Paper No. CL26



Another look to Rust Bullet

Manojkumar V Sheladiya

Asst. Prof. , Mech Engg Dept., AITS, Rajkot, Gujarat, India.

mvsheladiya@gmail.com

Shailee G Acharya

Asst. Prof. , Mech Engg Dept., SVIT, Vasad, Gujarat, India.

Dr. Ghanshyam D Acharya

Principal, AITS, Rajkot, Gujarat, India

ABSTRACT

In order to ensure the smooth and uninterrupted flow of liquid to the end users, it is imperative for the field operators, pipeline engineers, and designers to be corrosion conscious as the lines and their component fittings would undergo material degradations due to corrosion. This paper gives a comprehensive review of corrosion problems and its mitigation. The chemistry of corrosion mechanism had been examined with the various types of corrosion and associated corroding agents in the industry. Factors affecting each of the various forms of corrosion were also presented. It was noticed that the principles of corrosion and its prevention must be understood in order to effectively select materials and to design, fabricate, utilize metal structures, coating, and painting, etc. for the optimum economic life of facilities and safety in industries. Rust Bullet is a single component high solid coating. It is very different than the traditional rust conversion or rust encapsulation product. Rust Bullet is an advanced coating system which is far more than just Rust protection. This paper deals with unique feature and application of Rust Bullet to protect the metal.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India

Keyowrds: Rust Bullet, Urethane, Aliphatic

INTRODUCTION

Corrosion can be viewed as a universal phenomenon, omnipresent and omnipotent. There is no single figure for loss to the nation due to corrosion. It can be a minimum of 3.5% of the nation's GDP. Losses due to corrosion could be around Rs. 2.0 lacs crores per annum in India. ^[5] Corrosion costs manifest in the form of premature deterioration or failure necessitating maintenance, repairs, and replacement of damaged parts. Corrosion has a huge economic and environmental impact on all facets of national infrastructure; from highways, bridges, buildings, oil and gas, chemical processing, water and waste water treatment and virtually on all metallic objects in use. Other than a material loss, corrosion interferes with human safety, disrupts industrial operations and poses danger to the environment. Awareness to corrosion and adaptation of timely and appropriate control measures hold the key in the abatement of corrosion failures.

Corrosion can be classified in different ways, such as Chemical and electrochemical High temperature and low-temperature Wet corrosion and dry corrosion. Dry corrosion occurs in the absence of aqueous environment, usually in the presence of gases and vapors, mainly at high temperatures. Electrochemical nature of corrosion can be understood by examining zinc dissolution in dilute hydrochloric acid. Zn + 2HCI = ZnCI2 + H2 Anodic reaction is Zn = Zn++ + 2e with the reduction of 2H+ + 2e = H2 at cathodic areas on the surface of zinc metal. There are two half reactions constituting the net cell reaction. Environmental effects such as those of presence of oxygen and other oxidizers, changes in flow rates (velocity), temperature, reactant concentrations, and pH would influence rates of anodic and cathodic reactions. Table 1 shows the ASM classification of corrosion types.

Table 1	ASM	classification	of	corrosion	types
---------	-----	----------------	----	-----------	-------

Corrosior	Corrosion:	Degradation:	Induced Cracking:
Corrosive attack dominated by uniform thinningHigh rates metal 	of Affected by alloy chemistry h at & heat es treatment 1. Intergranular corrosion 2. Dealloying on corrosion	Corrosion with a mechanical component 1. Erosion corrosion 2. Fretting corrosion 3. Cavitation and water drop impingeme nt 4. Corrosion fatigue	Cracking produced by corrosion, in the presence of stress. 1. Stress – Corrosion Cracking (SCC) 2. Hydrogen Damage 3. Liquid metal embrittlement 4. Solid metal induced embrittlement

CORROSION PREVENTION:

The three more popular coating systems are Galvanization, Spray Coating, and Powder Coating. They are further discussed as follows;

GALVANIZATION:

Galvanization is the process in which a coating of zinc is applied over the metal such as steel or iron, in order to prevent corrosion. Zinc is a very corrosion resistant metal, which can survive under most conditions. It also acts as a sacrificial anode, so even when the coat is scratched, the exposed metal will not corrode, as zinc would corrode first. It is applied through hot dip process mostly although there are other methods used such as electrochemical and electro deposition process. Galvanization, however, has its limitations. It does not do very well against the marine environment, and if the environment increases the rate of corrosion, then the galvanized layer will give way and the metal will corrode. Therefore the lifetime of galvanized coatings will vary wildly as per the environmental conditions.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India

POWDER COATING:

Powder coatings are possibly the most popular solution for protection against corrosion. It comprises of fine particles of resins and pigments, which are then electro statically charged and applied to the surface of metals. Once they are applied, they are heated so as to melt and form a smooth coating on the surface.

