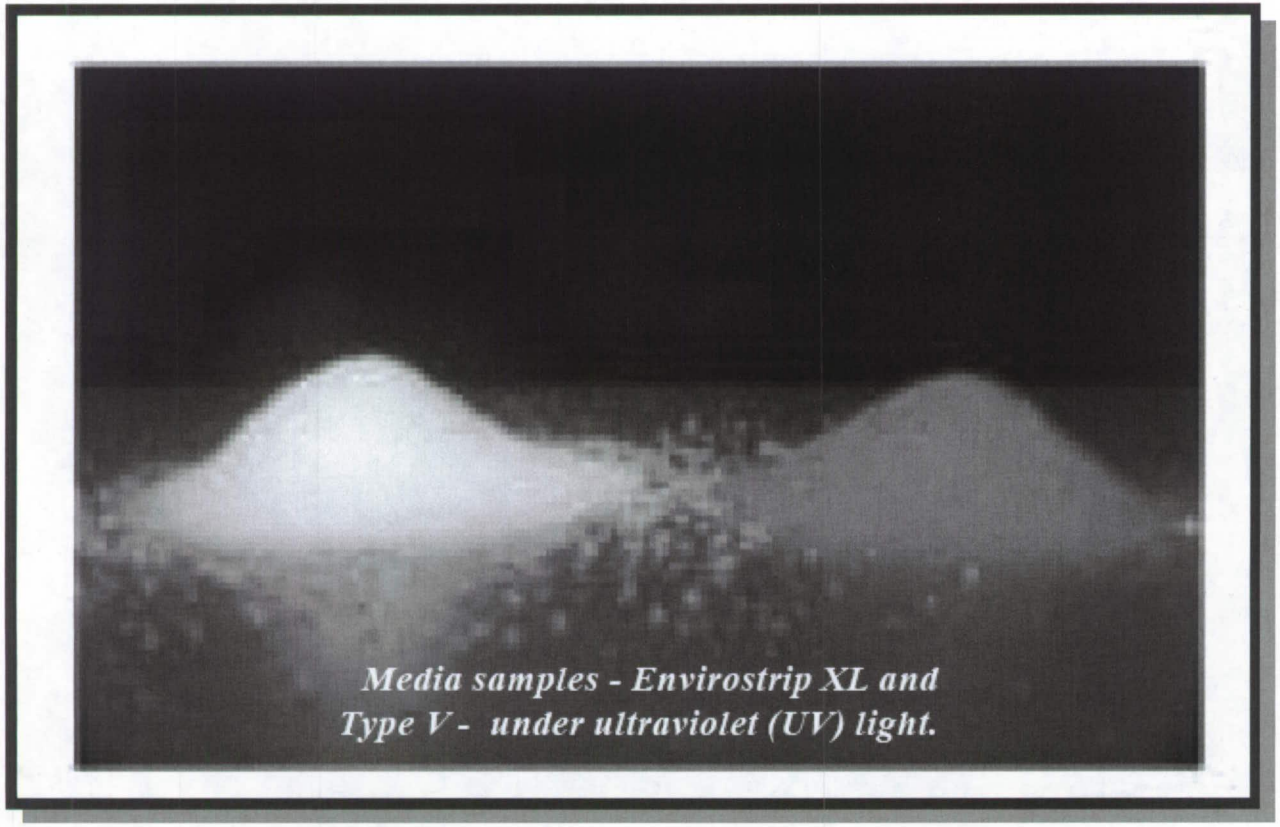
Prepared By: ADM	**Telephone #:**	**Revision Date:**
Archer Daniels Midland Company	450.659.1911	May 31, 2007

