Appendix: A Prediction Model for Chloride-Ion Ingress in Concrete Sleepers

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This appendix contains additional figures for "A Prediction Model for Chloride-Ion Ingress in Concrete Sleepers," by Morteza Esmaeili, Sadegh Kaviani, and Farzad Farivar, which appears on pages 86–102 in the January–February 2023 issue of *PCI Journal*.

Breakage and wear of concrete sleepers

Gradual degradation of bridges and obstruction of culvert entrances

Figure A1. The most important problems for railways in desert areas.

Rigidity of ballast layer

Track closure

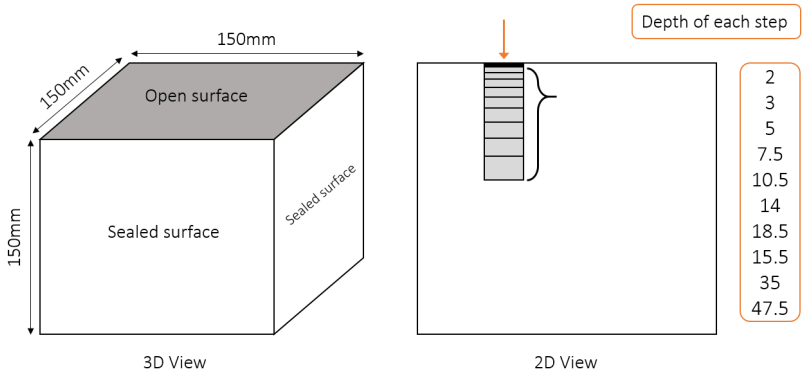
Figure A.2. Main problems for desert railways.

Figure A.3. Cracked concrete sleepers in Rudshur–Shur-e Gaz block.

Figure A.4. Longitudinal cracks in the midspan of the sleeper adjacent to the upper layer of wires.

Figure A.5. Longitudinal cracks in the midspan of the sleeper adjacent to the upper layer of wires.

Figure A.6. Extension of the cracks and sleeper failure.



Schematic view of cubic samples

Powder sampling

Figure A.7. Cubic samples. Note: All dimensions are in millimeters. 2D = two-dimensional; 3D = three-dimensional. 1 mm = 0.0394 in.

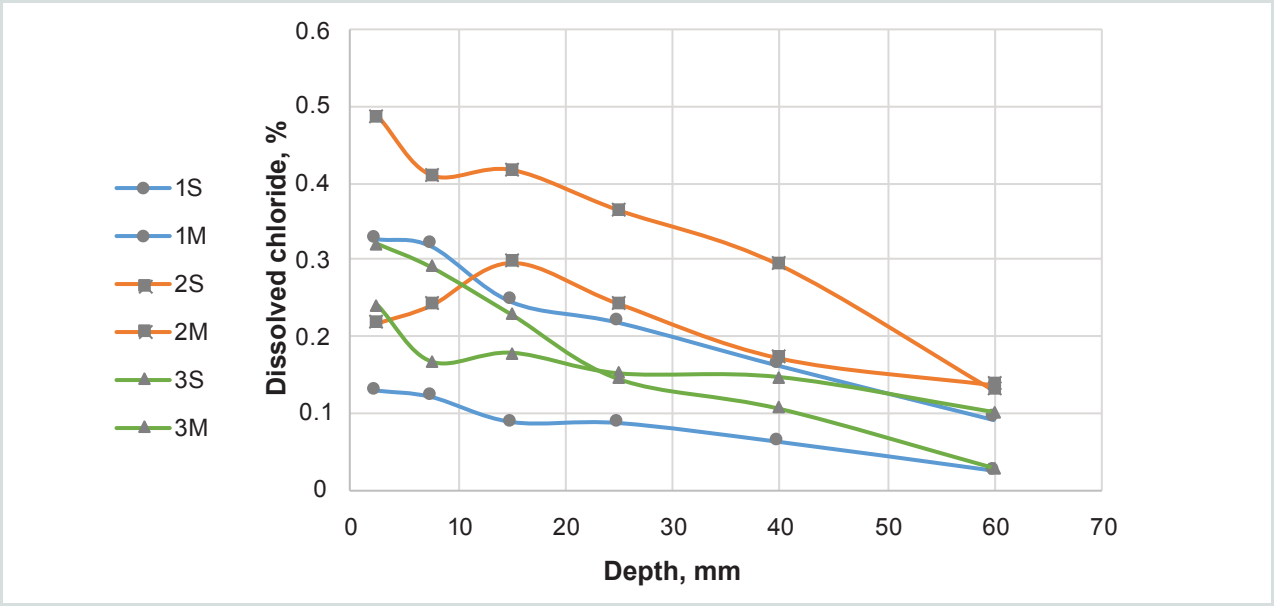


Figure A.8. Chloride measurements at designated depths from site profiles. Note: 1S = shoulder sample 1; 1M = midspan sample 1; 2S = shoulder sample 2; 2M = midspan sample 2; 3S = shoulder sample 3; 3M = midspan sample 3. 1 mm = 0.0394 in.

