The effect of water corroding Copper, Steel and Aluminum

Abstract

The purpose of this project is to show how much material is corroded on certain metals. The purpose was to show which metal corroded in the water, the most copper, steel, or aluminum. They hypothesis was that aluminum and steel would be the least corroded of the metals. The method I used was to dip each metal (all the same size) into a small bowl of water for 2 weeks. Each day the metals were checked for any amount of rust that may have accumulated. Each metal had a different weight, aluminum being the lightest, steel in the middle, and copper being the heaviest. The hypothesis was "How does Water affect the corrosion of Copper, Steel, and Aluminum?" The metals were weighed on a scale to Check their weight The 3 metals were dipped into a bowl of liquid (water and soda, juice). Each metal was dipped into each liquid (water and soda, juice) Each metal was put in the liquids for 2 weeks and allowed time for corrosion to take place. The data was observed visually and quantitatively using weight. The metals were weighed again to check how much the metal corroded.

Table Of Contents

Introduction

The point of this article is to show the strengths of aluminum. The results got down to the structure of the metal. With increased heat the structure got softer and less hard (in terms of Moe's scale of hardness, I believe). Another thing that happened at elevated temperatures was heavy oxidization of the metal. "Oxidation at elevated temperature results in the formation of a friable oxide film" (Page 555).

The article was about the corrosion resistance of titanium. The Grade-1 titanium sheets cold rolled to a thickness of 0.4 mm (about 0.02 in) were heat treated in a vacuum annealing furnace. The holding temperature and time were 873 K and 6 h, respectively. The titanium sheets were rinsed in acetone and immersed in a 0.06 M NH_4NO_3. The anodic oxidation was conducted at 80 V for 120 seconds (about 2 minutes). The results included black-colored titanium sheet obtained by the anodic oxidation of CP grade-1 titanium sheet in a 0.06 M NH_4NO_3 solution followed by heat treatment at 773 K. The absorbance of all the titanium sheets were decreased by the anodic oxidation.

Tungsten is an extraordinarily strong metal, so the point of the article was how it did in a fusion environment. The results from neutron and ion irradiation in tungsten are not well correlated. For example, the results of hardness testing from ion and neutron irradiation are presented in Figs. 16 (Pure tungsten) and 17 (W–5% Re). It is clear from these graphs that a higher level of irradiation hardening is observed for neutron irradiation than ion irradiation. This is particularly confusing since the ion irradiation took place at a lower temperature.

The importance of these articles includes the strength of different metals. The first article is a book about the strength of metals. The second article is about strength of titanium after anodization of the metal. The third is about predicting the performance of tungsten in a fusion environment. The fourth article is about Effects on body after getting shot.

These will be useful in the research of Metal strength and durability of metals. The use of these metals in how brittle they are determines their strength. The harder a thing is the more brittle they are. (ex. Diamonds at a Moes scale of hardness of 10 but are brittle if you smash it with a hammer.). Corrosion resistance is what I want to test in this, by dunking metals in liquids for a period.

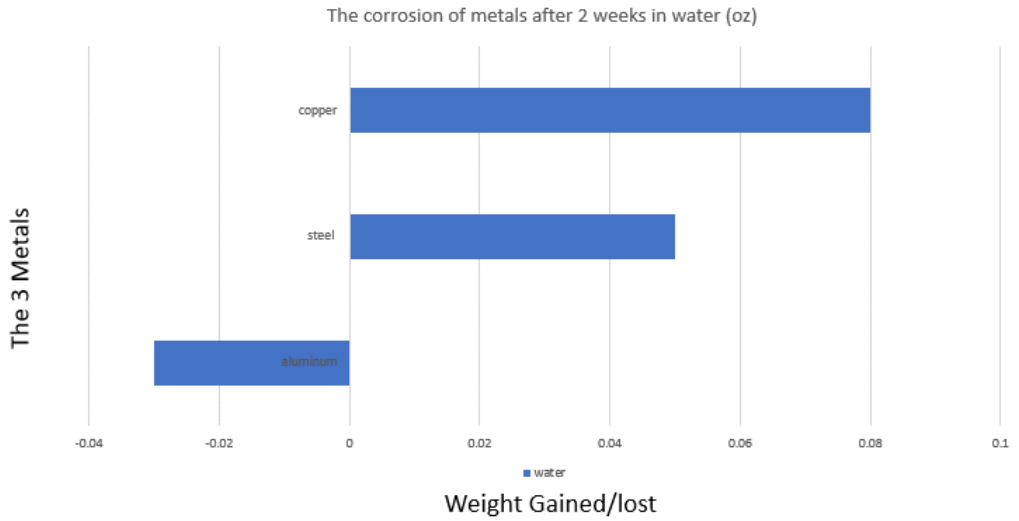
Procedure

- Materials: 3 bowls to hold liquid, 50 milliliters of 3 liquids water and soda, juice to corrode the metals, 1inch x 1inch x .25-inch pieces of 3 aluminum, steel, tungsten to dip into the liquids
- Dipping metals in liquids
- Step 1: The metals were weighed on a scale to Check their weight
- Step 2: The 3 metals were dipped into a bowl of liquid (water and soda, juice)
- Step 4: Each metal was dipped into each liquid (water and soda, juice) Each metal was put in the liquids for 1 week and allowed time for corrosion to take place.
- Step 5: The data was observed visually and quantitatively using weight. The metals were weighed again to check how much the metal corroded. This was repeated twice

