Theory of impact test essay sample

The impact toughness (AKA Impact strength) of a material can be determined with a Charpy or Izod test. These tests are named after their inventors and were developed in the early 1900's before fracture mechanics theory was available. Impact properties are not directly used in fracture mechanics calculations, but the economical impact tests continue to be used as a quality control method to assess notch sensitivity and for comparing the relative toughness of engineering materials. The two tests use different specimens and methods of holding the specimens, but both tests make use of a pendulum-testing machine. For both tests, the specimen is broken by a single overload event due to the impact of the pendulum. A stop pointer is used to record how far the pendulum swings back up after fracturing the specimen. The impact toughness of a metal is determined by measuring the energy absorbed in the fracture of the specimen. This is simply obtained by noting the height at which the pendulum is released and the height to which the pendulum swings after it has struck the specimen .

The height of the pendulum times the weight of the pendulum produces the potential energy and the difference in potential energy of the pendulum at the start and the end of the test is equal to the absorbed energy. Since toughness is greatly affected by temperature, a Charpy or Izod test is often repeated numerous times with each specimen tested at a different temperature. This produces a graph of impact toughness for the material as a function of temperature. An impact toughness versus temperature graph for a steel is shown in the image. It can be seen that at low temperatures the material is more brittle and impact toughness is low. At high temperatures the material is more ductile and impact toughness is higher. The transition temperature is the boundary between brittle and ductile behavior and this temperature is often an extremely important consideration in the selection of a material. In this test the specimen is positioned across the lowest point in the path of a striker mounted at the end of a pendulum.

The striker, having been initially lifted to a specific height h1, and then released, swings against the specimen and breaks it. The striker continues its swing to the other side of the specimen to a height h2. Clearly the difference between the two heights multiplied by the weight of the striker corresponds to the amount of energy that is absorbed in fracture. In the Izod impact test, the test piece is a cantilever, clamped upright in an anvil, with a V-notch at the level of the top of the clamp. The test piece is hit by a striker carried on a pendulum which is allowed to fall freely from a fixed height, to give a blow of 120 ft lb energy. After fracturing the test piece, the height to which the pendulum rises is recorded by a slave friction pointer mounted on the dial, from which the absorbed energy amount is read. The principle of the test differs from that of the Izod test in that the test piece is tested as a beam supported at each end; a notch is cut across the middle of one face, and the striker hits the opposite face directly behind the notch.

When the results of a number of tests performed in different temperatures are plotted, ductile-to-brittle transition curves, may be obtained. As the temperature is reduced through the transition range, the fracture surface changes from one having a ‘ fibrous’ or ‘ silky’ appearance with much distortion at the sides, to one of completely crystalline appearance with negligible distortion. There is a strong correlation between the energy absorbed and the proportion of the cross-section which suffers deformation in fracture, and the fracture surface is frequently described in terms of the percentage of its area which is crystalline in appearance. Typical fracture appearances with crystallinity increases as the temperature is reduced.