

## Chapter 15

# Formulating Policies for the Environmentally Sustainable Solution to Mitigate Corrosion

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### **ABSTRACT**

*For the development of a nation, three Es (Economy, Environment, and Energy) contribute greatly. Rapid economic development has increasingly been at loggerheads with environmental concerns. The two Es (Economic Development and Environmental Concerns) have a mutually exclusive and adversarial relationship. Metal dissolution, a big challenge ever since its discovery, has a huge economic and environmental impact on practically all facets of the world's infrastructure. The corrosion management is an essential element for the development of a sustainable industrial society, including issues such as the selection and development of corrosion resistant materials, coatings, and environmentally friendly inhibitors, which alone can reduce 70 percent of the losses due to corrosion. This chapter visualizes how, combining economic success, social responsibility, environmental protection, and energy conservation, natural resources are the best to use as green inhibitors. The designing and building of an algorithm that is translated into action plans is possible only by policy.*

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## INTRODUCTION

The phenomenon of corrosion has been known ever since the discovery of metals. Scientific investigation started at the beginning of the 19<sup>th</sup> century with Nicholson and Caryle's discovery of the electrolytic decomposition of water by the electric current supplied by a galvanic battery (W Lynes, 1951). Humphrey Davy established a relationship between the production of electricity and the oxidation of zinc, in which one of the two metals was Copper and the other acted as the generator of electricity. At the beginning of the 20<sup>th</sup> century, the electrochemical theory of corrosion theory was taken up by Whitney, and completed by Hoar and Evans (1932 and 1960).

The phenomenon of loss or conversion into another insoluble compound of the surface layers of a solid (generally a metal) in contact with a fluid is referred as **Corrosion** (NACE glossary 1965; Shaw & Kelly, 2006). Corrosion produces a less desirable material from the original metal, leading to 3-4% national income (GDP) losses of the developed countries. It has many serious economic, health, safety, technological, and cultural consequences to our society. Several studies (Vargel, 2004; Fontana, 2005; Roberge, 2008) over the past half a century have shown that the annual direct loss on account of corrosion to an industrial economy is estimated to be quite high and up to the extent of 3% to 4% of the country's Gross National Product (GNP). Based on studies regarding the cost of corrosion of developing as well as developed countries, Sharma (2011) reveal that the corrosion cost of US, UK, Japan, Australia, Germany, Finland, Sweden, Italy, China, India and some of African countries as well are drastically multiplying over the years, despite of vast technological developments. A survey conducted in Italy in the past 20 years (Sharma, 2011) reveals that the impact of corrosion on the domestic economy accounted for more than 3% of the country's GDP.

In the United States alone, the total corrosion costs now exceed \$1 trillion per year, as estimated by the National Association of Corrosion Engineers (NACE, 2013). It has been estimated that more than 20% of the steel produced each year is used to replace machinery construction destroyed by corrosion. In India also, an estimated loss of Rs. 56,000 crores (~US \$ 8 billion) occurs every year due to corrosion. Though corrosion is prevalent and inevitable, yet, it can be impeded and about 25 to 30% of annual corrosion costs (approximately \$2.2 trillion global cost of corrosion) could be saved and increased public safety only by better use of knowledge of corrosion protection and promoting relevant researches in this domain (NACE, 2013).

Owing to the tremendous economic loss it causes, corrosion has and continues to be the subject of extensive study especially with a view to its minimization at acceptable expense in terms of economy and environment. But, so far very little efforts are focused to make these efforts cost effective as well as environment –friendly. The first step is to construct a strategy of corrosion management, in addition to its

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