Review Article
Bulletin of Pure and Applied Sciences.
Chemistry , Vol.42 C, No.2
July-December 2023: P.106-111

http://www.bpasjournals.com/chemistry
DOI: 10.48165/bpas.2023.42C.2.7
Print version ISSN 0970 4620
Online version ISSN 2320 320X

A Review On – Material Selection For Corrosion Studies

Pruthviraj R.D.*

Author Affiliations
Chemistry R&D Centre, Department of Chemistry, Rajarajeswari College of Engineering, Bengaluru, Karnataka 560074, India.

***Corresponding Author**
Pruthviraj RD
Chemistry R&D Centre, Department of Chemistry, Rajarajeswari College of Engineering, Bengaluru, Karnataka 560074, India.
E-mail: pruthvirajrd@gmail.com

Received on 06.06.2023, Revised on 18.08.2023, Approved on 07.10.2023, Accepted on 23.11.2023, Published on 23.12.2023

ABSTRACT
Corrosion is the largest single cause of plant and equipment breakdown in the process industries. For most applications it is possible to select materials of construction that are completely resistant to attack by the process fluids, but the cost of such an approach is often prohibitive. In practice it is usual to select materials that corrode slowly at a known rate and to make an allowance for this in specifying the material thickness. However, a significant proportion of corrosion failures occur due to some form of localised corrosion, which results in failure in a much shorter time than would be expected from uniform wastage. Additionally, it is important to take into account that external atmospheric corrosion leads to many instances of loss of containment and tends to be a greater problem than internal corrosion. All these aspects of corrosive behaviour need to be addressed both at plant design time and during the life of the plant.

Keywords: Corrosion, Metals, Matrix Alloys, Alumimium Based Alloys, Castings.

How to cite this article: Pruthviraj R.D. (2023). A Review On – Material Selection For Corrosion Studies. *Bulletin of Pure and Applied Sciences-Chemistry,* 42C (2), 106-111.

Materials are divided into groups so that the mind can take care of its complexity to become aware of the material. It also can be labeled in line with their structure, applications. Based on the atoms sure together, the substances are categorized as metals, semiconductors, ceramics, and polymers. Recently, superior and Alloy materials have been developing because they are determined to call for diverse applications.

1. ADVANCED MATERIALS

The substances used in "High-Tech" industrial applications are normally deliberate for better performance; however, in standard, its price is excessive. Examples of advanced materials are magnetic Alloys used for laptop disks and titanium Alloys utilized in supersonic airplanes, special ceramics, etc.

2. PHYSICAL PROPERTIES OF METAL MATRIX ALLOYS

Properties of a material the denomination of which do not involve any deformation or destruction of the specimen are termed thermal expansion, damping, and corrosion resistance. The bodily residences of metallic matrix Alloy have no longer been considered identical to their mechanical conduct. This is because the observation of bodily homes is typically under-taken in detail most effective if the Alloy exhibits substantially improved mechanical residences than the matrix fabric. But the evaluation of mechanical homes of metal matrix Alloys in thermal environments, particularly at a high temperature, requires the expertise of its thermal conduct as a prerequisite. Therefore the temperature-dependent studies of the residences of the steel matrix Alloy are important. Also, corrosion inhibition or resistance studies are important concerning metallic matrix Alloys reinforced with particulates because it can be regarded as an isotropic material wherein properties are equal in all directions. [1-3]

3. METAL MATRIX ALLOY

In an Alloy material, if a metal or Alloy is used as a matrix, it is called metallic matrix Alloys. Normally Alloys are employed as a matrix to get progressed houses.

4. CHARACTERISTICS OF MATRIX ALLOYS

The Alloy fabric is a metal matrix Alloy if the matrix is metallic or an Alloy. The issues associated with the conventional substances are less load carrying functionality and performance poor at high-temperature programs. To avoid this shortcoming, steel matrix Alloys are developed. Different forms of reinforcements are added to the matrices. The particulate reinforced steel matrix Alloys are extensively used because of the uniform dispersion of tough ceramic particles embedded inside the matrix. In widespread, these substances exhibit exact mechanical residences and feature the abilities to withstand excessive-velocity impacts and high durability. It is very appealing to a wide range of engineering areas, including bicycle frames, cylinder block liners, automotive pistons, vehicle drive shafts, and so on. However, the downside of these materials is their low ductility caused by the production of voids in the material due to the ceramic reinforcing utilized. [4-5]

