CHAPTER - II

AIM AND SCOPE

2.1. Selection of Inhibitor

The selection of an inhibitor is based on the metal and the environment. It begins with the choice of physical properties. The variables like temperature, pressure as well as mechanical properties affect the corrosion environment. The cost, toxicity and availability are considerable importance in the selection and utilization of inhibitor.

Polymers are used as corrosion inhibitors which have attracted considerable attention recently because: (1) They are low cost and stable to metallic materials in aqueous media, (2) possession of multiple adsorption sites and (3) through their functional groups, they form complexes with metal ions, and on the metal surface, these complexes occupy a large area, thereby blanketing the surface and protecting the metal from corrosive agents present in the solution [1-5]. The inhibitive power of this polymer is related structurally to the cyclic rings, heteroatom (oxygen and nitrogen) that are regarded as centers of adsorption. Some polymers have been reported to inhibit the corrosion of mild steel in various aqueous media, such as Polyglycol, Poly ethyleneglycol [6], Pectine (P), Carboxy methyl cellulose (CMC), polyvinyl alcohol (PVA), poly ethylene glycol (PEG), poly acrylic acid (PAA) and sodium poly acrylate (NaPA) [7], polyethylene glycol methyl ether (PEGME) [8].

Polyacrylic acid is a biodegradable water soluble polymer with various industrial applications, including as a super adsorbent (e.g., in disposable nappies), in water treatment, etc. [9]. Poly (acrylic acid) (PAA) copolymers modified with block-
copolymers of poly (ethylene oxide) (PEO) and poly (propylene oxide) (PPO) have a wide range of medicinal applications as their components are considered pharmaceutically safe [10].

The unique property of Poly (acrylic acid) is that it exists as a liquid at pH 5 and as a gel at pH 7. Permeation of cations into the gelled polymer converts the gel back to a liquid [11]. It is ideal for particular delivery of ribozymes to the corneal epithelium as a drug delivery vehicle [12]. Hydrophobically modified poly (acrylic acid) (HMPAA) shows some interesting rheological properties in semi dilute aqueous solutions, such as inter chain aggregation followed by an increase in the apparent molecular weight and enhanced viscosity as well as shear sensitivity [13]. HMPAA is prepared by modification of PAA in its acidic form by alkylamines in an aprotic solvent in the presence of N, N- dicyclohexylcarbodiimide (DCCD) [14].

Poly (acrylic acid) based polymers are mainly used for oral and mucosal contact applications such as controlled release tablets, oral suspensions and bio adhesives. It is also used as a thickening, suspending and emulsion stabilizing agent in low viscosity systems for topical applications. For bioadhesive applications, high molecular weight acrylic acid polymer cross linked with divinyl glycol are extensively formulated in a variety of drug delivery systems for mucosal applications. Buccal, intestinal, nasal, vaginal and rectal bioadhesive products can all be formulated with such polymers [15].

Many polymers are used as corrosion inhibitors have been reported in the literature, no detailed study has been reported so far on poly (acrylic acid). Hence this new polymer is chosen in the present study aims at studying the synergistic effect of
poly (acrylic acid) (PAA), Zinc and Nickel ions to prevent/minimize the corrosion rate as well as microbial growth.

2.2. Selection of Samples

Mild steel, the most widely used engineering material, accounts for approximately 85% of the annual steel production worldwide. Despite its relatively limited corrosion resistance, mild steel is used in large tonnages in marine applications, nuclear power, cooling water plants and fossil fuel power plants, transportation, chemical processing, petroleum production and refining, pipelines, mining, construction and metal-processing equipment.

The cost of metallic corrosion to the total economy must be measured in hundreds of millions of dollars (or euros) per year. Because mild steels represent the largest single class of alloys in use, both in terms of tonnage and total cost, it is easy to understand that the corrosion of mild steels is a problem of enormous practical importance. This is the reason for the existence of entire industries devoted to providing protective systems for iron and steel.

2.3. Selection of Test medium

Open recirculating cooling water systems are commonly used for industrial cooling purposes to efficiently dissipate unwanted process heat. The essence of cooling water systems consists of plant heat exchange equipment and the water that passes through it to reduce heat from process fluids. Water is a universal solvent and thus becomes a potential medium to result into cooling water problems. It carries minerals, suspended colloidal and biological impurities. The main problems associated with this system are scaling, corrosion, fouling and microbiological growth.
which is left untreated can lead to various problems like reduced operating efficiency, increased maintenance cost, loss in heat transfer efficiency, energy and ultimate shut down. Deposit formation is either by suspended solids or due to precipitation of soluble minerals. Organisms that enter and grow within a cooling water system, causing fouling and scale formation, create biological fouling. Such deposits and scaling interfere with the heat transfer efficiency in exchangers. Three basic types of corrosion, which occur in the cooling water system, are uniform, pitting and galvanic corrosion.

Considering the above factors in the present study Poly (acrylic acid) selected for to improve its inhibition efficiency for mild steel corrosion and microbiological in 60 ppm Cl\(^{-}\) medium. The following ternary inhibitor formulations were investigated.

- PAA + Zn\(^{2+}\) + SG
- PAA + Zn\(^{2+}\) + SPT
- PAA + Zn\(^{2+}\) + TSC
- PAA + Ni\(^{2+}\) + SG
- PAA + Ni\(^{2+}\) + SPT
- PAA + Ni\(^{2+}\) + TSC

2.4. **Objectives of the present work**

- To study the effects (synergistic or antagonistic) of the above mentioned inhibitors and Zn\(^{2+}\) and Ni\(^{2+}\) on the inhibition of the corrosion of mild steel in 60 ppm chloride medium.

- To study the influence of various pH - 5, 7, 9 and 11 and the duration of immersion on the corrosion inhibition efficiencies of all the inhibitors.
To examine the corrosion inhibitive nature of the ternary inhibitor system on the mild steel in 60 ppm Cl⁻ medium using potentiodynamic polarization, electrochemical impedance spectroscopy and weight loss methods.

To investigate the nature of the protective film using FTIR spectroscopy, Scanning electron microscopy (SEM), Energy dispersive x-ray analysis (EDX) and Atomic force microscopy (AFM).

To elucidate the possible mechanism of the corrosion inhibition.

To study the biocidal efficiency (B.E %) and determination of colony forming unit (CFU/ml) of the biocides such as sodium lauryl sulphate (SLS), Benzyl triethylammonium chloride (BEC) in ternary combination inhibitor system.
REFERENCES


