Accelerated Aging of Aluminum 2618 Upon Quenching in Boiling Water

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Background

Aluminum 2618 is an Al alloy primarily alloyed with magnesium and copper. This alloy has high strength in applications up to 575oF, is light, and is commonly utilized in the aeronautical industry for engine construction [1].

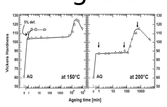
In the manufacture of this alloy, Queen City Forging normally quenches from the solution heat treatment into boiling water at 100oC to reduce residual stresses in the material that would occur during a room temperature quench. Samples are left in boiling water baths for various times, and afterwards, they are allowed to naturally age for up to 24 hour prior to artificial aging. Queen City Forging currently does not control the time set to quench or naturally age, and are interested in characterizing this alloy's hardening process.

This alloy is solution heed to 530oC to put the copper and magnesium into solid solution. When the temperature drops upon quenching, the solid solution becomes super-saturated. Aging, also known as precipitation hardening, occurs when the copper and magnesium come out of solution and form tiny precipitate that inhibit dislocation motion and thereby harden the alloy.

Abstract

In this study, we investigated the hardness changes in Aluminum 2618 at different times in the boiling water bath. Hardening was most significant during the initial seven minutes of quenching.

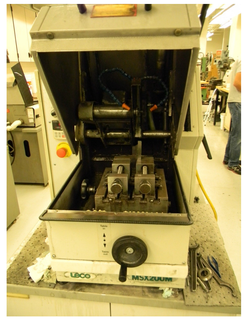
From age hardening characteristics found in this experiment, Queen City Forging may be able to better assess quenching times to reach appropriate product hardness levels.



Key to Metals Database: Hardening of Al-Cu-Mg Alloys, Part 1

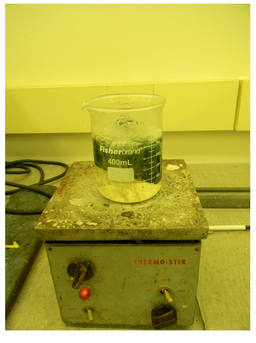
Experimental Procedure

Sample Preparation
First a billet of 2618 Aluminum (approximately 7.5 cm In diameter) was cut into quarters using a linear sectioning saw. These quarters were then sectioned into thin strips about 1.5mm in depth. The strip faces were then polished to 240 grit paper in preparation for hardness testing.



Experimentation

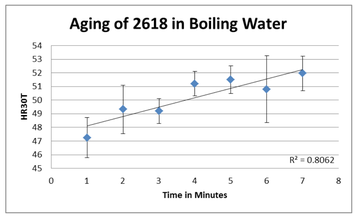
Samples placed in a 530oC furnace for two hours

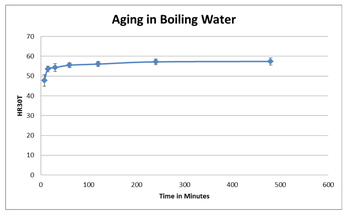


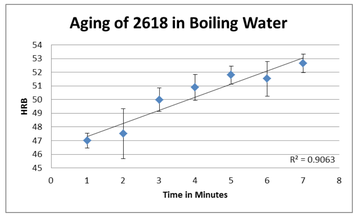
Samples removed and placed in a beaker of boiling water

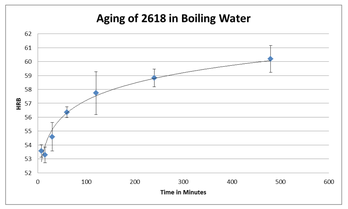
6 HRB/HR30T tests are run on samples after they undergo various times in boiling water

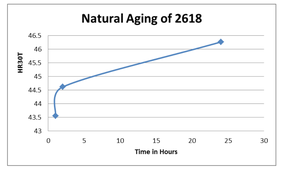
Results











Over the first 7 minutes of aging, the samples gain nearly 6 hardness points; however, samples only gained 8 hardness points in the interval between 7 and 480 minutes. Natural aging after a room temperature quench was significant as well.

Conclusion

The data suggests that samples should be quenched in the boiling water bath for at least 7 minutes for hardness consistency. Future tests should be dedicated to determining natural aging effects after quenching at 100oC for various times. Additionally, artificial aging should be performed to determine if final hardness depends on quench time.

References

"Aluminum 2618: Material Property Data." *Metal Suppliers Online*. Metal Suppliers Online, 2012. Web. 30 Jul 2012.

Flake, Campbell. *Elements of Metallurgy and Engineering Alloys*. United States of America: ASM International, 2008. 138-148. Print.

Acknowledgements

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