

US Army Research Laboratory

Weapons and Materials Research Directorate

Coatings Developments for Vehicles Way Forward

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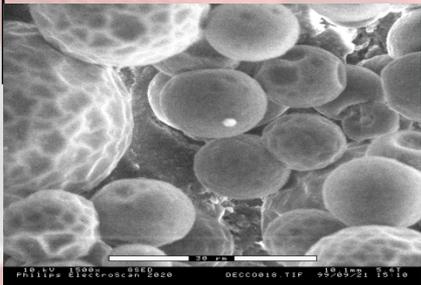
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Courtesy of U.S DoD



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Courtesy of U.S. Army

- ***Who we are & What we do.....***
- ***Prior History and Evolution of CARC***
- ***Considerations for the future***
- ***Coatings Systems for Land Vehicles***
- ***GAPS to address and Considerations for Coatings Advancement***



Courtesy of U.S. DoD

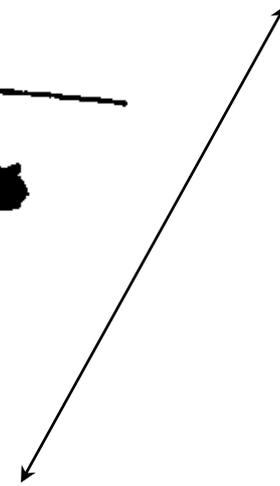
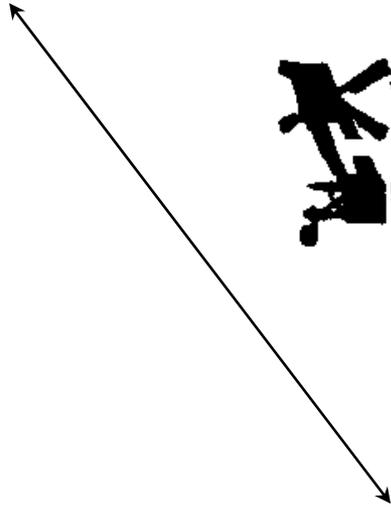


- **ARL is the Lead DOD R&D Activity for CARC**
 - Innovative formulations approaches
 - New raw materials selections
 - Advanced characterization
- **Maintains Ownership for all key specifications regarding pretreatments, primers and topcoats for all tactical and related support equipment and munition coatings.**
- ❖ *Elements above assist to implement and transition products*