PAINTING:

Painting over the surface of the metal has been done from a long time now. It not only increases the aesthetic value, it also works as a barrier between the metal and the atmosphere. New age paint solutions also have inhibitors in them which prevent the electrochemical reactions. The presence of a metals particles means paint also acts as a sacrificial anode to prevent metal from corroding.

All these methods give pleasing aesthetics, and to prevent deterioration of the underlying substrate when exposed to various environments. Besides protection and beauty, however, coatings provide light reflectivity, camouflage surfaces, reflect and absorb heat, and provide a variety of other functions. However, in order to provide these functions, the protective coating must remain intact and adherent on the surface to which it has been applied. The vast majority of all protective coatings perform admirably until an old age, at which time natural deterioration and degradation occur. However, a coating can fail prematurely, preventing its aforementioned functions from being realized.

The major reasons for the occurrence of corrosion usually are poor or deficient surface preparation or insufficient coating thickness. There are, of course, many other reasons why coatings deteriorate and corrosion occurs:

- 1. A paint or coating is incorrectly formulated or manufactured by the coating supplier.
- 2. An unsuitable coating is specified for a given environment.
- 3. Environmental conditions are different than that understood by the specifier.
- 4. There is improper, or insufficient, mixing of the coating at the time of application.
- 5. There are adverse ambient conditions when the coating system is applied.
- 6. The drying and/or curing of the coating after application are impaired.
- 7. There is chemical, physical, and/or mechanical damage to the coating system during exposure.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India

RUST BULLET AS MODERN SOLUTION FOR CORROSION RESISTANCE:

Rust Bullet is moisture cured urethane means using the natural elements of the atmosphere for curing, no artificial heat source is required, no additional activator or hardener/curing agent required.

The rust bullet is having following advantages:

- 1. Little or no surface preparation required
- 2. Coats directly over rusted and clean metal
- 3. Easy to apply for new building or maintenance
- 4. Superior adhesion
- 5. UV Resistance
- 6. No need thinner or no need hardener
- 7. One/ single component
- 8. Can be applied on many substrates of steel: carbon, stainless, aluminum, fiberglass, concrete, wood, and other solid substrates.

Rust bullet is suited for application in offshore, marine, petrochemical, power plant, waste water treatment plants, infrastructure facilities, food & beverage and all industries

COMPARISON OF RUST BULLET WITH AVAILABLE BEST COATING:

While powder coatings are considered to be the best coating available against corrosion, rust bullet tops every possible aspect. Table 2 shows the comparison of Rust bullet with powder coatings in the market.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India

Table 2 Comparison of Rust Bullet with powder coatings

Attributes	Rust Bullet	Powder Coatings
Ease of Application	Yes	No
Who can apply	Amateur to professional	Skilled applicators only
Application Methods	Brush, roll, or spray	Electro statically applied and
		heat cure oven only
Application	HVLP, conventional, airless or	Specialty electrostatic spray
Equipment	commercial spray equipment	equipment and convection or infrared ovens only
Application Location	Apply at project location	Application facility only
Project Restrictions	No size limitations to on site project	Limitations on projects of any
	applications	great size. piece by piece
		applications requiring
		transport to project site
Surface Preparation	Little to no prep required	Chemical or mechanical
		surface
		preparation
Orange Peel	Proper application prevents orange	Powder coatings require more
	peel	product to achieve an
		acceptable
		finish with no orange peel
Curing Process	Moisture cured in ambient atmosphere	High heat oven cure
Finish	Smooth, hard finish & impermeable	Hard finish, tougher than
	surface, tougher than conventional	conventional paints
	paints	
Repair	Scuffing & reapplication of original	Multiple component repair kits
	product by amateur or professional	professional repair only
Cost	Moderate even on large commercial	High even on small projects
	projects	

RUST BULLET APPLICATION

When applied, does not form a film immediately, but rather it penetrates the porous rust reaching the metal underneath. Rust Bullet dehydrates, or dries out the corrosion by a chemical activity, allowing the resin to solidify into a tough coating with phenomenal adhesion. The subsequences coat of rust bullet fills any pinholes in the first coat and build up to become a nearly impenetrable coat. The corrosion particles become intertwined in the resin matrix and remain a permanent part of the coating.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India

Rust Bullet prolongs the life span of materials, and thus reduces the burden to landfills and is highly cost effective in the long run. Rust Bullet contains no zinc, no chromates, no acids, no heavy metals and complies with Volatile Organic Compound (VOC) limits regulated by the Environmental Protection Agencies.

