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THE AIRCRAFT COATINGS REMOVAL ISSUE

A Strategic Overview by Earl S. Vigne, Consultant, ES&K Associates, LaGrangeville, New York

INTRODUCTION

Throughout the decade of the 1980's and into the early 1990's, the "Aircraft Coating Removal Industry" has been evaluating many alternatives to the toxic liquid chemical strippers which have been used to remove coatings from aircraft exteriors for maintenance inspection. Worker safety and environmental concerns are the driving forces behind the search for alternative stripping methods. Everyone in the "Industry" acknowledges the need to protect the worker and the environment. However, until these alternative processes are proven to be non-damaging to the aircraft to the satisfaction of the "regulators/approvers" of aircraft maintenance procedures, toxic chemical strippers will continue to be used.

The evaluation, approval and implementation of these new coating removal processes has been painstakingly slow, primarily because of the complexity of the Aircraft Coating Removal Industry. This article discusses the structure of the "Industry" in general, presents an overview of the new stripping alternatives under evaluation and suggests a possible course of action to expedite understanding, implementation and approval of alternative processes.

THE INDUSTRY

Every "business" within an industry can be described by a very simple model. There is a product or service (1) provided to a customer. (2) There is something unique about the products and services that defines the business within the industry (and the competitors within that business) while at the same time creating strategic barriers to entry for those outside the business. (3) There are suppliers of raw materials, equipment and services to the business. (4) There is the threat of substitute products or services from outside the business. (5) There is often a regulatory body that controls/approves how the industry conducts business. (6) Exhibit A shows the generic model.

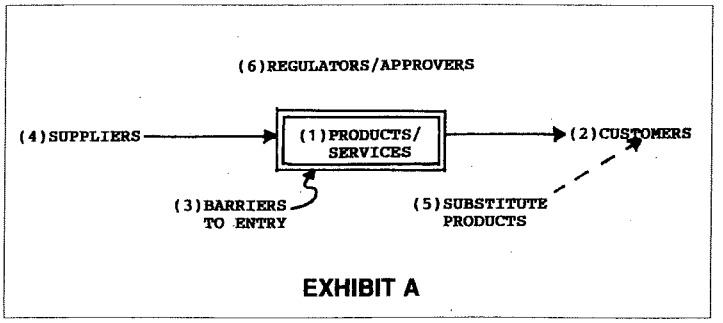

EXHIBIT A

The complexity of the model, of course, is a function of the specific industry and the specific business within that industry.

The Aircraft Coatings Removal Industry consists of the following segments if we define the actual coating removal process as the "business":

1. Owners of aircraft (2).
2. Aircraft Manufacturers and component/ sub-assembly suppliers (6)

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3. Aircraft coating manufacturers (4)
4. Coating removal contractors/operators (1)
5. Suppliers of coating removal equipment and materials (4)
6. Waste treatment/disposal firms (4)
7. Regulators/approvers of the coating removal process (6)
8. Consultants (5)

NOTE: Numbers in parentheses relate to Exhibit A.

Looking at the industry from the perspective of the coating removal contractor/ operator business, the generic model in Exhibit A would be as shown in Exhibit B.