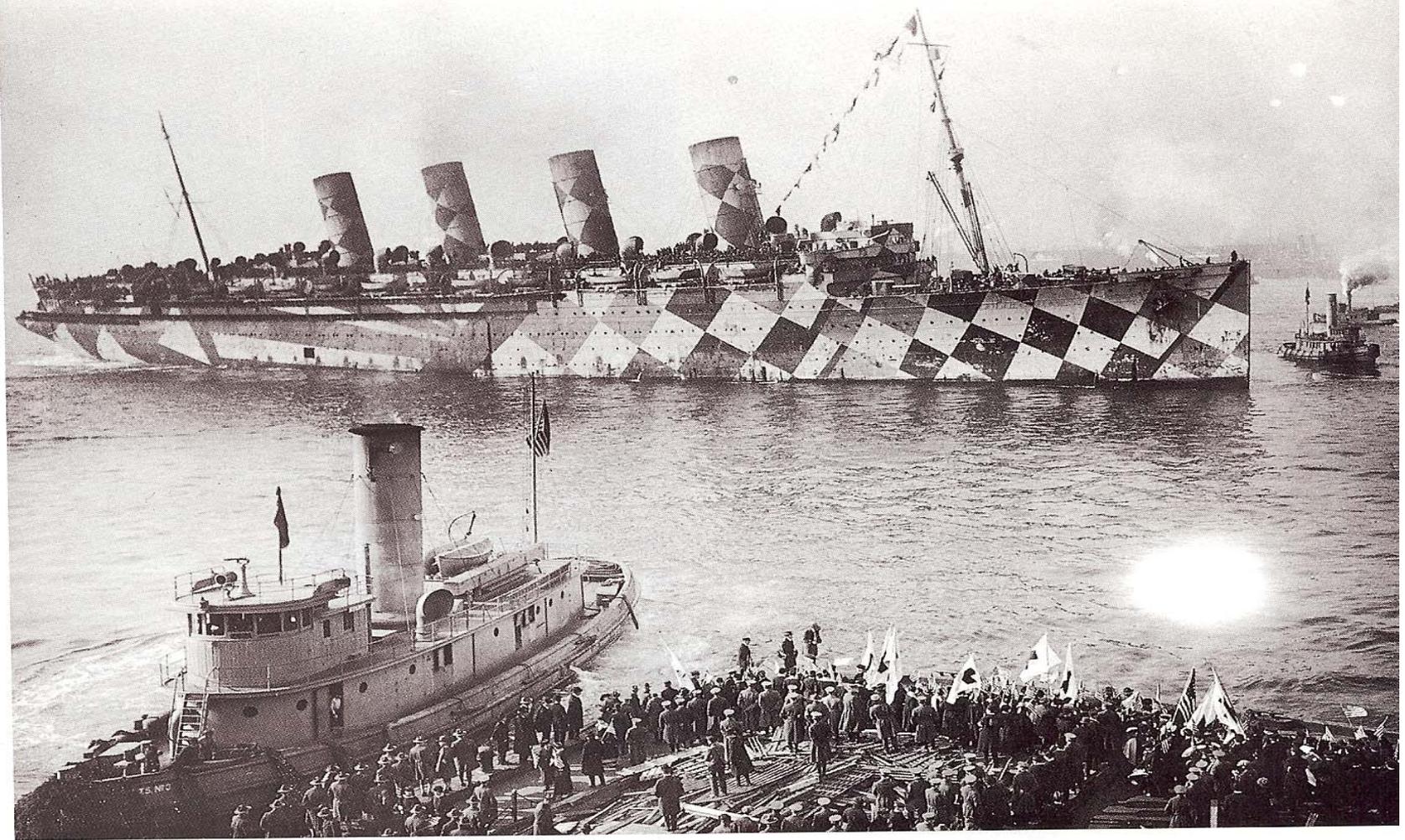
Environmental



Survivability



Durability



During World War I, the British passenger liner *Mauretania* was painted in a camouflage scheme reminiscent of Picasso's *Harlequin*. Thayer, who advocated painting ships white, likely viewed the project as a misapplication of his theory of disruptive coloration.

Smithsonian Magazine , April 1999

- ❖ **Recent Coatings represent superior durability, environmental compliance**
- ❖ **Stereotypes associated with Emulsions, Water Based or Hexavalent Chromium Free chemistries no longer hold true.**
- ❖ **Current efforts establishes solid foundation for present and future survivability enhancements and multifunctional capabilities**
- ❖ **Services are moving rapidly to eliminate standard coatings used and are implementing a new generation of coating technology throughout DOD**

