# CORROSION AND PROTECTION

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Corrosion is a metal-environment reaction and often leads to degradation in physical properties of metallic components. It is therefore essential to control corrosion. This can be brought about by altering aspects related to the metal or the environment or by introducing a barrier between the metal and the environment. It is often essential to determine the corrosion behavior of new materials/alloys in specific environments to evaluate their:

(a) susceptibility and therefore the need to protect;

(b) usefulness to protect less noble metals.

The different projects carried out in 2000-01 can be grouped as:

(a) corrosion control with rare earths; and

(b) corrosion behavior of various alloys and coatings.

## Corrosion control with rare earths

The high reactivity of rare earths (RE) permit their use in corrosion control:

(a) to enhance the high temperature (HT) oxidation and/or sulfidation resistance of heat resistant alloys;

(b) enhance aqueous corrosion resistance of various alloys and

(c) as aqueous corrosion inhibitors.

A number of projects are underway to develop:

(a) HT oxidation resistant alloys;

(b) H.T. sulfidation resistant alloys; and

(c) RE coatings, by the sol-gel process to improve H.T. oxidation resistance of chromia and alumina forming alloys. Various iron-chromium alloys containing Y, Nd, La, Pr and Dy or their oxides have been prepared and characterized. An overall mechanism by which RE bring about significant improvements in oxidation resistance has been proposed and shown to be operative. The effect of Y and Al additions as well as pre-oxidation on the high temperature sulfidation resistance of iron-chromium alloys has been studied and sulfidation mechanisms have been proposed. The conjoint effect of adding Al + Y and pre-oxidation resulted in marked improvements in sulfidation resistanceof the alloys.

## Corrosion behavior of various alloys and coatings.

The different systems that have been studied include:

(a) RE based magnetic materials: RE-Fe-B magnets are promising materials for use as permanent magnets but lack corrosion resistance. Hence, attempts are in progress to characterize their corrosion behavior and develop protective coatings.

(b) sintered austenitic stainless steels (ASS): ASS are well known for their aqueous corrosion resistance. However, sintered ASS exhibit reduced corrosion resistance. The effect of surface treatments to improve the corrosion resistance of ASS has been studied.

(c) corrosion of carbon steels and Al alloys in alcohols: resurgence of alcohol driven automobiles has brought forth the need to evaluate the corrosion resistance of certain common alloys in this media.

(d) amorphous alloys: amorphous alloys in general exhibit high aqueous corrosion resistance. They can therefore be used to protect less noble alloys like carbon steels. Electrodeposition being a cheap and viable technique has been used to develop amorphous and/or nanocrystalline Fe-Cr-P deposits on C-steel surfaces. These coated surfaces revealed increased corrosion resistance. Problems related to stresses in the deposit need to be addressed.

(e) Erosion-oxidation resistant materials: the conjoint effect of erosion and oxidation at high temperatures causes marked degradation of metallic materials. An apparatus to simulate HT erosion-oxidation conditions was installed and many alloys/coatings have been tested.

(f) Corrosion resistant coatings: this project focuses on the development of:

(1) particulate zinc coatings containing;

(2) tanin containing coatings for protection of steel reinforcement used in the civil engineering industry and

(3) galvanized and electrodeposited Zn based coatings.

(g) Corrosion of biomaterials: the corrosion behavior of Ti alloys and stainless steels for use in biomedical applications is being studied and the cytotoxicity of their corrosion products is also being determined.