EXPERIMENT 5(A): IZOD PENDULUM IMPACT RESISTANCE TEST

Title:

Determination of the impact strength of the fiber reinforced composite specimens using Izod impact test.

Objectives:

1. To understand the construction and working of the cantilever beam (Izod type) impact machine.
2. To determine the impact resistance of given specimens.

Equipments used:

1. Cantilever beam (Izod type) impact machine
2. Vernier Caliper
3. Scale

Test Specimens:

E-glass woven fiber reinforced composite of fibre volume fraction, V_f =

Brief Introduction:

Cantilever beam (Izod type) impact machine:

The machine is as shown in the figure below

The machine consists of a massive base on which a vise is mounted for holding the specimen. A pendulum type hammer is connected to the base through a rigid frame and bearings. The machine has a pendulum holding and releasing mechanism and a pointer and dial mechanism for indicating the excess energy remaining in the pendulum after breaking the specimen. The hammer at the end of the pendulum moves from the topmost position to the bottommost position. If the specimen is placed at the bottom then all the kinetic energy associated with the hammer is dissipated into the specimen. But not all energy of hammer is consumed to break the specimen. So, the hammer swings on the other side to certain height to convert the remaining kinetic energy into potential energy.

Impact tests provide information about the resistance of a material to sudden fracture where a sharp stress riser or a flaw is present. Various standard impact tests are widely employed in which notched specimens are broken by a swinging pendulum. The most common tests of this category are the Charpy V-Notch Test and the Izod Test. Another test method, although not a standard test method, is the Tension Impact Test. Izod Test is described in the ASTM D 256 – 97: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

These types of impact tests have given way to testing methods that make use of fracture mechanics. Fracture mechanics methods allow more sophisticated analysis of materials containing cracks and sharp notches. However, the advantages of fracture mechanics are achieved at the sacrifice of simplicity and economy. Impact tests such as the Charpy, Izod, and tension impact have thus remained popular despite their shortcomings, as they serve a useful purpose in quickly comparing materials and obtaining general information on the material behavior.

Impact strength is the amount of energy consumed in breaking a test specimen, divided by the cross-sectional area of the specimen, when the specimen is broken by the stroke with the pendulum-type hammer having specific energy (25 J). This test can be used as a quick and easy quality control check to determine if a material meets specific impact strength requirements or not and to compare materials for general toughness. As composite materials contain some air voids and gaps in micro scale, notches are not required to give local stress concentration.

Procedure:

Setting the Pointer:

Before you start a test, check the "zero" of the pointer. The impact tester is calibrated for friction and wind loss therefore, it should read zero after a free swing. The following procedure should be used to check the zero:

1. Raise the safety latch and place the operating lever in the latch position. Lift the pendulum counterclockwise till the latch clicks and places it in upper release position.
2. Set the pointer to the maximum value of the range for your test. Ranges and pendulum positions as illustrated on the dial.
3. Make sure that no person is standing in the path of the pendulum. **Safety is most important!** Move the control lever to the release position. When the pendulum has started to swing back, push the control lever to the brake position.
4. If the pointer reads zero, you are ready for your test. If not, loosen the screw that holds the pusher arm, turn the arm to produce a zero reading and tighten the screw.
5. Repeat until the free swing reads zero.

Performing the test:

1. Block the pendulum away from the anvil. Place the Izod specimen across the anvil with the centerline of the specimen coinciding with the centerline of the anvil. A gauge is used to make proper alignment.
2. Raise the pendulum and set the pointer and pusher arm as you would to zero the machine.
3. Release the pendulum and allow it to swing through the specimen and apply the brake as previously described.
4. The maximum pointer reading indicates the amount of energy used to break the sample.
5. The following should be reported in the lab report according to the ASTM D 256-97:
    a. The type of specimen
    b. The capacity of pendulum in Joules
    c. Number of specimens tested (N)
    d. Type of fracture
    e. Impact resistance of a single specimen in J/m^2
    f. Average impact resistance of N specimens in J/m^2

Observations:

Report the observations in the following format

Capacity of Pendulum =

Specimen Name	Width (mm)	Thickness (mm)	Energy (J)	Impact Strength (J/mm^2)	Type of Fracture

The common report for each experiment is expected to be of about 3-4 pages that describes the aim, schematic representation of the set-up, observations, calculations, results, uncertainties, discussion of the experiment and results in terms of your own interpretation, special observations / remarks if any and conclusions.

Exercise:

1. Why do we need to do an Impact test?
2. Can we find fracture toughness using stress-strain curve?
3. Note your observation about the scale of impact testing machine.
4. Name some applications of impact test.

Suggested Reference:

[1] ASTM D 256 – 97: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.