DATA MINING OF EXPERIMENTAL CORROSION DATA USING NEURAL NETWORK

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The objective of this work is the mining of existing experimental databases on metals and alloys to predict the corrosion resistance and behavior of metals and alloys over extended periods of time. The data mining is aimed at establishing the conditions under which certain parameter sets (i.e. pH, temperature, time of exposure, electrolyte composition, metal composition, metallographic characteristics, etc) may impact the alloy's localized resistance characteristics. The data mining results will allow us to categorize and prioritize those parameters for which the alloy may be at risk of general and/or localized corrosion attacks. It will also help us to understand, along with the information gained through theoretical models, the synergetic effects of those variables on electrochemical potentials and corrosion rates (i.e. pitting, crack, and crevice growth rates). To accomplish the objective, corrosion-related data on corrosion allowable, as well as corrosion resistive, alloys was collected for both DC and AC corrosion experiments from studies of general and localized corrosion.

Collected data was transformed according to the corrosion failure modes and variables. The transformed data was checked for consistency and missing values and cleansed, as per requirements. Data from multiple experiments, figures and tables that represent the same corrosion variables were integrated into a single database for further analysis. Neural Network (NN) Backpropagation method was used to fit a preliminary model to the collected (mostly experimental) data. NN models were tested on available experimental data on corrosion allowable alloys to predict the life of the metals/alloys. NN models were also used to predict future corrosion rates for user-specified conditions and time frames.

This work is part of a multi-university Corrosion Cooperative of the DOE-OCRWM Science and Technology Program established to enhance the understanding of corrosion processes and materials performance.

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[5] Cooperative Agreement of Office of Science and Technology International of United States Department of Energy (DOE), the Office of Civilian Radioactive Waste Management (OCRWM), Office of Repository Development.

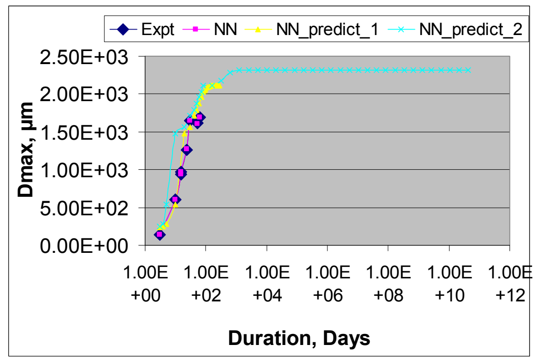

Fig. 1. Prediction of maximum pit depth in the study of crevice corrosion damage function for grade-2 titanium.
NN_predict1: predicted Dmax for 7.7 years,
NN_predict2: predicted Dmax for 235x10^6 years.

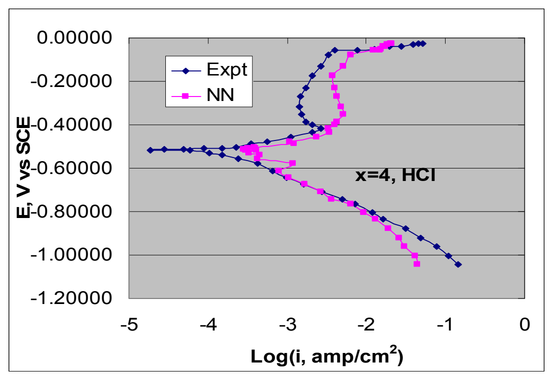

Fig. 2. Polarization curve for $Fe_{68}Ni_{14-x}Mo_xSi_2B_{16}$ metallic glasses for x=4 in 1N HCl. The Neural Network (NN) is validated with a test data set.

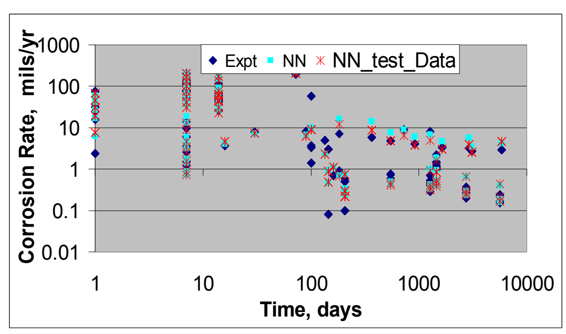

Fig. 3 Prediction of Corrosion Rate using NN for Carbon Steel under different environmental conditions.

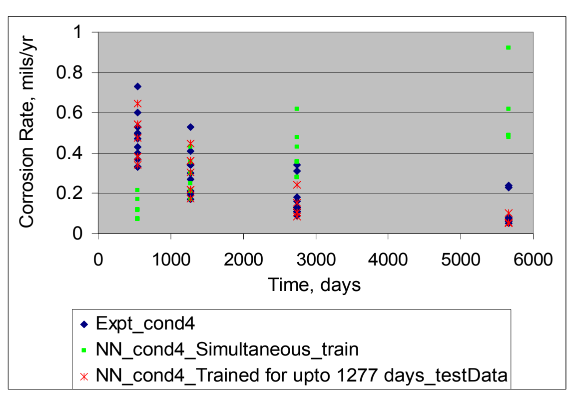

Fig. 4 Prediction of Corrosion Rate using NN for Carbon and Alloy Steel under a single environmental condition.

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