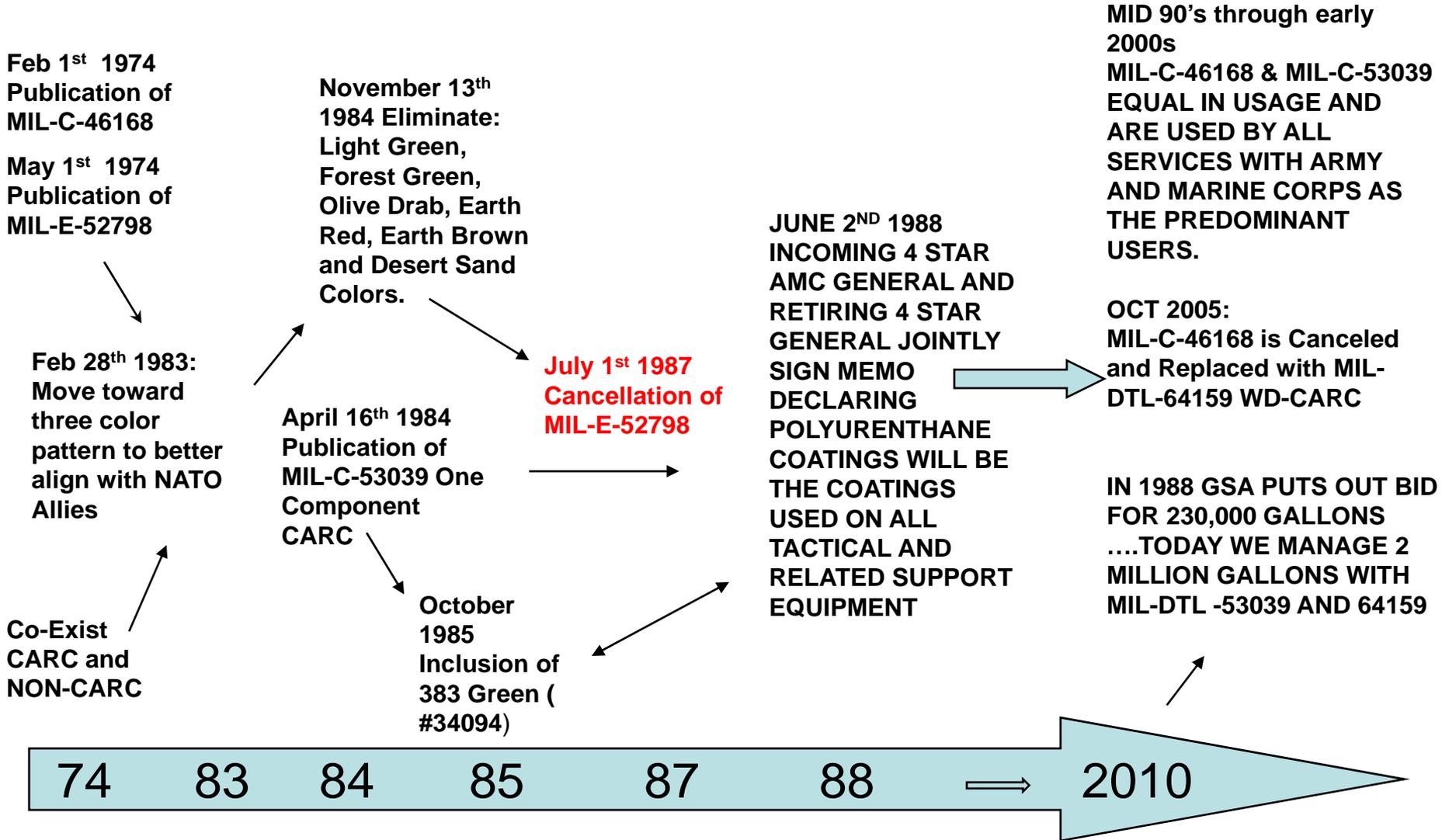
- **20-25 years ago Army- Marine Corps Coating systems well defined.**
- **DoD had sufficient outdoor exposure history and submissions were similar to one another.**
- **It was appropriate to use neutral salt fog for QC validation.**
- **Since we had field history and correlation were in hand, confidence was high if lab test were satisfactory outdoor life cycle would be predictable .**
- **Today this is no longer the case**

- Today this is no longer the case.....
- We have numerous mandates, existing laws and guidelines that require novel and unique chemistries
- Multiple substrates to contend with and a larger selection of topcoats, primers and pretreatments that when evaluated as a “system” mitigate and prevent corrosion and degradation in different ways.
- HENCE AS A COMMUNITY WE CANNOT DO AS WE ARE DOING