The urethanes also play a key role. Rust Bullet is an aromatic urethane with aliphatic properties. Aliphatic and aromatic coatings differ in the types of polyols and isocyanates used in the formulation, hence their stabilities in atmospheric conditions differ significantly. Aliphatic coatings are the superior choice for exterior protection because they are very stable when exposed to ultraviolet light, weathering, and hydrolysis. The raw materials used in formulating aliphatic systems are generally more expensive and have higher viscosities than their aromatic counterparts. Aromatic coatings are more heat and chemical resistant than the aliphatic coatings. Aromatic coatings do not stand up as well against atmospheric exposure since UV light causes yellowing and chalking. Due to the crosslinking density of a polyurethane coating (short chains and branching), it has a high degree of chemical and moisture resistance, as well as excellent adhesive properties. These qualities position polyurethane coatings as the best choice for protecting metals from corrosion. As elastomeric coatings do not perform as well in such areas, they are superior in terms of abrasion and impact resistance as well as protection for substrates that demonstrate more movement than metals (such as concrete). The Rust Bullet coating exhibits exceptional flexibility, and impact and abrasion resistance. The Taber Abrasion Test Cycles (ASTM D4060) corresponding to Rust Bullet shows 29% good result compared to any other alternates. [Source: Rust Bullet, Reno NV]

Rust Bullet is not paint in the ordinary sense of the word. It requires no preparation, except the removal of large flakes of loose rust by light scraping or brushing. When applied, the coating does not form a film immediately, but rather penetrates the porous rust, reaching the metal underneath. Its method of protection dehydrates or dries out the corrosion through chemical activity, allowing the resin to solidify into a tough coating with phenomenal adhesion.

The corrosion particles become intertwined in the resin matrix and remain a permanent part of the coating. Subsequent coats fill any pinholes in the first coat and build up to provide an impenetrable coat. The layers of specialty aluminum form a new surface that protects the substrate against corrosion attack, also serving as a sacrificial anode. The polyurethane component provides a moisture barrier. As it cures, the urethane captures the dehydrated rust and incorporates it in the resin matrix – killing the rust permanently. With all the components combined, Rust Bullet becomes a corrosion-free, fire-retarding, chemical-resistant, UV-resistant and armor-like coating. Figure 1 shows the condition of Mustang before and after the application of Rust Bullet. The Rust Bullet requires no preparation other than the removal of large flakes of loose rust by light scraping or brushing.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India





Figure 1 (a): Significant corrosion on the Figure 1 (b): Condition after application of Rust underside of Mustang

Bullet

RUST BULLET CALCULATION

The volume required for surface area calculated from following relation based on the experience of the manufacturer of rust bullet with the specific surface condition. The requirement is 100 ml per m² area of application of rust bullet.

CONCLUSIONS

Rust Bullet has been proven through independent lab testing and university research to be an effective replacement to zinc-rich, environmentally unsound corrosion-control products. It can be used widely in many applications such as the automotive, oil and gas, marine and construction industries. By protecting the metal it ensures longer life of equipment and property improves structural integrity and helps retain property value.

REFERENCES

- 1. Sully J R, Taylor D. W, Electrochemical Methods of Corrosion Testing, Metals Hand Book. Vol 13, 1987
- 2. K.B. Tator, Organic Coatings, and Linings, Corrosion: Fundamentals, Testing, and Protection, Vol 13A, ASM Handbook, ASM International, Materials Park, OH, 2003, p 826
- 3. ISO 129444-2, Corrosion Protection of Steel Structures by Protective Paint Systems—Part 2: Classification of Environments, International Organization for Standardization, 1998
- 4. Tator, K. B., & Lackey, R. O. (1987). U.S. Patent No. 4,698,507. Washington, DC: U.S. Patent and Trademark Office.

NIGIS * CORCON 2017 * 17-20 September * Mumbai, India Copyright 2017 by NIGIS. The material presented and the views expressed in this paper are solely those of the author(s) and do not necessarily by NIGIS.

- 5. Website resource: <u>http://timesofindia.indiatimes.com/city/vadodara/Corrosion-costs-India-Rs-</u> 2-lakh-crore-loss-a-year/articleshow/17484225.cms
- 6. Website resource: www.rustbullet.com
- 7. Website resource: <u>http://clearroads.org/wp-content/uploads/dlm_uploads/Revised_Task-2_Corrosion-Manual.pdf</u>
- 8. Website resource: <u>http://www.media-mosaic.com/assets/white-paper/Battle_Corrosion-rust</u> <u>bullet-david.pdf</u>
- 9. Website resource: http://www.nace.org/
- 10. Website resource: http://www.corrosion.org/
- 11. Website resource: http://corrosion-doctors.org/