The Effects of Microgravity on Oxidation

SSEP Mission 10 - iLEAD Consortium
Santa Clarita Valley International Charter School

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Abstract

Our SSEP project aims to test the effects of microgravity on the oxidation of iron. By exposing an iron sample to water while in a microgravity environment, we hope to study the effects of microgravity on the formation of iron oxide. Upon the experiment's return to Earth, we will be conducting an extensive metallurgical study of the iron oxide that forms. We predict that microgravity will have an effect on how the iron oxide develops.

Questions to be Addressed

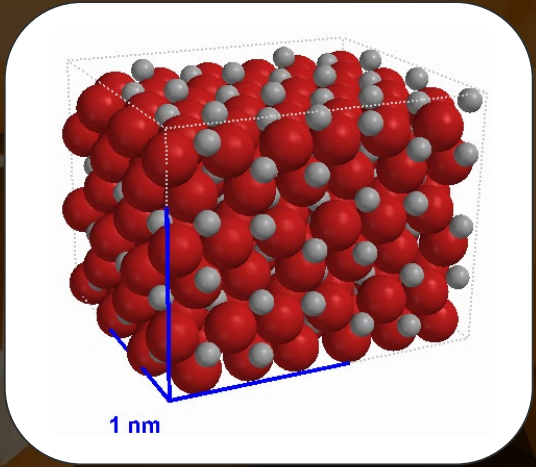
- How does a microgravity environment affect the density of iron oxide crystals?
- Will a microgravity environment affect the rate at which the iron oxide forms?
- Does rust attach itself to the iron rod differently in a microgravity environment?
- Will the solidity of the rust crystals be affected by a microgravity environment?

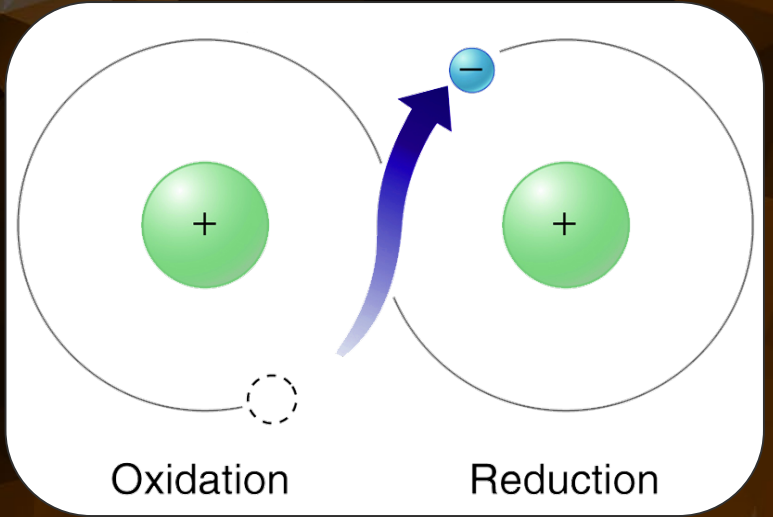
Applications for Corrosion Research in Microgravity

- The International Space Station is partly made of high-grade steel
- Steel is an iron alloy. Therefore, it would be logical to study one of the base metals, iron
- Having a better understanding of how microgravity could affect oxidation and corrosion would let us solve possible future issues for space travel
- We hope to provide insight on oxidation in microgravity conditions to further the study of corrosion as a whole and the susceptibility of materials used in space travel

What is Oxidation?

- Oxidation is a reaction where an atom (iron) loses an electron(s) while another atom (oxygen) gains an electron(s)
- In the case of iron (III) oxide, iron (Fe), loses its two outermost electrons to two separate oxygen (O) atoms. The oxygen atoms themselves take two different electrons from two different iron atoms
- Oxidation occurs in iron because iron oxide is more stable than iron in crystal form





