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Instantaneous, portable and battery operated atmospheric corrosion rate monitoring instrument

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The severity of corrosion due to atmospheric pollutants on metals are measured by using chemical methods or electrochemical sensors along with potentiostats, function generators and recorders etc. In this paper, a direct reading, digital, portable atmospheric corrosion rate monitoring instrument along with a specially designed electrochemical sensor is described. Using this instrument, the corrosion rate for different humidities were studied by keeping the electrochemical sensor in a salt fog chamber. The corrosion rate was also monitored while a known amount of pollutant was introduced in a constant humidity chamber. The results are tabulated.

Key words: Atmospheric corrosion monitor, corrosion rate, electrochemical sensors

INTRODUCTION

Corrosion of metals in the atmosphere can take place only when a film of moisture is present on the metal surface. Though the corrosion of metals in the atmosphere is electrochemical in nature, so far only field exposure tests are employed for determining the corrosion rates. But these field trials are time consuming and costly. Therefore, efforts have been made to develop an electrochemical method that would permit a complete understanding of the kinetics of atmospheric corrosion and the influence of the each variable responsible for corrosion [1-4]. The present paper describes the development of an instrument and its use in the measurement of corrosion rate instantaneously.

INSTRUMENT DESCRIPTION

The block diagram of the instrument is shown in Fig. 1. This consists of a square wave generator of ± 20mV amplitude. This is applied to an electrochemical sensor(electrolytic cell). The output of the electrochemical sensor is fed to a current to voltage converter and then rectified. This d.c. voltage is integrated by an integrator 'I' to produce a voltage proportional to the charge 'Q' due to this current. Integrator 'IC' produces a voltage proportional to the time 'T' for which the current flows. Integrator 'ID' produces a voltage proportional to the ratio of charge 'Q' to time 'T' which after proper scaling is displayed digitally as the corrosion rate in mils per year.

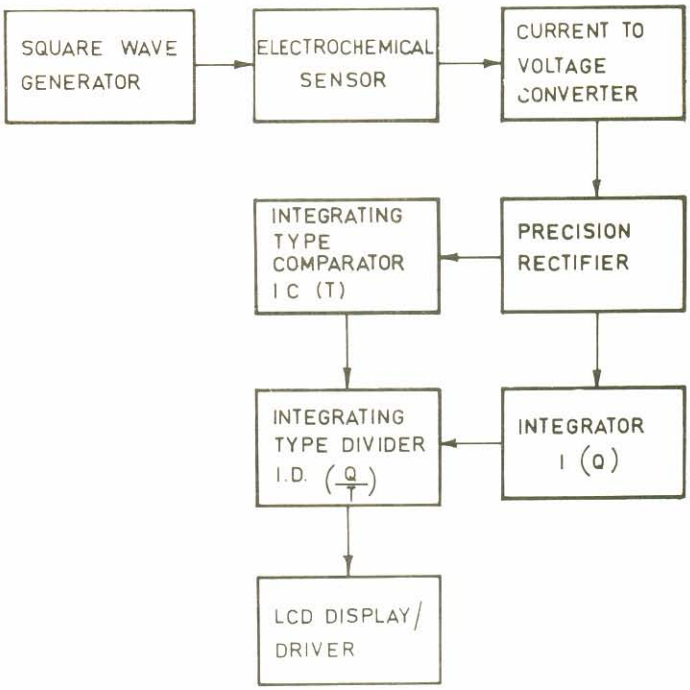

Fig. 1: Block diagram of atmospheric corrosion monitor (Atmocorr)

EXPERIMENTAL

The electrolytic cell used for determining the corrosion rate has been described in an earlier paper [5]. The effect of humidity on corrosion of steel in presence of known quantity of sodium chloride was studied by using glycerol-water mixture for preparing different humidity solutions. Corrosion rate measurements have also been made with different concentrations of Na_2SO_4 at 80% R.H. All the experiments were carried out at room temperature and for a duration of ten minutes. The monometal atmospheric corrosion monitor (electrochemical sensor) was used with the instrument developed for instantaneous measurement of corrosion rate and weight loss was calculated by employing mild steel panels of same area as that of monitor.

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RESULTS AND DISCUSSION

Table I gives the corrosion rate in mils per year (mpy) obtained by both the methods at different humidities. It may be seen from the table that as the humidity increases, the corrosion rate also increases and there is good agreement between the instrument's reading and the value obtained by weight loss method with 0.1% NaCl solution. In Table II the corrosion rate obtained at different concentrations of Na_2SO_4 at 80% RH is given. Here again, a good agreement between the two methods employed is observed. This shows that the atmospheric corrosion monitor developed gives directly the corrosion rate of mild steel in mpy under controlled conditions.

TABLE–I: Corrosion rate measurements with 0.1 NaCl at room temperature for ten minutes at different relative humidities

Relative humidity %	Corrosion rate obtained from	
	The instrument (mpy)	Weightloss method (mpy)
50	10.6	11.75
60	32.8	31.72
70	40.0	40.18
80	52.4	52.87

TABLE–II: Corrsion rate at different concentrations of Na_2SO_4 at 80% R.H. for ten minutes at room temperature

Concentration of Na_2SO_4 %	Corrosion rate obtained from	
	The instrument (mpy)	Weightloss Method (mpy)
0.001	14.6	14.9
0.01	18.9	16.92
0.1	22.6	23.26
1.0	34.2	34.99

CONCLUSION

The atmospheric corrosion monitor developed can be used for determining the corrosion rate instantaneously in mpy and thus the corrossivity of a place can be gauged.

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