University of Portland SHILEY SCHOOL OF ENGINEERING

EGR270 – Materials Laboratory

Lab 5 - Precipitation Heat Treatment of Aluminum

Assigned date: Week of Feb 19th Due date: Week of Feb 26th

Description

Students explore the heat treatment of aluminum and precipitation hardening. Several specimens are tested to allow students to see the effects of elevated temperature and varying exposure durations on the properties of aluminum.

Learning Objectives

In completing this assignment, you should be able to:

- Apply good graphical presentation techniques to describe the heat-treatment of aluminum.
- Apply good technical writing skills to produce a two-page technical letter.
- Outline the phases of precipitation heat treatment of 2024-T351 Aluminum as performed in this lab.
- Describe the effects of precipitation heat treatment on the hardness of 2024-T351 Aluminum.
- Explain the changes in microstructure of 2024-T351 Aluminum throughout the process of heat treatment.
- Explain what over aging is, why it happens, and what its effects are.
- List the various elements which compose 2024-T351 Aluminum.
- Predict the behavior or other aluminum alloys when exposed to precipitation heat treating.

Suggested Reference

You may wish to refer to following in completing this assignment:

- ASM Handbooks
- Reliable Web Sources
- Materials Science Textbook.

Grading

See the checklists for memos, letters, and graphs on the Moodle page.

Submission and Late Policy

Assigned work will be collected exclusively during the first 5 minutes of class. No other mode of submission is acceptable unless expressly specified by the professor.

Electronic submissions, when necessary, will be submitted via Moodle in the specified format. Any file not submitted in the correct format will not be accepted.

See the syllabus for the late submissions policy. If you have questions or concerns, please contact your professor.

See next page for assignment details.

Theta Prime Materials

February 19, 2018

Students
Materials Science Laboratory
5000 N. Willamette Blvd.
Portland, Oregon 97203

Dear Students,

We am requesting your assistance in evaluating material performance of an aluminum alloy. We understand that last week you conducted testing to investigate the cold rolling and annealing of copper. This week, we would like you to conduct tests to investigate the effects of elevated temperature on 2024 aluminum alloy in the context of both processing (intentional heat treating) and service applications (long term exposure to elevated temperature).

As with most technical letters, you should convince us (using facts and data, not a "sales pitch") that you understand what is going on (or at least what you think should be happening) and interpret for us the meaning of the results. Think of yourself as a trial attorney trying to layout a logical argument for the jury. You need to start with an introduction/summary/overview (big picture overview) so the jury has a sense of what to expect. Then educate them on the relevant knowledge of the subject (background). Then discuss your evidence (aka data - perhaps it behaves as expected, perhaps not), and finally reach a conclusion (attorneys call this a closing argument - at least on TV).

This lab's background should be a bit more extensive than typical since you are not only communicating to us, you are also teaching yourself. Therefore, this letter can be up to two pages maximum (plus attachments). You should describe the microstructure at each step of heat treating: during solution heat treating; after quenching in water; and after precipitation heat treating. You should explain what over aging is (its effects on properties and microstructure). You should discuss 2024 aluminum (its composition and how it is typically strengthened). You should discuss how other aluminum alloys might behave under similar conditions (are all aluminum alloys heat treatable, do they all naturally age, do they all overage?). Sketches or photographs are often very helpful in written documents (properly cite them if they are not your own figures). Again, ASM Handbooks[1] may be of help.

Thank you for your help in this matter. If you have further questions, do not hesitate to contact any of your lab professors (see syllabus). (Yes, you need to write a technical letter for this.)

Sincerely,
(electronic signature)
Your Professors
Theta Prime Materials

Enclosed: eleven (11) test specimens of 2024-T351 aluminum alloy

[1] http://0-products.asminternational.org.clark.up.edu/hbk/index.jsp

Lab Title: _____ Date Conducted: _____ Location: _____

Table 1: Calibration Data

Equipment	**Date of Calibration**	**Calibration Expiration Data**	**Target Temperature**
Furnace 1 (Temp Cal.)			950 ° F (510 ° C)
Furnace 2 (Temp Cal.)			500 ° F (260 ° C)
Furnace 3 (Temp Cal.)			250 ° F (93 ° C)
Rockwell Hardness Tester			N/A

Table 2: Hardness Calibration Data

Hardness Calibration Block S/N	**Calibration Block Hardness** *(HRB)*	**Hardness Reading** *(HRB)*

2024-T351 Hardness Reading: _____

Table 3: Short Term Natural Aging (~70° F)

Time *(min)*	**Hardness** *(HRB)*
0	
5	
10	
15	
20	
30	

Table 4: Long Term Natural Aging (~70° F)

Time *(hrs)*	**Hardness** *(HRB)*
0	
24	
48	
72	

Table 5: Warm Aging (~250° F)

Time *(min)*	**Hardness** *(HRB)*
0	
5	
10	
15	
20	
30	

Table 6: High Temp Aging (~500° F)

Time *(min)*	**Hardness** *(HRB)*
0	
5	
10	
15	
20	
30	

Photo Log

Specimens: ☐ Furnaces: ☐ Hardness: ☐

I actively participated in the collection of this data. The information contained here has not been falsified and to the best of my knowledge correctly records the data obtained in lab.

Print Name: _____ Signature: _____