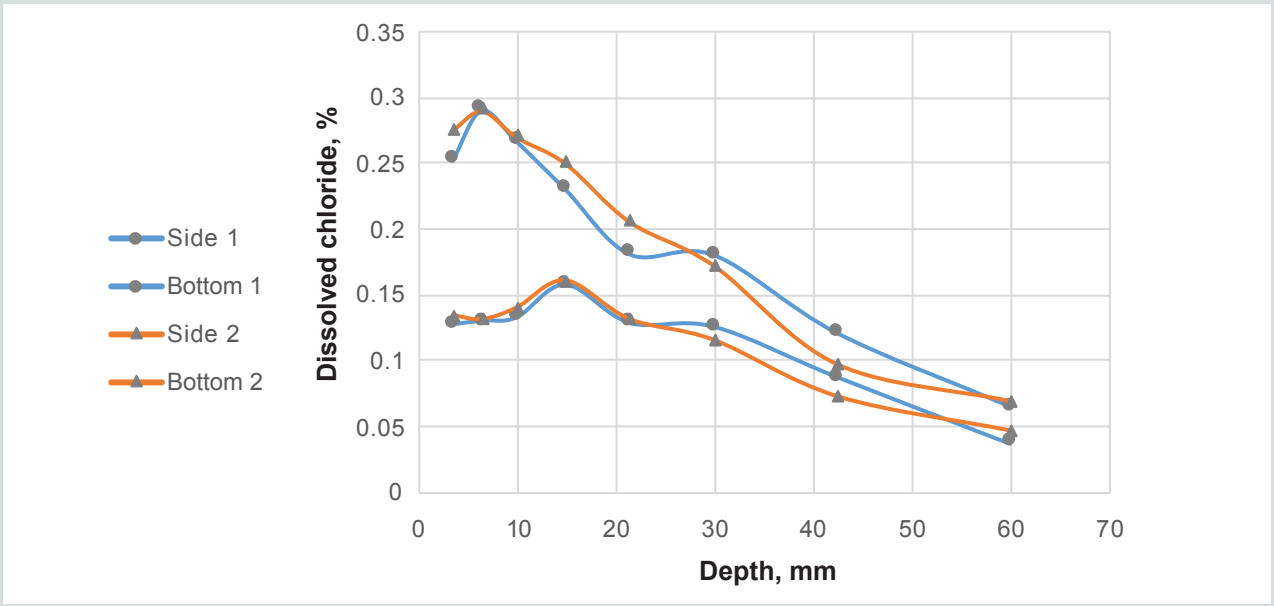


Figure A.9. Chloride measurements at designated depths from laboratory profiles. Note: 1 mm = 0.0394 in.

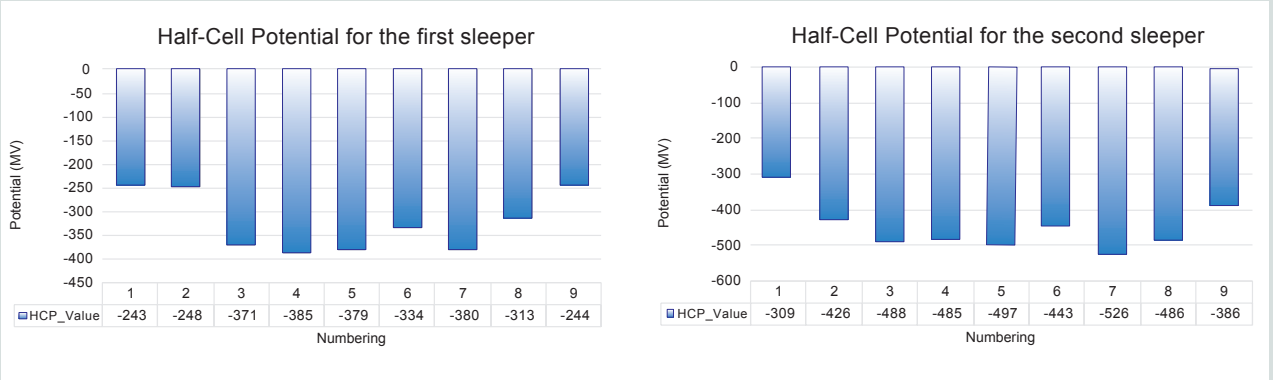


Figure A.10. Half-cell potential test on sleepers transferred to the laboratory.