5. SELECTION PROCEDURE

5.1 Matrix material

The matrix Alloy has to be chosen carefully about its properties. The reinforcement conduct as its miles foremost constituent in the matrix Alloy needs to be selected simplest after being cautious subject to its chemical compatibility with reinforcements. Researchers have proposed numerous matrix substances relying on their houses. Aluminum, titanium, and magnesium are widely used amongst these to be had materials. Beryllium is the lightest structural substance available and having more tensile modulus as compared to steel. It is thought that Beryllium is brittle, and it isn't suitable for the use of preferred programs. Though magnesium is light, it's far more reactive with oxygen. Aluminum is certainly one of the top first-rate choices for matrix, due to its better mechanical belongings, with excessive corrosion resistance, high sturdiness, and low density. In addition, Aluminium is likewise not high-priced in comparison to different light elements. Thus, Aluminum based steel matrix Alloys offer ability inside the location where advanced structural packages, true put on resistance at multiplied temperature, and better Mechanical residences are significant. [6-8]

6. ALUMINUM-BASED ALLOYS

Now, due to the feasibility of less expensive reinforcement, Alloy materials' fabrication costs have come within our reach. This has also been made feasible by way of the feasibility of using traditional casting techniques for Alloys. In the location of packages, the number one become thru Toyota of Japan, which introduced ceramic fiber bolstered squeeze cast Al 2024 used for excessive velocity diesel engines.

There is a massive research pastime for generating Nano Alloy materials for automobile functions like pistons, connecting rods, and only engine elements due to their sturdiness, excessive temperature strength, low weight, and occasional fee. Thus low fee mass manufacturable Aluminium Alloys constitute the maximum essential Aluminium Alloys interest in developing international allocations. Materials form the center of all engineering packages. A technological improvement in any place necessitates development inside the subject of substances. The shortage of suitable fabric for the software program has often changed the direction of a wonderful style of improvement. The primary purpose of any improvement is its suitability to needs; this suitability is useful to the utility environment.

6.1 Aluminum Alloy processing techniques

The following explains the numerous methods of guidance of hybrid Alloy materials.

6.2 Injection Method:

The most important gain in this device is the dispersoid addition alongside aspect degassing of the melt. But because of longer injection time, it may result in nonhomogeneous distribution of the debris, and at times, the clogging of particles inside the injection gun may moreover occur.[9-11]

6.3 Pellet Method:

This device is nicely ideal for dispersing debris finer than 50m which in any other case isn't always feasible through the usage of the vortex method. A few drawbacks encountered in this process are Non-uniform dispersion Rejection of the particles to the softened floor.

6.4 Pressure Casting/Forging:

This advanced technique of manufacturing particulate Alloys yields casting freed from porosity and shrinkage. Here the soften is squeezed and solid into the final product in an appropriate mold. Due to the stress software, the defects due to the entrapped gasses alongside porosities and shrinkages are eliminated. Higher costs of cooling are facilitative with inside the uniform dispersion of particles. [12-15]

7. CORROSION PHENOMENON

Metals and Alloys are beneficial substances for humankind. They are utilized in constructions fabrication, in making various utensils in industries and power flora, etc. These are liable to numerous forms of corrosive attacks. The phenomena of metal and Alloy undergo destruction through the act of the environment is known as corrosion. Brass is resistant closer to the impact of the atmosphere, but it's far known that it is vulnerable to corrosion during many chemical compounds and in aggressive media. The use of corrosion inhibitors in such situations is necessary. The use of inhibitors is one of all the first-rate strategies of protecting metals/alloys against corrosion. The literature survey reveals that the fragrant conjugated compound, a larger heterocyclic compound, and O, S, N containing ligand/ compounds are also relevant as corrosion inhibitors for numerous metallic and Alloys. Hydroxytriazenes above residences is a widely renowned chelating agent that has been extensively utilized as a complexometric and spectrophotometric reagent for the quantitative determination of transition and non-transition metals in our laboratory for the past forty years, according to our records. However, very little work has been done in the field of corrosion inhibition the use of hydroxytriazenes. Earlier research work has been shown that hydroxytriazene is an ability corrosion inhibitor for steel/Alloy. There is also are wide scope of use of a natural product like Punica granitum, tea, latex plant, etc., as corrosion inhibitive agents. Synthesis of hydroxytriazenes and plant extracts viz. Azadirachta Indica (Neem) for corrosion inhibition of Brass in diverse media. The investigation of corrosion inhibition was completed in numerous media like ammonicall and acidic medium. For this have a look at weight loss approach has been used to decide inhibition efficiency (IE) and corrosion rate (CR) [16-19].

