Abstract (very general explanation of the lab experiments)

We study changes in mechanical properties of a specific aluminium alloy by using two different thermal treatments.

Our results prove softening or rehardening of the alloy which is followed by simultaneous modification or recovery of other properties.

These include modulus of elasticity, yield strength, ultimate tensile strength, stress at fracture, percentage of elongation, and toughness.

Hardness is determined using a hardness testing machine; the other properties are derived from the stress-strain plot obtained by a tensile testing machine.

Altering mechanical properties of metal alloys by heat treatments is critical in engineering.

Not only it allows tailoring the strength of materials, but it has strong implications on manufacturing (e.g., on facilitation of mass production, on reduction on energy consumption, or on more efficient material selection for specific applications).

Abstract (with more details)

We study changes in mechanical properties of (HE30/BS1476) aluminium alloy (120HV5, E=6GPa, UTS=500MPa) by using two different thermal treatments (60min @ 520°C or 60min @ 520°C followed by 30min @ 184°C, both in open air).

Our results prove softening (40HV5) or rehardening (132HV5) of the alloy, respectively. This is followed by simultaneous modification or recovery of other properties.

These include modulus of elasticity, yield strength, ultimate tensile strength, stress at fracture, percentage of elongation, and toughness.

One example is UTS. It drops to 225MPa but recovers to 489MPa after second treatment.

Hardness is determined using a (Zwick Roell ZHU) hardness testing machine; the other properties are derived from the stress-strain plot obtained by a (Zwick Roell 2050) tensile testing machine.

Altering mechanical properties of metal alloys by heat treatments is critical in engineering.

Not only it allows tailoring the strength of materials, but it has strong implications on manufacturing (e.g., on facilitation of mass production, on reduction on energy consumption, or on more efficient material selection for specific applications).

Introduction

To provide an adequate rationale for our experiment, it is critical to first explore the purpose for studying materials in depth. In 1963, English geologist Henry Clifton Sorby made a remarkable discovery which paved the way for the mass production of steel. His interest in microscopy led him to investigate the mineral composition of rock structures by examining samples cut to about a thousandth of an inch. After deep analysis, he was able to demonstrate that all solid metals and alloys are crystalline. But even more astonishingly, he was able to exact the rates of crystal transformation and represent this information through reaction rate curves. This discovery has since served as the bedrock on which many geological experiments (such as the one illustrated in this report) have taken place (Rowe, 2018). It is this ability to transform materials for suitable applications which necessitates the tensile strength experiment. Essentially, we perform this experiment to ensure that our material is capable of its intended purpose.

Experimental

SAMPLES:

description of the alloy, composition, CSA (mention dimensions are measured by a calliper), nomenclature, heat treatments, picture before testing, etc

HARDNESS:

Testing machine (pics)
Procedure (pics)

TENSILE TEST:

Machine (pics)
Procedure (pics)

OTHER CONSIDERATIONS:
Safety, PPE,

THEORY

Mechanical properties, implication (general concepts).

Hardness
Stress-strain plot in tensile test
Modulus of elasticity
Yield strength
Ultimate tensile strength
Stress at fracture
Percentage of elongation
Toughness (mention is strongly correlated to area under the plot, as you will not check toughness specifically)

Use equations, define each variable, do not give units, or if so, only relevant ones (e.g., E is typically measured in GPa)

The circumference of the section (C) is determined as follows:

$$C = \pi d \qquad \text{Eq. 1,}$$

where d is the external diameter of the cross section and is typically measured in mm.

RESULTS

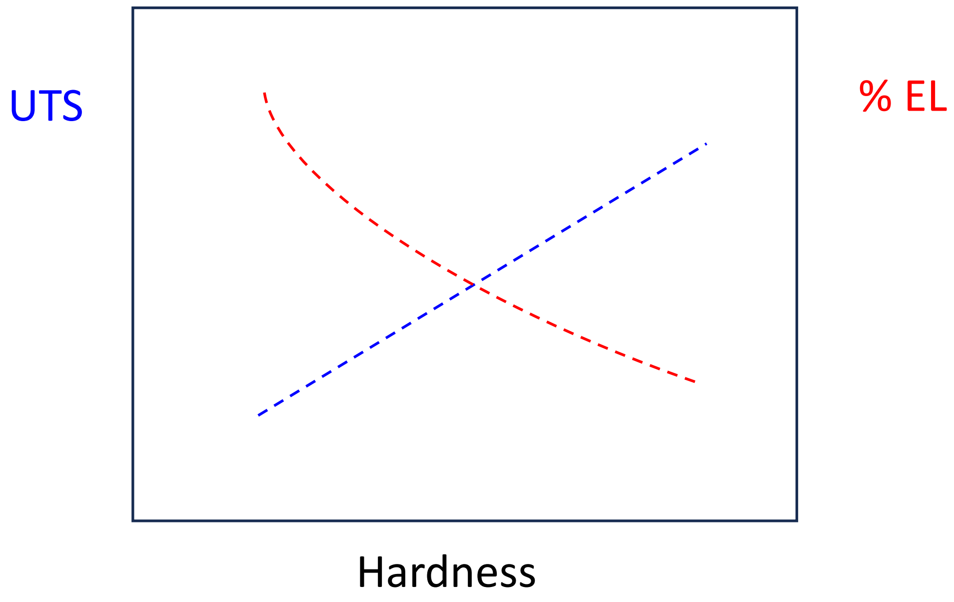
As engineers, we expect to see just numbers, figures, and units (properly derived from equations given in Theory)

Hardness
Stress-strain plot
Modulus of elasticity
Yield strength
Ultimate tensile strength
Stress at fracture
Percentage of elongation
Toughness (areas under the plot)

Use PROPER and relevant UNITS, e.g., $E_{AR} = 6\ GPa$

DISCUSSION

A proper analysis of why we see these results. Trends, implications, ANALYSIS



Toughness: all areas are within 5% variation, so you can change UTS, E, YS, but not toughness because…

While E decreases 20%, YS decreases 90%, so material became extremely ductile…

WRITING

Keep it simple, even complex stuff
Short sentences, never more than 15 words
Always General to Specific
Precision and clarity is a must
Use proper units and use units properly
Read three times what you have written
Read at least twice what others have written
No distracting elements (unnecessary information)
WORK IN TEAMS PLEASE

Read info in CANVAS booklet:

“The file name should contain the surname of student submitting the report and module name (e.g., Williamson_ Engineering Mechanics and Materials).”