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COST OF CORROSION

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ABSTRACT

Corrosion affects all materials - metal and non-metal. Annually, it costs society billion of dollars. It is not only financially damaging to the economies, but also wasting our limited natural resources, damaging the environment and causing a great deal of human suffering. The understanding of corrosion with correct engineering application could greatly reduce the damaging effects and cost of corrosion.

INTRODUCTION

Corrosion is defined as the destruction of deterioration of a material, either metal or non-metal, because of reaction with its environment (Mars G Fontana, 1987). Corrosive environments include air and moisture; fresh or salt water; rural, urban and industrial atmospheres; steam and other gases such as hydrogen sulfide, sulfur dioxide; mineral and organic acids; alkalis; soils; petroleum oils; etc. Based on the environment present, corrosion can be classified as wet or dry corrosion. Wet corrosion occurs when a liquid is present (in aqueous or electrolyte environments) while dry corrosion occurs in the absence of liquid phase or above the dew point of the environment (the corrodents are vapors and gases) (Ibid, p.9). Since all environments are corrosive to some degree, the damaging effects cost billion of dollars annually.

COST OF CORROSION

Corrosion costs society billions of dollar annually. The costs vary with the degree of the problem: a car owner may have to spend $70-80 his-hard earned money to replace his car's broken exhaust pipe while the U.S. government has to spent billion of dollars of tax payers money to repair bridges damaged by deicing salt.

Many studies have been done to estimate the cost of corrosion to the community. It has been concluded that the total annual corrosion costs in the industrialised countries amount to about 4% of the gross national product (Einar Mattsson, 1989). In 1971, U.K. economy alone suffered a staggering £1365 million (1971 prices) as a cost of corrosion. A summary of the costs involved is presented in Table 1 (K R Trethewey, J Chamberlain, 1990). The values shown in Table 1 may seem to be surprising at first. How can the cost of replacing corroded components be so great?

The answer lies in the fact that the cost of corrosion not only of the actual part's replacement but also the indirect costs involved. The indirect cost may occur as a result of:

(a) Lost production during a shutdown. For example, in U.K. it costs £5000 per day (1977) to take a 400 kV transmission line out of service to deal with corrosion damage (Ibid, p.6).

(b) High maintenance costs. For example, in the U.S., the gas utilities spent, U.S. $1.7 billion in new piping and U.S. $2.2 billion in repairs, renovations and replacements in 1989. 0f this, most repairs were for corrosion leaks, third party damage and material defects ("Upfront", November 90).

(c) Warranty claims. Because of corrosion to their cars, the 0ntario Rusty Ford Owner Association obtained substantial compensation from the courts (K R Trethewey, J Chamberlain). Another automaker, Subaru of America recalled 285,000 front wheel drive cars manufactured during 1980-86 for inspection and rust proofing. The recalled were made because of the corroding of rear suspension as a result of the used of the deicing salts on the streets ("Upfront", July 1990).

Besides monetary values, corrosion also cause a waste of natural resources. In the U.Kingdom, I tonne of steel is completely converted into rusts every 90 seconds, wasting not only the metal itself but the energy that has been used to produce the metal from its ore. The energy required to produce a tonne of steel from iron ore is sufficient to provide an average family home with energy for three months (K R Trethewey, J Chamberlain).

Corrosion can also cause damage to the environment. A leak underground oil tank which results from corrosion poses a threat to ground water. The used of deicing salts in the U.S. caused U.S. $2.7 billion worth of corrosion damage annually not only to bridges and cars but also harming roadside vegetation and water supplies ("Upfront", Sept. 1987). To avoid ecological hazards to the harbours, the U.S. Coast Guard has barred entry into U.S. ports several foreigns flag petroleum tankers that are so badly corroded. Iver Christian, a Norwegian tanker was barred from Boston in November 1990 ("Upfront", March 1991).

Corrosion also caused considerable inconvenience to human beings and sometimes even loss of life. In 1985, the roof of a 13-year old swimming pool in Switzerland collapsed, killing 12 and injuring others as a result of stress corrosion cracking of the exposed stainless steel hangers which supported the 200-tonne suspended reinforced concrete roof (K R Trethewey, J Chamberlain).

CONCLUSION

Enormous amount of damage is caused by corrosion in terms of financial damage to the economies, wasting of natural resources, and causing a great deal of human suffering. Corrosion damage and its cost can be reduced by better exploiting the corrosion prevention knowledge we have today. It is also vital that every engineer during his education is made aware of the effects and implications of corrosion. With better

understanding of corrosion and correct engineering application, cost of corrosion would be greatly reduced.

REFERENCES

1. Mars G Fontana: "Corrosion Engineering" 3rd edition, McGraw-Hill International Edit., p.4, 1987.
2. Ibid, p.9.
3. Einar Mattsson: "Basic Corrosion Technology For Scientists and Engineers" Ellis Horwood Limited, p.13, 1989.
4. K R Trethewey, J Chamberlain: "Corrosion for Students of Science and Engineering" Longman Scientific & Technical, p.6, 1990.
5. Ibid, p.6.
6. "Upfront" Material Performance (November 90), p.2.
7. K R Trethewey, J Chamberlain: " Corrosion" p.8
8. "Upfront" Material Performance (July 1990) p.3.
9. K R Trethewey, J. Chemberlain: "Corrosion", p.5.
10. "Upfront" Material Performance (September 87), p.5.
11. "Upfront" Material Performance (March 91), p.4.
12. K R Trethewey, J Chemberlain: "Corrosion", p.5.

Table 1 : The U.K. National Cost of Corrosion and Protection in 1971
(Reproduced by the permission of the controller, HMSO)

Industry	Estimated cost (£ m. p.a.)	Estimated potential saving (£ m. p.a.)
Building	25	50
Food	40	4
General Engineering	110	35
Government Departments	55	20
Marine	280	55
Metal Refining	15	2
Oil and Chemical	180	15
Power	60	25
Transport	350	100
Water	25	4
TOTAL	1365	310