In our life, we use excessive energy metals, and most of the metals except gold and platinum are unstable and usually present within the mixed state being decreased in energy. As soon as the metals are extracted from their ores, nature tries to transform their lower back into the shape they occur. Metals, therefore, react with the aggressive species present in surrounding surroundings forming compounds like steel chlorides, carbonates oxides, sulfides, etc. The maximum common shape of corrosion is aqueous metal corrosion, wherein the cloth is a metallic or an Alloy, and the environment is an aqueous solution. This herbal phenomenon is called steel corrosion. Corrosion confirmed itself in diverse forms in our everyday life. For example, holes in auto bodies, Reddish-orange spots on the metal floor, brown murky water taps, corroded nails leaking warm water tanks, etc. Thus it is a serves fabric technology problem. One can outline the period corrosion because of the conversion of metallic to a steel compound. Corrosion takes region when there has been a difference in metal ion attention. For example -the impure zinc dissolved faster in acid solution. [20]

8. IMPORTANCE OF CORROSION

Corrosion is an inherently tough phenomenon, and it's far subjected to studies. It involved issues related to human existence and economic impact, safety, environmental pollutants, and conservation of metallic and materials. The consequences of corrosion are each direct and indirect. Economic losses due to corrosion indirect losses Economical

(a) Contamination of the product
(b) Loss of valuable products
(c) Loss of production
(d) Loss of efficiency
(e) Shutdown losses Social Safety, hearth, explosion or release of poisonous merchandise to the surroundings Direct losses
(f) Over –designing.
(g) Inability to use in any other case suitable substances
(h) Cost of repair or substitute of corroded equipment.

The dangerous outcomes of corrosion are nuclear hazards-The Chernobyl catastrophe is an example of nuclear hazards. The delivery of radioactive corrosion merchandise in the water turns dangerous for living lifestyles like Fatal to human, animal, plant, and biological existence. Contamination of fluids in vessels, tubes, and pipes. It may additionally contaminate chemicals, pharmaceuticals, dyes, packed food, and water, etc. Loss of time in the availability of profile-making industrial equipment. Factors Influencing Corrosion Rate and quantity of corrosion depend on the nature of metals/Alloys and environments. The nature of the environment, in addition to metal, affects corrosion.

(i) Nature of the environment

The following are the parameters of surrounding surroundings that have an impact on corrosion. Presence of humidity, temperature, pH of the medium, nature of anions and cations present, the concentration of the medium, conductivity of the medium, presence of impurities in the atmosphere, attention of oxygen and formation of oxygen awareness cells, presence or absence of an inhibitor, go with the flow pace of technique stream.

(ii) Nature of the metals

The following characteristics of the metal affect corrosion. They are purity of the metallic, bodily country, the solubility of the corrosion merchandise, oxidation capability, over-voltage, relative areas, and nature of the oxide/surface film.[21-23]

9. CORROSION PROBLEM AREAS

If the attack is rapid, penetrating deep into the metallic ensuing in loss of strength, the actual mechanism differs with every Alloy system. Pitting corrosion sharply produces a hole on the floor of metallic and Alloys. It is frequently termed as under deposit corrosion. This is a localized shape of corrosion and deep penetration of the steel surface with little preferred corrosion inside the surrounding area. This hole on the floor may be small or massive in diameter. Corrosion causes pits in the floor, making it difficult to clean.

In many cases, pitting extends through the metallic floor, creating an unusual or difficult floor profile. In other circumstances, pits are localized in specific regions, leaving the metal floor untouched. In pitting corrosion, incomplete chemical protective films, sand, iron oxide, natural insulating or barrier deposits of dust, and other overseas substances took place at the pipe or any metal surface. Pitting corrosion might include crevice corrosion, waterline assault, beneath deposit assault, erosion-corrosion attack, and awareness-mobile corrosion. Three - In copper-zinc Alloy, zinc is extra vulnerable to dezincification. Zinc is always eliminated first from Alloys and motive dealloying. In brass zinc, eliminate first and leave behind copper and copper oxide and make it susceptible and porous. Dealloying finally penetrates metallic, Allowing liquids or fuel leakage. Removal of ferrite (dealloying) from grey iron is called graphitization or graphitic corrosion- It is dealloying in iron. It is located in grey forged irons in relatively moderate environments wherein selectively leaching of iron leaves a graphite network. In this corrosion, it loses its energy and metal residences, and no dimensional change occurs.

Galvanic corrosion is a localized shape of corrosion that occurs due to the electrochemical reaction regularly observed among metallic floor and surrounding environment. Organic corrosion inhibitors are one of the five ways, besides material selection, design, cathodic protection, and coatings, to protect materials against corrosion. Organic corrosion inhibitors adsorb on the surface to form a protective film that displaces water and protects it against deteriorating. [24-26]