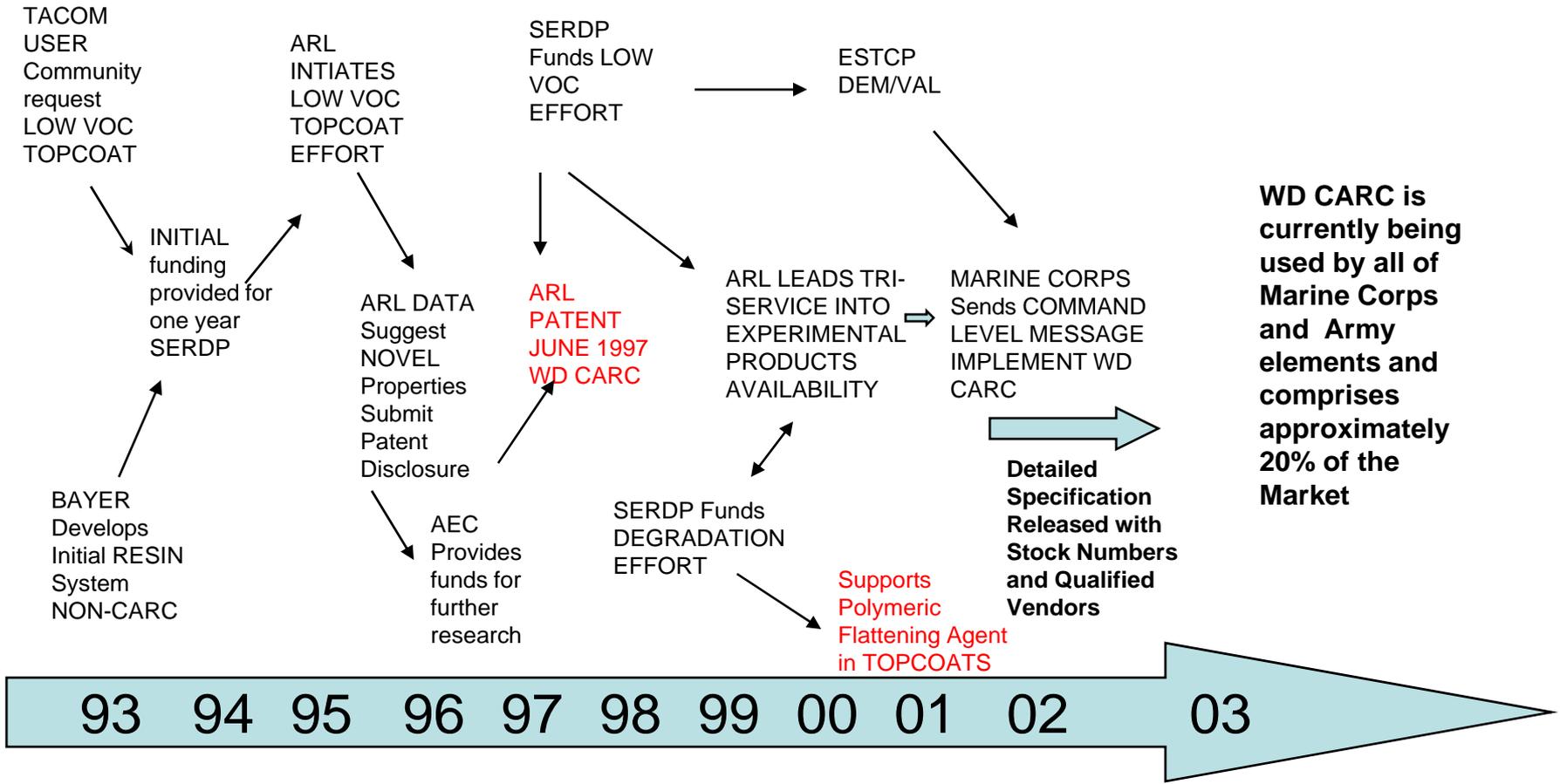
- **HENCE AS A COMMUNITY WE CANNOT DO AS WE ARE DOING:**
- **MAKE ASSUMPTIONS THAT ALL CORROSION INHIBITORS WILL RESPOND OR ACT SIMILAR IN ANY ACCELERATED CHAMBER EVALUATION**
- **X HOURS IN TESTING PROVIDES CONFIDENCE**
- **SERVICES RESPONSIBLE FOR VALIDATION NOT KNOWING THE COMPOSITION OF MATERIALS USED**
- **THINKING THAT AN “ADVANCE ACCELERATED PROTOCOL” WILL BE THE ANSWER FOR QUICKER OR MORE EXPEDIENT DATA**

- **THINKING THAT AN “ADVANCE ACCELERATED PROTOCOL” WILL BE THE ANSWER FOR QUICKER OR MORE EXPEDIENT DATA**
- **UNLESS WE KNOW THE CHEMISTRIES AND CAN CONFIRM SIMILAR DEGRADATION MECHANISMS IN OUTDOOR EXPOSURE AND CHAMBERS IT IS A FAÇADE TO BELIEVE X HOURS IS PREDICTIVE OF X TIME OUTDOORS.**