WHMIS HAZARD RATING INDEX	
0	HEALTH
1	FLAMMABILITY
0	REACTIVITY
A	PROTECTIVE EQUIPMENT

Supporting Documents

Approval	Application	Product
Agusta	Composite stripping approval	EnviroStrip XL Corn
Airbus	Engineering Approval Composites Models A300, A310 and A340	EnviroStrip Wheat Starch
Airbus	Adhesive Bond Removal Snecma process guidelines	EnviroStrip XL Corn
Goodrich Aerospace	Adhesive Bond Removal	EnviroStrip XL Corn
Boeing Commercial	Broad OEM approval for Metals (>0.032-inch thickness) Unlimited use (all models)	EnviroStrip Wheat Starch
Boeing Commercial	Broad OEM approval for Composites (all models) Carbon fibre, Fibreglass, Kevlar	EnviroStrip Wheat Starch
Boeing Commercial	Adhesive Bond Removal	EnviroStrip Wheat Starch
Boeing Military	Metals KC-135, B-52	EnviroStrip XL Corn
Bombardier	Metals	EnviroStrip Wheat Starch
Cessna	Adhesive Bond Removal	EnviroStrip XL Corn
Raytheon	Metals	EnviroStrip WS/XL Corn
Korean Air Lines	Process Spec. Metals/Composites	EnviroStrip Wheat Starch
Sikorsky Aircraft	Composite Approval	EnviroStrip XL Corn
US Army	Helicopter Composite Approval	EnviroStrip Wheat Starch
Bell Helicopter	Metal and Composites	GPX
US Coast Guard	Helicopter and Fixed Wing Fleet	GPX
US Air Force	Mil P 85891A Approved/Fleet	GPX
Vought Aircraft	Paint and Adhesive Removal	EnviroStrip® WS/XL
US Navy	Metals and Composites	Envirostrip XL & GPX

Supporting Documents



Supporting Documents

Starch Delivers 4 to 10 Times less Impact than Plastic Abrasive

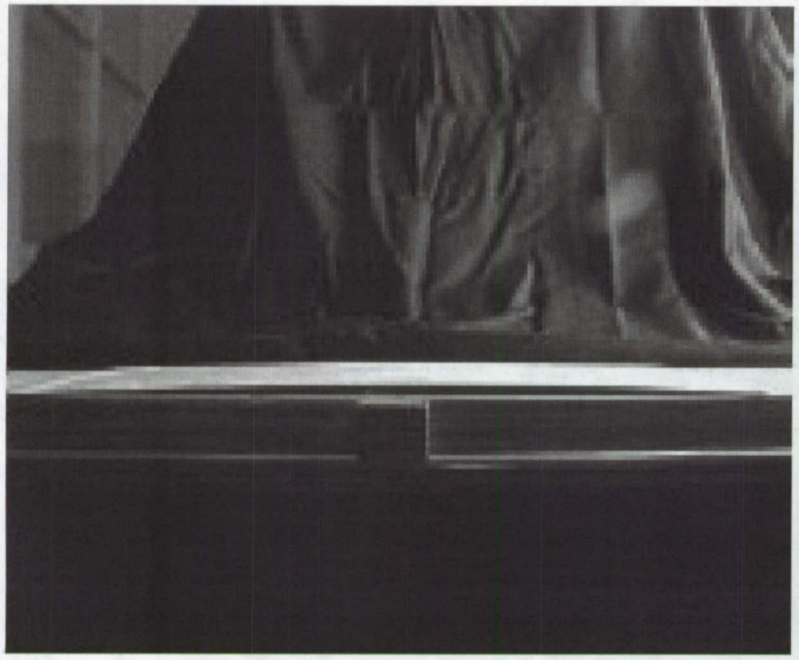


FIG 4 DEFLECTION WITH ENVIROSTRIP

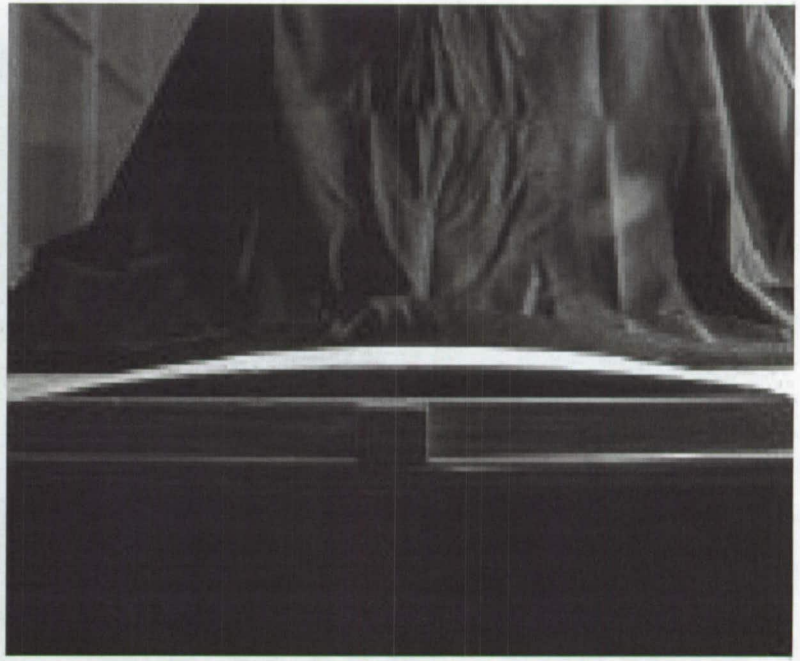


FIG 5 DEFLECTION WITH PLASTIC MEDIA