REFERENCES

1. Harish, N. Nagaiah, T. Niranjana Prabhu, K. T. Varughese (2010). Thermo- Mechanical Analysis of Lead Monoxide Filled Unsaturated Polyester Based Polymer Alloy Radiation Shields, *J. Appl. Polym. Sci.,* 117, 3623–3629.
2. Harlow D.G. (1983). Statistical properties of hybrid alloys I; recursion Analysis, Proceedings of Royal Society, London – A, 389, 67–100.
3. Harris B and Bunsell AR. (1975), Impact properties of glass fiber/carbonhybrid alloys. *Alloys,* 6, 197-201.
4. Ho TH and Wang CS. (2001). Modification of epoxy resin with siloxane containing phenol aralkyl epoxy resin for electronic encapsulation application. *European Polymer Journal,* 37, 267-274.
5. Hoffmann B; Kressler J; Stoppelmann G. (2000). Synthesis and characterization of inhibitors based on layered silicates and polyamide-12, *ACS Polymeric Materials: Science & Engineering*, Spring Meeting 2000. 82, 286-287.
6. Horowitz H H, Metzger G. (1963). A New Analysis of Thermogravimetric Traces. Analytical Chemistry, 35, 10, 1464-1468.
7. Hubbe and Lucia (2007. Love, Hate, and Biomaterials, *Bio-resources* 2(4), 534-535.
8. Hull D., Clayne T.W., (1996). An Introduction to Alloy Materials, Cambridge University Press, Cambridge, 12-20.
9. J. Grobelny, (1997). Cross polarization/magic angle spinning ^{13}C NMR study of cross- linked polyesters, *Polymer,* 38(4), 751-757.
10. J.H. Chang, D.K. Park, J.H. Chang and D.K. Park. (2001). Inhibitors of poly (ethylene terephthalate-co-ethylene naphthalate) with organoclay, *Journal of Polymer Science, Part B: Polymer Physics,* 39(21), 2581-2588.
11. J.H. Chang, S.J. Kim, Y.L. Joo, S. Im. (2004). Poly (ethylene terephtalate) Inhibitors by in-situ Interlayer Polymerization: the Thermo-Mechanical Properties and Morphology of the Hybrid Fibers, *Polymer* 45, 919-926.
12. James F. Shackelford and William Alexander, (2000). Materials Science and Engineering Hand Book, 3rd Edition, CRC press LLC, Florida, USA.
13. Jane Maria Faulstich de Paivaa, Sérgio Mayerc, Mirabel Cerqueira Rezendea, (2006). Comparison of Tensile Strength of Different Carbon Fabric Reinforced Epoxy Alloys, *Materials Research*, 9(1), 83-89.
14. Jang BZ, Chen LC, Hwang LR, Hawkes JE, Zee RH. (1990). The response of fibrous alloys to impact loading, *Polymer Alloys,* 11, 144-157.
15. Jang J and Lee C. (1998). Fabrication and Mechanical Properties of GF-CF/PP Functionally Gradient Materials, *Polymer Testing,* 17, 383-394.
16. Jang J and Moon S. I. (1995). Impact behavior of carbon fiber/ultra-high modulus polyethylene fiber hybrid alloys, *Polymer Alloys,* 16, 325-329.
17. John W. Connell, Joseph G. Smith Jr, Paul M.

Hergenrother, (2003). High Temperature Transfer Molding Resins: Laminate properties of PETI-298 and PETI-330, *High Performance Polymers*, 15, 375 –394.

18. K.J. Wong, BF Yousif, KO Low, YNg, and SL Tan. (2010). Effects of fillers on the fracture behaviour of particulate polyester alloys, *J. Strain Analysis*, 45, 67 – 78.

19. K.K. Chawla and A.C. Bastos (1979). Proceedings of the International Conference on the Mechanical Behavior of Materials III, Pergamon Press, Oxford, p191.

20. Kardos J.L. (1985). Critical issues in achieving desirable mechanical properties for short fiber alloys, *Pure and Applied Chemistry,* 57 (11), 1651—1657.

21. Kashiwagi T, Harris RH, Xin Zhang, Briber RM, Cipriano BH, Raghavan SR, Awad W H, Shields JR. (2004). Flame retardant mechanism of polyamide 6-clay inhibitors, *Polymer*, 45 (3), 881-891.

22. Kaya E, Tanoglu M, Okur S. (2008). Layered clay/epoxy inhibitors: thermomechanical, flame retardancy, and optical properties. *Journal of Applied Polymer Science*, 109, 834–840.

23. Kaya E, Tanoglu M. (2005). In: Proceedings of advancing with alloys conference, Italy, p27.

24. Kaw A.K., (1997). Mechanics of Alloy Materials, First Edition, CRC Press, LLC.

25. Kim, J.K., Hu, C.G., Woo Ricky, S.C., Sham, M.L., (2005), Moisture barrier characteristics of organoclay-epoxy inhibitors, *Alloy Science and Technology,* 65(5), 805-813.

26. KishiH, Hayashi M, Higashi T, Odagiri N. (2000). Resin compositions for fiber reinforced alloy materials and processes for producing the same, pre-pregs, fiber-reinforced alloy materials and honeycomb structures, Patent Number: US 6045898

****