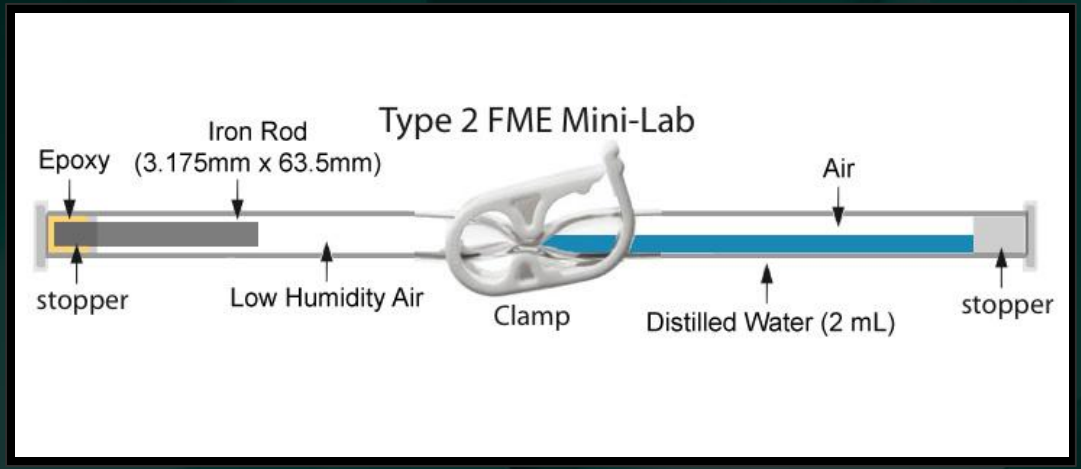
Experiment Materials and Handling Requirements

Volume One:

- Iron Rod 3.175mm x 63.5mm
- Low Humidity Air
- Epoxy

Volume Two:

- Water 2 mL
- Air

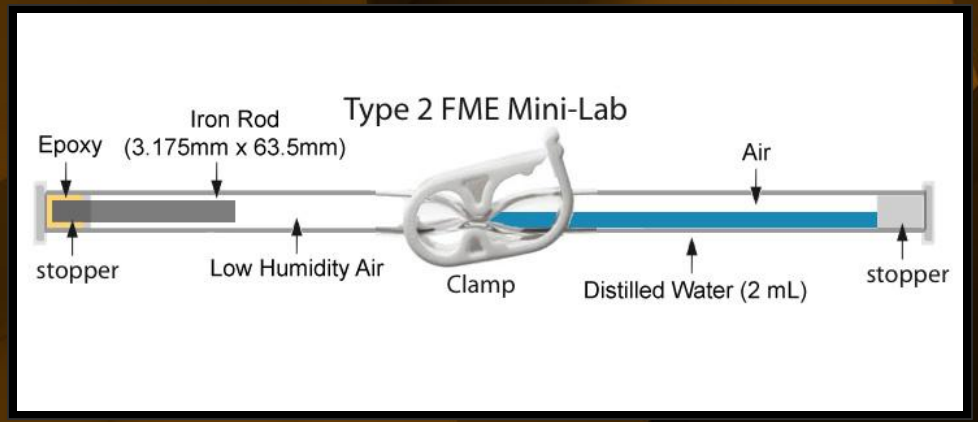


Proposed Timeline for Crew Interactions:

A=0 Un-Clamp Clamp 1, shake gently for 30 seconds

Experiment Design

- The iron rod, in preparation for the experiment, will be contained in a low moisture environment
- The rod will be mounted level in the FME; it will not be touching any of the side walls of the FME
- We will achieve this “floating” position by epoxying the iron rod into one of the end cap stoppers
- Having the rod suspended in the tube will allow for more even formation of rust
- It will also help prevent any rust from falling off the rod upon re-entry



Experiment Design Extended

- We will be using three FMEs during our experiment; all FMEs will be identical in construction
- The first FME (FME 1) will be sent to the ISS and examined upon return
- The second FME (FME 2) will be our main ground truth experiment and will be examined with FME 1
- The third FME (FME 3) will be our secondary ground truth experiment and will be examined upon re-entry of FME 1
- Having FME 3 will allow us to compensate for the time FME 1 spends in a gravity environment between post flight and examination

Post Flight Analysis

- We will first perform a visual examination and basic comparison between our flight sample and our ground truth samples as soon as we receive our flight sample from NASA
- Then we will perform an optical microscope inspection of a small sample of our rust. We will use various microscopes to further examine our samples (1x, 3x, 10x, 50x, 250x magnifications)
- Finally we will reach out to a local metallurgical lab to perform a cross section of our samples. We will then gather additional information on the crystal structure’s construction and the depth of rust penetration into our iron rod sample

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