Mechanical testing lab report

Business

This experiment was intended to make students familiar with some common methods of mechanical testing. The laboratory sessions included mechanical testing such as Rockwell hardness testing, the tensile test, the Charpy impact test, and the Jominy end-quench test. Materials and Methods For the first method of this experiment, the Rockwell hardness testing of brass, the TA prepared three different types of brass for testing.

Free machining cartridge brass: 360 brass 70% Cu – 30% Zn) The three types were: the as received brass specimen, the cold rolled brass specimens of 10%, 20%, 30%, 40%, and 50%, and the annealed brass specimens from 20% cold-rolled. The last type of brass specimens was annealed at 500°C for times 5, 10, 15, 20, and 25 minutes. The TA then calibrated the scale using a calibration block to ensure accurate measurements. This scale required the use of a 1/16″ stainless steel ball for indentation, coupled with a 100kg load. This scale was utilized in this case because brass is being tested, which is a relatively soft material. Q3) Once the hardness tester was prepared, each specimen was tested several times using the Rockwell B (RB) hardness scale and the results were averaged and recorded as shown in Table 1.

Table 1 – Data collected using Rockwell hardness test Specimen #| Condition| Initial thickness (in)| Final thickness (in)| Actual % reduction| HRB 1| HRB 2| HRB 3| HRB 4| HRB 5| Average RB| 1| As received| 0. 124| 0. 124| 0| 83. 5| 83| 83. 5| 83. 5| 83| 83.

3| 2| 10% reduction| 0. 125| 0. 113| 9. 6| 79| 80| 81. 4| 79| 80. 6| 80| 3| 20% reduction| 0.

124| 0. 099| 20. 16129| 92| 90| 90. 5| 91. 8| 90. 8| 91.

02| 4| 30% reduction | 0. 23| 0. 086| 30. 0813| 93| 92. 5| 92.

5| 92. 7| 92. 6| 92. 66| 5| 40% reduction| 0. 123| 0.

0735| 40. 2439| 88| 87. 5| 86. 5| 87| 88. 5| 87. 5| 6| 50% reduction| 0.

124| 0. 062| 50| 97. 5| 97. 2| 96. 5| 95. 5| 95.

2| 96. 38| 7| 5 min| | | | 90. 5| 90| 91| 89. 5| 90| 90. 2| 8| 10 min| | | | 91| 89.

5| 88| 85. 5| 87. 5| 88. 3| 9| 15 min| | | | 70| 70. 5| 71| 70. 8| 69.

8| 70. 4| 10| 20 min| | | | 62. 51| 67| 64| 65| 63. 7| 64. 444| 11| 25 min| | | | 58. 2| 58.

4| 56. 4| 58. 1| 57. 5| 57. 72| Figure 1- Tensile specimen shape The next method demonstrated in this experiment was the tensile test. The tensile test was exemplified using the Instron mechanical loading frame.

By gripping the ends of a thin, dog-shaped specimen (see Figure 1) with crosshead grips and pulling at a constant speed, a load vs. displacement relationship can be determined. 1 Five materials were tested: galvanized steel, brass, aluminum, polymethyl methacrylate (PMMA), and high-density polyethelene (HDPE). The TA recorded all of the dimensions of each specimen and input them into the Instron program. The program derives the raw data by using the formulas ? = P/A where engineering stress ? s determined by dividing load P by cross-sectional area A and ? = ? L/L where engineering strain ? is determined by dividing the change in guage length ? L by the original length of the specimen L.

(Q2, Q3, Q4) Each specimen was then loaded into the grips and the mechanized testing began. Once the specimen reached the failure deformation stage (or as close it gets to it), the Instron program recorded the data and automated stress – strain curves for each of the five specimens as shown in figures 2a, b, c, d, and e respectively. The final method demonstrated in the laboratory was the Charpy impact method. Charpy specimens are bars with square cross-section and v-shaped notch machined into the center of one of the four faces, which creates stress intensity in order to assist in the fracture. The TA prepared five Charpy specimens each of 1020 Steel, 2024 Aluminum, and Brass (10mm x 10mm x 100mm).

Next, the TA placed one specimen of each material into five different environments: Liquid Nitrogen(-210°C), Ice Water(approx 0°C), room temperature(about 10°C), 100°C, and 250°C. To allow the specimens to reach the temperature of its environment, the samples were left at those temperatures for an adequate amount of time. Immediately after removal from temperature, the TA carefully placed each sample into the Charpy machine using specialized tongs. With the machine being zeroed out and the area around it cleared, the impact head (weighted pendulum) was released from its fixed height. The impact energy was then recorded and tabulated as well as the broken samples to view the ductility. The results from the Charpy test are shown in Table 2.

Table 2 – Raw results from Charpy test | -210° Celsius| 0° Celsius| (Apprx 10° C) RT| 100° Celsius| 250° Celsius| 1020 Steel| 9. 5| 91| 90. | 118. 5| 104| 2024 Al| 20| 21| 19| 19| 16. 5| Brass| 17| 16| 17.

5| 19| 17. 5| The remaining method that was discussed in this experiment is the Jominy quench-test. The Jominy quench-end test is the standard method used to measure the hardenability of steel. The hardenability of steel should not be confused with the hardness of steel. The hardness of steel refers to the measure of resistance of a material to an applied force, whereas hardenability refers to the measure of the capacity of the steel to harden in depth under a given set of conditions. Q3) Small phase particles are distributed throughout the steel's ductile matrix due to precipitation hardening.

By holding an alloy at the solid solution temperature until these particles form, quenching it to keep them from going back into solution and aging at a lower temperature. The aging causes the precipitates to increase in order and produce strain within the matrix crystal, increasing hardness. On the other hand, if too much aging occurs hardness will decrease, due to the precipitates growing and losing coherence with the matrix. Q1) Therefore the driving force behind the hardening is the temperature time. (Q2) Discussion Hardness is a property of material, which quantifies its resistance to plastic deformation.

Hardness testing is important because you can determine when the steel starts to separate and becomes weak, which would highly important if you were using the steel to build a bridge. Engineers would be able to see that the bridge is no longer sturdy or safe and that it is time for a new one. Another example when hardness is important is when design a bike. It is important because designers must insure that the metal won't bend or brake when a person of larger weight gets on the bike. Another situation where hardness is very important is in the designing of cars.

Engineers must make sure the metal is sufficient enough to protect the passengers of the car, but also maintain the efficiency of the vehicle as well. (Q1) Material Scientists must always keep in mind that increases in dislocation will result in a decrease in the hardness of the material. (Q2) As seen in Figure 3a, as the amount of cold rolling increases, the hardness varies but gradually increases. Q4) Similarly in Figure 3b, as time annealed increases, the hardness steadily decreases. (Q5) Important material properties determined by a material's stress-strain curve are the upper yield point, lower yield point, and the failure point. (Q1) The tensile test has four stages of deformation during tensile testing: elastic region, plastic region, necking region, and the failure region.

(Q5) Conclusion References 1. W. D. Callister, Jr. , " Materials Science and Engineering: an Introduction, 5th Edition," John Wiley and Sons, New York, 2000, 115-116, 124-130, 134-140, 409-410, 474-479