36 YEAR TIME LINE OF CARC



Details: Water Dispersible CARC



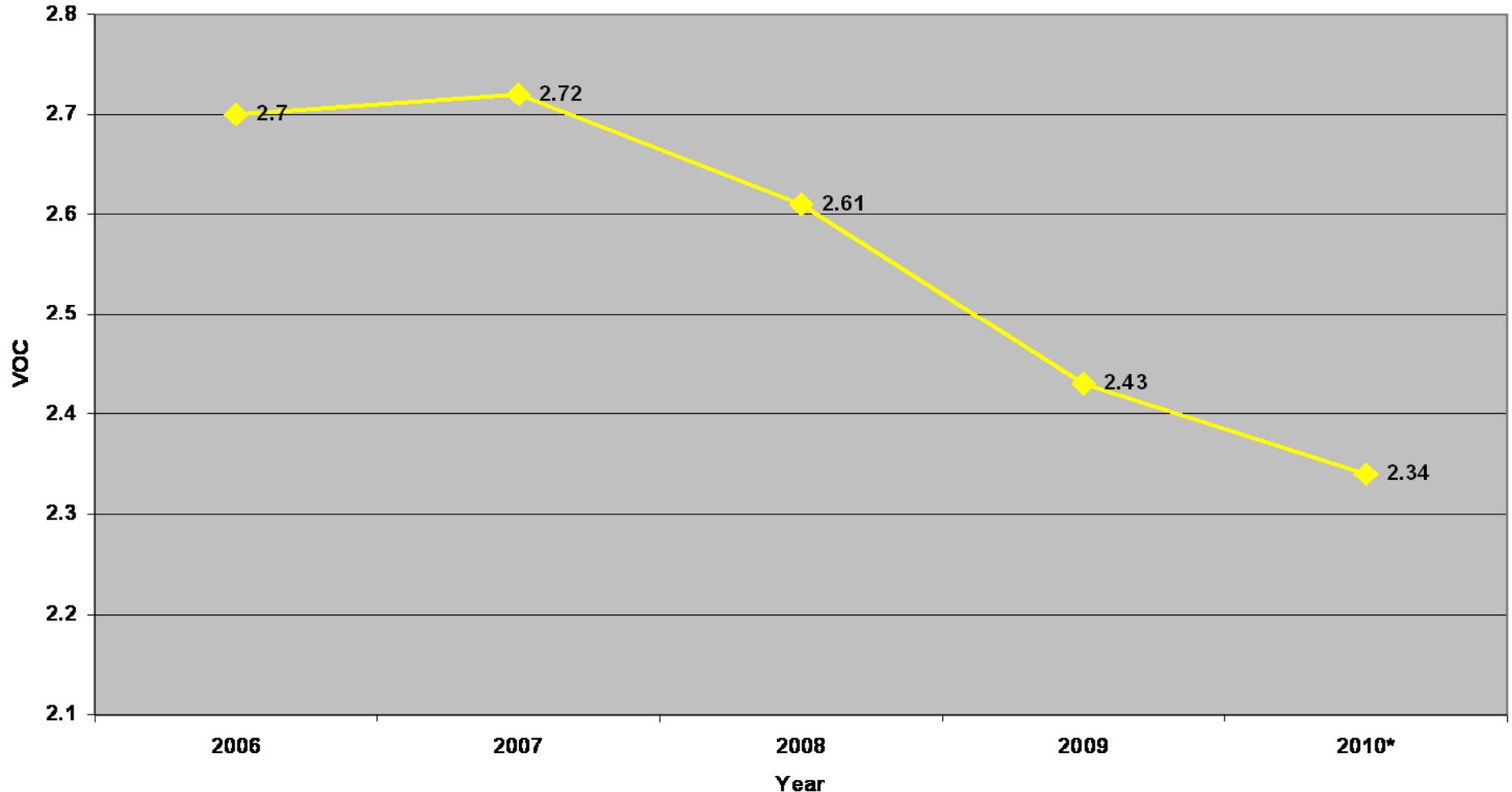
- Chemical Agent Resistant Coatings (CARC) is mandated by AR-750-1 for all tactical equipment.
- Every initial submission is fully tested and validated for Qualified Listing.
- Each batch from the initial submission is tested for color, gloss, IR and decontamination resistance. Included in the batch submission is batch volume. Next slide total volumes*
- Volume of coatings usage by Army is enormous: Several million gallons costing several hundred of millions of dollars annually will be reduce as developments are implemented and durability is improved.



