CORROSION MONITORING SYSTEM

1. Objective

Half-cell potential measurements cover the estimation of the electrical half-cell potential/corrosion potential of uncoated reinforcing steel in field and laboratory concrete, for the purpose of determining the corrosion activity of the reinforcing steel.

2. Apparatus Required

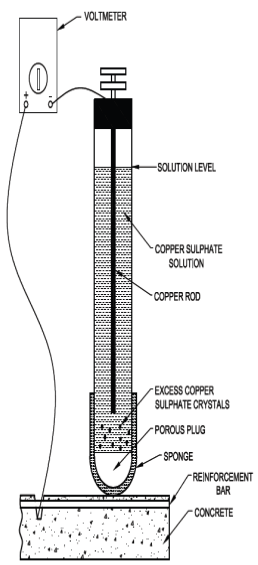

FIG.1 SCHEMATIC OF HALF-CELL POTENTIAL MEASUREMENT

Fig.1:Schematic of Half Cell Potential Measurement

2.1 Half cell,

2.2 Electrical junction device,

2.3 Electrical contact solution,

2.4 Voltmeter, and

2.5 Electrical lead wires.

3. Reference

IS 516 (Part 5 - Non Destructive Testing Section 2 - 2021 - "Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete".

4. Procedure

4.1 Potential measurements can be performed with a single electrode (point measurements) or with one or several wheel electrodes (potential mapping). The primary goal of potential measurements on reinforced concrete structures is to locate areas of corroding reinforcement. Thus before starting to take measurements a coordinate system has to be put onto the structure in order to be able to relate readings with the point on the structure where they were taken. In homogeneous surface conditions such as wet and dry areas or not embedded re-bars that are encountered should be located on a sketch in order to facilitate the interpretation of potential readings. For a statistical evaluation of the data (cumulative probability plot, histogram) the grid spacing must be kept constant.
4.2 Spacing between measurements shall be consistent with the member being investigated and the intended end use of the measurements.
4.3 Electrical connection to the reinforced steel shall be direct electrical connection by means of a compression-type ground clamp, or by brazing or welding a protruding rod to the positive terminal

of the voltmeter.
4.4 Electrically connect one end of the lead wire to the half-cell and the other end of this same lead wire to the negative (ground) terminal of the voltmeter.
4.5 After placing half-cell on the concrete surface, the voltmeter reading shall be observed. If the measured value of the half-cell potential does not change or fluctuate with time, pre-wetting the concrete surface is not necessary. However, if the measured value of the half-cell potential changes or fluctuates with time, prewetting is required for an amount of time such that the voltage reading is stable (0.02 V) when observed for at least 5 min. In case of pre-wetting no free surface water should remain between grid points when potential measurements are initiated.
4.6 Recording half-cell potential values shall be done to the nearest 0.01 V. Report all half-cell potential values in volts and correct for temperature if the half-cell temperature is outside the range of 22.2 ± 5.5^{0}C. The temperature coefficient correction of about 0.000 91 V more negative per ^{0}C for the temperature range from 0 to 49 ^{0}C shall be applied. (see Note).

NOTE — Present criteria based upon the half-cell reaction of Cu → Cu++ + 2e− indicate that the potential of the saturated copper-copper sulfate half-cell as referenced to the hydrogen electrode is − 0.316 V at 22.2 ^{0}C. The cell has a temperature coefficient of about 0.000 91 V more negative per ^{0}C for the temperature range from 0 ^{0}C to 49 ^{0}C.

5. Interpretation Of Results

5.1 Half-cell potentials are normally interpreted using:
(a) Numeric magnitude technique, or
(b) Potential difference technique, or a combination of the two.

5.1.1 Numeric Magnitude Technique

Laboratory testing (partial immersion in chloride solutions) and outdoor exposure (including chloride exposure) of various reinforced concretes above-ground in an area in which the precipitation rate exceeded the evaporation rate, indicate the potential values and the likely corrosion condition is given in Table 1.

5.1.2 Potential Difference Technique

Where large areas of electrically interconnected, embedded steel exist, for example, in bridge decks, reinforced columns, or beams, careful measurement of potentials in a closely spaced grid pattern and the subsequent plotting of equipotential contour maps may allow identification of high versus low corrosion rate areas.

Sr. No.	Cu/$CuSO_4$ Electrode	Likely Corrosion Condition
1	> – 200 mV or less negative than – 200 mV	Low (there is a greater than 90 percent probability that no reinforcing steel corrosion is occurring in that area at the time of measurement)
2	– 200 mV to – 350 mV	Corrosion activity of the reinforcing steel in that area is uncertain
3	< – 350 mV or more negative than – 350 mV	High (there is a greater than 90 percent probability that reinforcing steel corrosion is occurring in that area at the time of measurement)
4	< – 500 mV	Severe corrosion

Table 1 : Criteria for Corrosion Condition of Rebar in Concrete for Different Half-Cells

6. Video

- Corrosion Monitoring System

7. Download

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