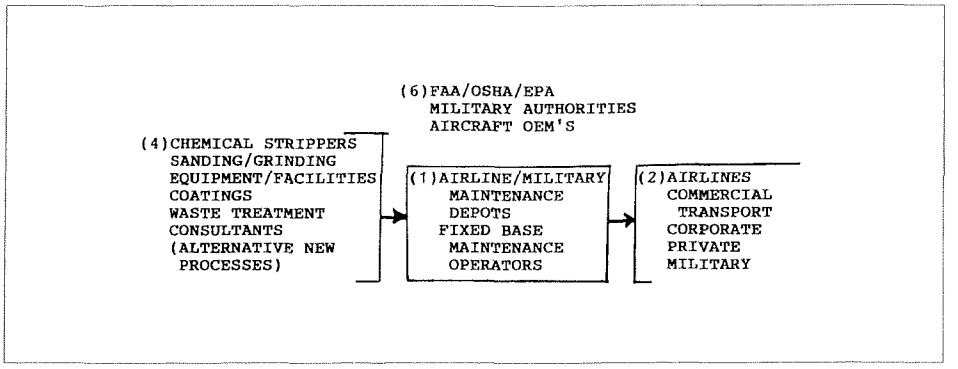

EXHIBIT B

Suffice it to say that the industry is much more complex than is shown in Exhibit B. The customer base (aircraft owners) have aircraft with a variety of substrates (several aluminum alloys both alclad and bare, harder structural alloys, composites, varying substrate thicknesses, etc.). The aircraft coatings themselves vary (although the most common is an epoxy primer with a polyurethane topcoat with a total thickness of 2.5-3.0 mils). Also, depending upon who owns the aircraft, differing regulatory bodies come into play in the approval process.

The coating removal contractors/operators are under severe pressure from OSHA/ EPA to eliminate toxic chemical strippers for the obvious reasons. Sanding and grinding processes are not economically viable for the complete airframe and pose potential fatigue life/fatigue crack growth rate problems. Also, chemical strippers cannot be used on most composite materials for chemistry reasons.

Alternatives are clearly needed.

THE ALTERNATIVES

Alternative coating removal approaches that have been under evaluation and are at various stages in the approval process are as follows:

PLASTIC MEDIA: Several different loose grain abrasive plastic materials have been evaluated by the military, the aircraft OEM's and the aircraft component suppliers. The Air Force Technical Order for stripping and repainting aircraft (T.O. 1-1-8) includes those materials that are approved for use on Air Force planes as well as a list of approved plastic media suppliers. The military plastic media specification (MIL-P-85891AS) specifies six different plastic media as of this writing and is scheduled for another rewrite this year. Aircraft OEM's (and component manufacturers) have approved the use of plastic media for specific applications on selected airframes. To my knowledge, the FAA has not approved any plastic media for any airframe application in the absence of the technical information required for the review process.

At this juncture, acrylic (polymethylmethracylate) is the plastic media preferred by the military, particularly on thinner substrate. Acrylic plastic media is being used as well on some thin skin airframes (Army helicopters). Urea, the first plastic media used in quantity for aircraft stripping, is still finding substantial use on thicker aircraft skins and structures.

While the plastic media itself is not hazardous waste, it combines with the residual paint as it breaks down during the paint stripping process. Breakdown rates vary according to blasting process parameters and substrate hardness but under controlled blasting, consumption rates below 3 percent per cycle are being realized.

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SODIUM BICARBONATE: A specially formulated and classified sodium bicarbonate powder is propelled via direct pressure blasting with a modest amount of water injected at the nozzle to control dusting. The product has been shown to remove aircraft paint systems. Early concerns about corrosion have been reduced through the introduction of corrosion inhibitors and the process has been approved on a limited basis. Sodium Bicarbonate is innocuous and water soluble. However, it cannot be recycled like the plastic media products. A fair amount of waste must be treated to separate the dissolved sodium bicarbonate from the residual paint.

CARBON DIOXIDE/DRY ICE: Liquid carbon dioxide is frozen, ground, classified and propelled upon the aircraft surface again via direct pressure blasting. Testing to date has shown the process to be very slow and there are some concerns remaining about residual stress. Tests are planned combining carbon dioxide with flashlamps to increase the surface temperature differential and cause thermal stripping rather than mechanical abrading. The EPA advantage is obvious as the carbon dioxide goes away by itself following blasting and all that is left are the paint chips.

WHEAT STARCH: Specially formulated, polymerized, ground and classified wheat starch is under evaluation for use by the industry. Like sodium bicarbonate, the wheat starch is water soluble, offering environmental advantages. Early testing revealed expected media flow problems associated with high humidity. However, this problem is being addressed by the manufacturer. As this material offers the recycling advantages of plastic media with some of the environmental advantages of other alternatives, further development and testing is warranted.