Average VOC (lb/gal) CARC Topcoat



Average VOC per Gallon
Topcoat



* January to May

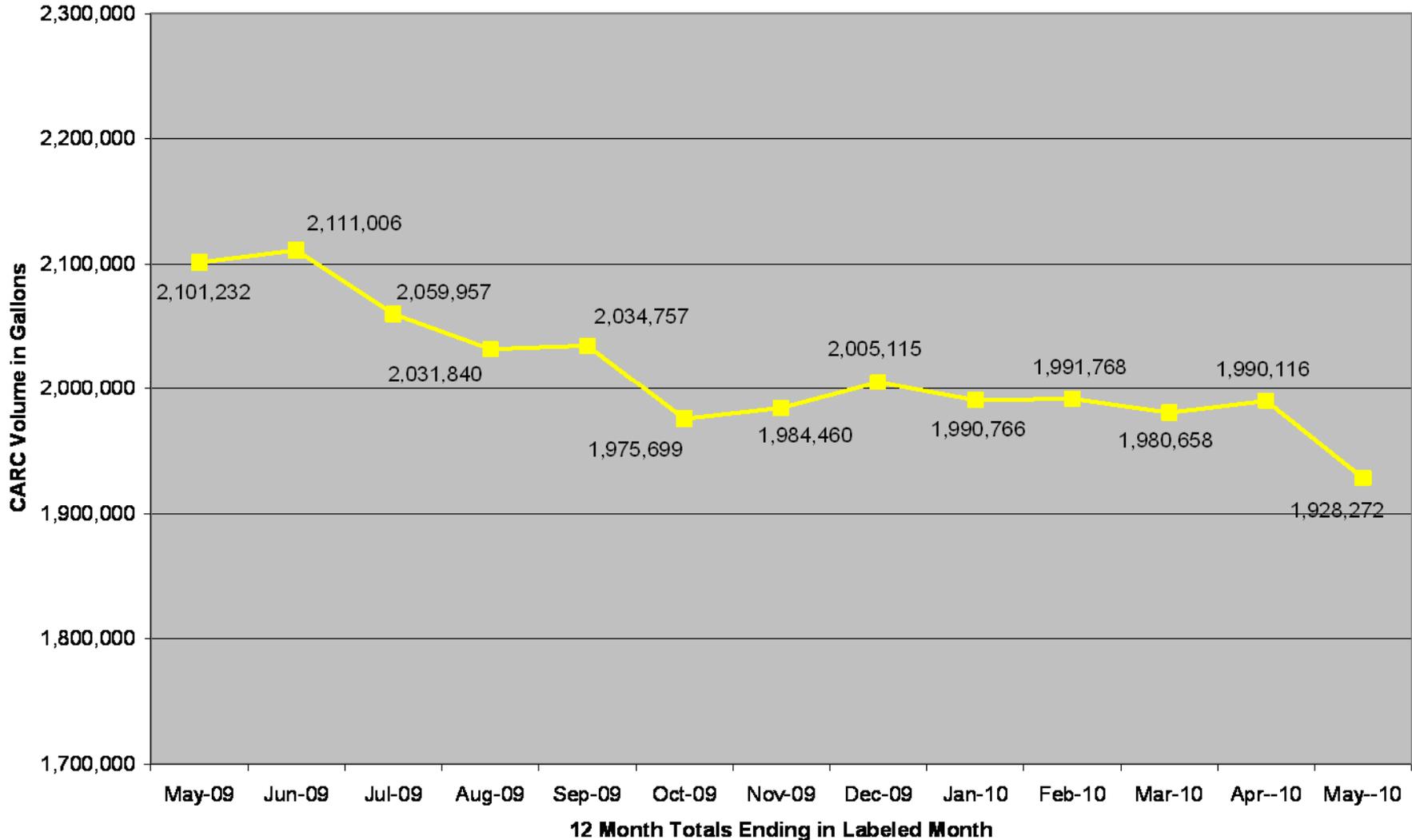
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CARC Batch Volume May 2009 – May 2010