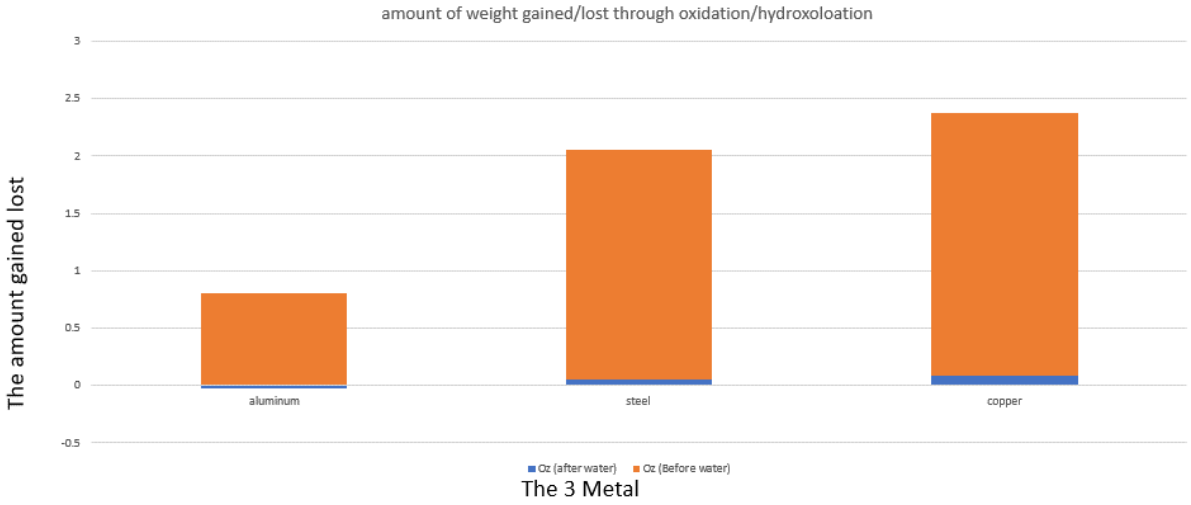
Results

	Aluminum	steel	copper
water	-.0375%	.025%	.03478%

This shows the percent amount of rust that accumulated in the metals via how much oxygen had combined. The Aluminum lost weight from the aluminum becoming Aluminum Hydroxide. The Aluminum started at .8oz ended at .77 Steel started at 2oz ended at 2.05 Copper started a 2.3oz ended at 2.38oz



The bar graph will show in a visual form the difference of weight of the metal in how much it gained or lost (in oz) due to Oxidation/Hydroxylation.



The bar graph will show in a visual form the difference of weight of the metal in how much it gained or lost (in oz) due to Oxidation/Hydroxylation. Aluminum was the only one to dissolve in the water.

Conclusion

My claim is that the least corroded metal will be steel. The amount of rust gained on the steel will be exceedingly small due to the carbon in the steel. The data will show that each metal has a different corrosion rate. This is shown through the fact that stainless steel is used in knives and other strong objects and is used because it is not as easy to corrode. These are supported by the fact that stainless steel is supposed to be extremely hard to rust. Steel supports that steel corroded the least.

Data Anylisis/Error

In the data Analisis it went smoothly. I had only one problem and that was having to keep the water filled in each bowl over the course of 2 weeks. An error is the water evaporating and not rusting the metals equally. I recorded my data by subtracting the weight of each metal before and after being in water, to show how much in ounces that each metal lost or gained in weight.

Science Talk

The different metals corroded in an unexpected order 3 Steel, 2 copper, 3 aluminums. I was surprised to see that aluminum was the most corroded metal. The aluminum had been dissolving in the water in a process known as hydroxylation. The copper and steel did not start to rust till 3 days before the projects ended. Out of all the metals only copper and steel oxidize

Real world Application

The use of metals is widespread with steel, copper, and aluminum being used most. Copper is used as it is extremely great at conducting electricity. Steel is used for extraordinarily strong but unfortunately heavy parts. Aluminum is used to make light parts that do not require high tension forces.

References

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- 3 Formation Mechanism of Micro- and Nanocrystalline Surface Layers in Titanium and Aluminum Alloys in Electron Beam Irradiation
- 4 Full article: Predicting the performance of tungsten in a fusion environment: a literature review (tandfonline.com)
- 5 Lead poisoning from retained bullets. Pathogenesis, diagnosis, and management. (nih.gov)