Data miners dig for corrosion resistance

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(PhysOrg.com) -- A better understanding of corrosion resistance may be possible using a data-mining tool, according to Penn State material scientists. This tool may also aid research in other areas where massive amounts of information exist.

In data mining -- a branch of computer science -- computer programs categorize large amounts of data so they become more useful. Different types of data-mining programs can find correlations between data on specific subjects, or in different areas of a single subject. Data mining finds similarities and differences among data parameters that frequently, in a complex problem, would go unnoticed because they would not normally be observed by human inspection.

Kamrun Nahar, research associate, Center for Neural Engineering, along with Mirna Urquidi-Macdonald, professor of engineering science and mechanics, used data mining to find the most relevant information about the corrosion-resistant properties of Alloy 22, an alloy candidate for nuclear-waste canisters. They reported their findings in the latest issue of Corrosion Science.

"Data is collected when a phenomenon is poorly understood and laboratory experiments are carried out," said Nahar. "Large amounts of data exist everywhere. Every area of study has terabytes of information that could be used better by using data mining techniques to extract valuable information from data."

Alloy 22 is known for its corrosion-resistant properties and is most

commonly used where resistance to rust and damage is crucial, such as in radioactive waste containment. Alloy 22 also is used in waste incinerators, pollution control, nuclear-fuel reprocessing and chemical manufacturing.

Alloys are mixtures of metals combined for their specific traits. An alloy usually has different properties than its components and is engineered to produce a material with the desired properties.

"We looked at corrosion properties," said Nahar. "What are the factors, what are the problems with corrosion, and what can we focus on? If you use this alloy for different applications, what are the effects in a certain time period? In how many years will you see corrosion and will it not fade?"

The alloy data came from other researchers' work on Alloy 22. Nahar and Urquidi-Macdonald used statistical techniques to clean the data and put it into a unified format. The data was fed into the computational model the researchers developed for this project. They used an artificial neural network -- ANN, one type of data-mining system that works similarly to a human brain, asking questions, answering them, finding patterns and learning from previous conclusions.

Data mining is most often used for mapping consumers' behaviors, like patterns of purchases, television viewing or Internet use. This work enforces the idea that data mining is applicable to science.

Using the data from other experiments on Alloy 22, the researchers predicted future corrosion patterns of the alloy when put under similar environmental conditions to those in the study. Weight loss numbers were successfully calculated by the data mining system to estimate how much corrosion of a certain material would likely take place. The neural network model learned the functions necessary to map such variables as

corrosion rates.

"What comes from this work and the parallel work is that if you manufacture a cylinder or vessel, you can predict its life depending on the environment that the vessel is in contact with," said Nahar. "For example, if you put it under this environment it is going to last this many years."

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