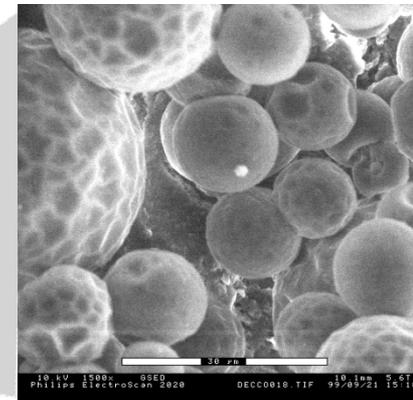
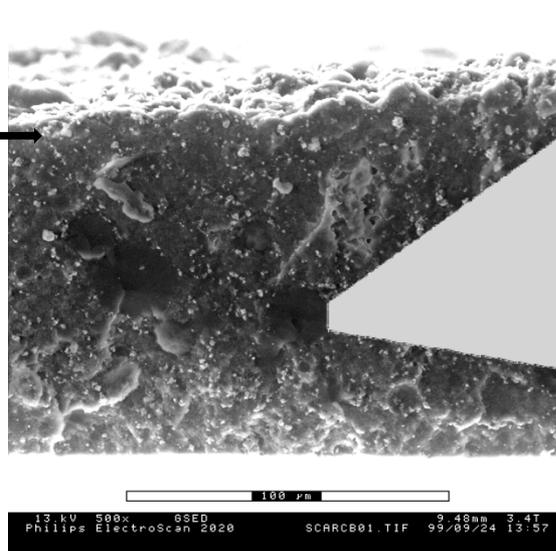


CARC Batch Volume



Polymeric beads

Army will
Discontinue use
of Silica based
topcoats



• Integrated within Film

- **Polymeric beads**
 - Reduce chalking effect
 - Improve UV resistance
 - Improve performance



Diatomaceous silica

Talc

- Letter has been issued:

Key Points

- No longer accepting silica based coatings
- November 1st 2010 discontinue batch validation
- Deplete inventories until consumed



MIL-DTL-53030 Water Based Epoxy & MIL-DTL- 53022 Solvent Based



- New type to include Enhanced Corrosion Resistance and require cyclic corrosion evaluation.
- 1000Hrs Neutral Salt Fog
 - ASTM D610 RATING OF 9
 - ASTM D1654 RATING OF NOT LESS THAN 6 FOR STEEL
 - ASTM D1654 RATING OF NOT LESS THAN 8 FOR AL.
- 40 Cycles
 - ASTM D1654 RATING OF NOT LESS THAN 7 FOR STEEL & AL.
- Open to novel corrosion inhibitors
- Allowing vendors to provide exempt solvent package and provide a universal exempt solvent
- Similar effort to occur for 53022



MIL-DTL-53084 E-Coat

MIL-PRF-32348 Powder Coat



- MIL-DTL-53084 and Powder to include the color Black.
- Open to novel corrosion inhibitors
- Powder Specification to include both Primer and Topcoat within same document
- Coordination Date 8/10

- The key hurdle is acquiring long term outdoor exposure data for platforms making current and near future decisions.
- Confidence that our accelerated screening processes are relevant to long term exposure results.
- Ensuring pretreatment and coating processes are followed accurately to enhance corrosion resistance and provide adequate adhesion/compatibility for subsequent coatings.

Phase I:

Data, claims and performance parameters (acceptance based on environmental compliance, cost to include return on investment and process requirements)

Phase II:

ARL/TARDEC testing and evaluation of pretreatment or process using coupon panels to include accelerated and cyclic corrosion, EIS, and related adhesion type evaluations etc.

Phase III: Application of component parts /panels

Phase IV:

Outdoor exposure in corrosive environment of component parts/panels (Items would be monitored for x years at 6 month intervals)

This Phase type process would allow PMs to be aware of what items are currently being evaluated and also providing a certain level of confidence to select or use a particular new process. Baselines will be selected and used as standards for comparison. In this way new technologies can be evaluated and data acquired.

Increased Options for Balanced Requirements

