

INTRODUCTION TO TEMPORARY CORROSION PREVENTIVES

OVERVIEW

Metal is the indispensable constituent in most of our industry today. For reasons of economy, Iron (Fe) in its various forms, especially Mild Steel has come to occupy the centerstage of our engineering industry in spite of its vulnerability to corrosion. Consequently, corrosion is an invariable occurrence by which good part of our valuable metal (*and metal value*) is lost & structures are deteriorated.

Overcoming this metal-loss & upgrading metallic products with better look & service life is a constant need, towards which various anti-corrosive coatings & metal treatment chemicals have been developed. Anti-corrosive coatings can be broadly classified into the following:

1. Metallic coatings
2. Organic coatings

Organic coatings can further be classified into:

1. Paints and allied coatings such as lacquers, etc.
2. **Temporary Corrosion Preventives**

Temporary Corrosion Preventives are not necessarily short term in nature. They are used for protection of components, tools, spares and accessories during service, assembly, storage, transit and on the shelf. Typical examples include Cold Rolled Acid Cleaned Steel sheets (storage/transit), Antifriction Bearings (storage/service), Motorcycle chains and sprockets (service), drawn wires (storage/transit), auto-components (storage/on the shelf), hand tools (transit/ service), etc. The requirement of transit becomes critical in the case of exporters of engineering goods, as these are exposed to highly corrosive marine atmosphere during their shipment by sea. What to talk of rusting, even slight staining/dicolorization in case of CRC Sheets or tools or components will invite summary rejection of the entire lot !

Temporary Corrosion Preventives can be classified into the following types:

1. Straight Oils: These resemble automotive engine oils and come in various viscosities to suit different requirements of protection and coverage.
2. Petroleum Jellies: These resemble greases in appearance but are fundamentally different as they do not contain any soaps. These provide the maximum film thickness and about the best protection.
3. Solvent Cutback: As the name suggests, these are based on solvents as carriers. After application, the solvent evaporates leaving behind a protective film.
4. Dewatering Type: These are based on solvents and are used in-process where the penultimate operation leaves the components wet with water or other aqueous solutions. Such rust preventive will remove all water and leave a protective film.

5. Resin based hard film type: These resemble lacquers and provide long-term protection.

TECHNOLOGY

Normally, a drop of water will sink through a film/layer of (unformulated) oil covering a metal substrate (Remember, water is heavier than oil), displace the oil film in contact with the metal and wet the substrate. Thus onsets the process of corrosion. And this is quite contrary to the common perception that any oily substance may be used to protect against corrosion.

In the present day technology, oils and other related substances act only as carriers. The actual protection is provided by polar additives, which get adsorbed on the metal-oil interface in the form of nearly close-packed and vertically oriented molecular monolayers. The polar compounds having low water solubility and the ability to form oleophobic and/or hydrophobic monolayers are good corrosion preventives. Or in a layman's language, these polar organic compounds form bonds with the metal that are stronger than those made by water. Esters, fatty acids and metal-substituted esters are some examples of the above.

Second part of the technology involves treatment of substrates previously wet with water or aqueous solutions. Most of the abovementioned polar compounds that act as effective rust inhibitors cannot completely remove water from such a surface. This requirement is known as Preferential Wetting of Metal Surfaces. Separate series of polar compounds exhibit such properties.

In the design of a commercially successful Rust protective compound, several non-ideal conditions have to be provided for:

1. The substrate is usually contaminated with process residues such as machining oils, lubricants, etc. which may be acidic, alkaline or even emulsifying in nature. This materially alters the protective ability by interfering with the adsorption phenomenon, or by accelerating desorption of adsorbed protective monolayers. This requires application specific treatment.
2. Nature of the substrate: For example, copper and lead based alloys require different chemical species for their protection.
3. Service or storage conditions may involve temperatures higher than ambient conditions. Higher temperatures lead to desorption of protective films.
4. In-process components, especially those exposed to aqueous conditions may already be nascently rusted before being treated with rust preventive. There cannot be any adsorption on oxide or hydroxide films.
5. Exposure: Often parts, drawn wires, sheets are exposed to fumes, acidic vapors from pickling operations within the same premises. Special additives are necessary.
6. Outdoor exposure: Besides direct exposure to rain, even incipient precipitation in the form of dew, etc. has a leaching effect on the adsorbed monolayers. This will substantially reduce life.
7. Economy: The Ultimate Paradox. Provide the maximum protection with the lowest price per unit and the lowest film thickness.

This usually requires that the process of the customer be studied in detail so that the rust preventive treatment is actually effective in protecting against corrosion. Often small but significant changes may need to be effected in the work process to obtain consistently good results.

EVALUATION

For evaluation of the corrosion protective ability of compounds, accelerated corrosion testing techniques are used. Metal specimens, properly cleaned and treated with the compounds under scrutiny, are exposed to the Corrosion tests, and the time required to failure noted in hours. These tests include Humidity Chamber Test, Salt Fog (Spray) Testing, Sulphur Dioxide (IP) tests, etc. **Salt Fog (Spray) Testing** (as per standards ASTM B 117 or ISO 9227) is the most prevalent method today.

In this test, a solution of NaCl (5% w/v) is sprayed as a fine mist/fog into a non-metallic chamber maintained at $35\pm 2^{\circ}\text{C}$, wherein it precipitates on the test specimens. The precipitation rate of salt fog is maintained within 1-2 ml per 80 sq. cm. collecting area per hour. Properly formulated rust preventives withstand 15 - 72 hours of continuous Salt Spray under test conditions. Under actual conditions of processing, components must withstand at least 10 hours for assembly/in-house storage and at least 20-24 hrs for storage/transit. Anything less than this is a sure shot recipe for trouble.

CONCLUSION

Although **temporary corrosion preventives** have been in use in the West for over 70 years now, they have not achieved grassroots acceptability due to a host of reasons that include lack of knowledge, lack of application guidance, and the misconception about economy (The ultimate paradox once again- you spend so that you may save). Most of those using temporary rust preventives as on date are doing so sub-optimally. Through proper choice of the most suitable compound, application system and maybe some modification of process sequence, better protection can be attained at the same, if not lower costs. Better techniques and technologies are evolving continuously that will further improve the cost-benefit dynamics.