Module -5

Corrosion and its Prevention

Introduction:

- All metals are affected to some extent by the atmosphere.
- Corrosion: Natural process which converts a refined metal to a more chemically-stable form, such as its oxide, hydroxide, or sulphide.
- Corrosion - Deterioration of a metal as a result of chemical reactions between it and the surrounding environment.
- Aircraft - reduces the strength and ductility of metals to an alarming extent if not restrained.
- Moisture in the air.

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Types of corrosion:

There are two distinct types of corrosion to which metals used in aircraft construction are subject.

1. Eating away or pitting of the surface
2. Intergranular or intercrystalline corrosion

Eating away or pitting of the surface:

- Rusting of steel and iron.
- All metals - this type of corrosion - oxidized in the presence of air.
- Visible and can be prevented or retarded by protecting the surface with a plating or paint.

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Intergranular or intercrystalline corrosion:

- Not visible on the surface and is, therefore, very dangerous.
- It eats its way internally through the metal around the grain or crystal boundaries.
- Aluminum alloys and some corrosion-resisting steels.
- Protective coatings have little or no influence on this type of corrosion.

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Corrosion Protection:

- Aircraft metal parts are always given special treatments to improve their resistance to corrosion.
- Cleaning treatment (Sandblasting or pickling) - plating process (cadmium plating, chromium plating, or galvanizing) - painted.
- Steel parts.
- Aluminum-alloy parts are usually cleaned, anodically treated, and painted.
- Corrosion-resisting steel, Inconel, Monel, and other corrosion-resistant materials - left in their natural state without plating or paint unless it is desirable to match a colour scheme.

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Cleaning Operations:

Sandblasting:

- Abrasive particles are blown against the surface.
- Sand, steel grit, and other abrasives are sometimes used.
- Steel parts - welded or heat-treated - remove the scale.
- Aluminum-alloy parts are rarely sandblasted because of their softness, thinness, and loss of ductility after blasting.
- Abrasive particles - nozzle by means of air pressure.
- Distance, angle of nozzle and the air pressure - dependent upon the type of work.
- Parts must be cleaned by means of an air blast or by brushing to remove excess abrasive.
- Painted as soon as possible.

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Pickling Steel:

- Remove scale, rust, and so on, particularly before plating them.
- Pickling solution: Sulphuric acid solution or a hydrochloric acid solution.
- Pickling solution - stoneware tank, is heated to 140-150°F by means of a steam coil.
- Paint, oil, grease are removed before pickling followed by rinsing in running water
- Immersed in the pickling solution.
- Pickling time varies from 5 to 15 minutes.
- Heavy scales are removed by scrubbing with a wire brush to reduce the pickling time.

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Plating Operations:

1. Cadmium Plating:

- Cadmium plating is used more generally on aircraft parts
- Generally all steel parts are cadmium-plated prior to painting.
- Steel parts are cadmium-plated to increase their corrosion resistance.
- It is difficult to make paint stick to cadmium-plated surfaces unless they are kept exceptionally clean.
- It is an electrical process carried out at a low voltage not exceeding 12 volts.
- Cadmium is deposited directly on the surface.
- Cadmium deposit must be adherent, and without blisters, porosity, or other defects.
- A coating 0.0005-inch-thick is usually specified except on threads, where a minimum coating 0.0002 inch thick is required.

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2. Galvanizing (Zinc Plating):

- Before cadmium plating became common, it was the general practice to galvanize all steel aircraft fittings before painting.
- Galvanizing is not as effective as cadmium plating in resisting corrosion.
- Parts are dipped in molten zinc maintained at a temperature between 800-925°F.
- The parts remain in the zinc bath only a short time and are then removed and hung up until cool.
- Before dipping - perfectly clean.
- Electroplating process similar to that described for cadmium plating.
- Solution of zinc sulphate and cyanide is used as the electrolyte and metallic zinc as the anode.
- A somewhat thicker plating is used than for cadmium plating to obtain equivalent corrosion resistance.

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Other plating process are:

3. Sherardizing
4. Parkerizing
5. Bonderizing
6. Metal Spraying
7. Chromium Plating

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Aluminum and Aluminum-alloy Surfaces:

1. Chromatizing
2. Alodizing Process

Alodizing Process:

- Relatively new process - American Chemical Paint Company.
- Military services - aluminum and aluminum alloys except the outside surfaces of seaplanes.
- Because of its simplicity, it is rapidly replacing anodizing in aircraft work.

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Alodizing Process:

The alodizing process consists of the following operations:

Cleaning: An acidic or alkaline metal cleaner can be used to prepare the work. Dipping or spraying.

Rinsing: Rinsing is done by spraying the parts with fresh water under pressure for 10 to 15 seconds.

Alodine Treatment:

- This increases the corrosion resistance and improves the paint bonding qualities.
- Dipping, spraying, or brushing.
- Alodine bath must be maintained between 100-120°F.
- The work is dipped for 1 to 2 minutes.
- The work is drained over the Alodine bath for 1 to 2 minutes and then transferred to the rinsing bath.

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Alodizing Process:

Rinsing:

- The first rinsing is done with clear, cold or warm water for a period of 15 to 30 seconds.
- A second rinsing for a period of 10 to 15 second rinse done in a Deoxylyte bath maintained at 100-120°F.

Drying: Infrared lamps or in air at temperature below 150°F.

Painting: The alodyzed surface must be kept absolutely clean to insure good paint adherence.

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Magnesium-alloy Parts:

1. Chrome pickle Treatment
2. Sealed Chrome-Pickle Treatment
3. Dichromate Treatment
4. Galvanic Anodizing Treatment

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Chrome pickle Treatment:

- Protect the material during shipment, storage, machining, and for installed material requiring a good electrical bonding connection.
- Chromic-pickle solution: 1.5 pounds of sodium dichromate, 1.5 pounds of nitric acid, and water to make 1 gallon.
- Work should be immersed in this solution at a temperature of 70 to 90°F, for 1/2 to 2 minutes until sufficiently etched.
- Exposed to the air for at least 5 seconds while draining, thoroughly washed in cold running water, then given a dip washing in hot water.
- Chrome-pickle solution stored in an ceramic, aluminum, or stainless-steel tank.