LASERS are being evaluated for paint removal from aircraft alloys and composites and offer promise in highly critical applications where coatings must be removed selectively. While it appears that lasers can be developed to the point that they can be used in commercial applications, robotic controls will be needed and air scrubbing equipment will be required for the blasting facility. The cost will be very high for selective applications and airframe turnaround time may be too slow for use on complete aircraft.

FLASHLAMPS with fewer light pulses per unit of time are intended to burn off the coating without volatizing it and causing air pollution problems. If sufficient strip rates can be obtained, the process might become viable, however robotics will likely be required to control the process.

HIGH PRESSURE WATER/ICE: Evaluation continues, however strip rates have been very low and overall economics and turnaround time are areas of concern. High pressure water, of course, has been used in combination with appropriate cleaning agents for cleaning aircraft skins.

THE COURSE OF ACTION

Early alternative coating removal testing at Hill AFB was fairly straightforward. The test matrix included one airframe (F-4), three alternative plastic medias (polyester, urea and melamine) and a modest number of blasting parameter alternatives. The media manufacturer was able to work with the Air Force on a joint evaluation program.

Today we have airframe and substrate alternatives too numerous to list and an ever growing number of alternative stripping approaches, all of which perform best under differing process parameters.

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Coating removal contractors would welcome new alternative approaches. However, each alternative product or process must be "approved" before it can be used on the aircraft.

Returning to the earlier model and defining the "business" as the manufacture of equipment and supplies used in the coating removal process, we have the situation shown in Exhibit C.

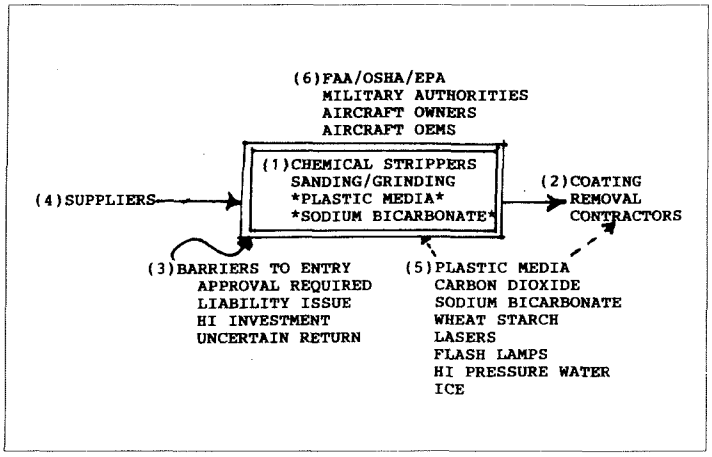

EXHIBIT C

The problem in Exhibit C is clear. The customer (coating removal contractor) cannot approve new methods for paint stripping on his own. Manufacturers trying to enter the business described in Exhibit C need to go through the regulators/approvers before the coating contractors can use their products.

However, there is no "general criteria" established by the regulators/approvers which the alternative coating removal processes must meet. Approvals that exist so far are based upon testing done on a case-by-case basis.

What we are faced with is a variety of emerging alternative approaches to serve an undefined market need. The market need must be defined by FAA/OSHA/EPA, Aircraft Owners, Aircraft OEM's, Aircraft Component Manufacturers and military authorities.

We have a situation where processes are being approved because they have been shown to be no more damaging than current paint stripping methods. This is probably a valid approach in the absence of a good data base of technical information.

In order to get away from the "case-by-case" approval process, we need to get good technical information flowing to the approvers/ regulators.

An "Aircraft Coatings Removal Association" with the involvement and input of all segments of the Industry is one possible answer. If we can get the necessary communication going, we have the opportunity to improve worker safety and the environment by implementing cost effective alternative coating removal processes which could be supported by a technical data base.

No one segment of the Industry can do it alone. However, if the "regulators/approvers" and the "aircraft owners" lead the way, the issue will be resolved.

Bingo No. 3