IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

High Strain Rate Tensile Testing Set-up by Impact Loading

IITM Technology Available for Licensing

Problem Statement

- Current methods inadequately assess materials under **high strain rates**, impeding progress in crash-worthy structure design.
- Existing setups, like **Split Hopkinson Pressure Bars**, lack coverage for **medium strain rates** (**1-100 s^{-1}**), leaving a gap in material behavior.
- Discrepancies between **brittle failure** in dynamic tests and **ductile failure** in quasi-static tests emphasize the need for a **more comprehensive testing approach.**
- Traditional machines, including **universal testing machines**, are unsuitable for **high-strain-rate testing**, limiting accurate assessments of material responses in dynamic loading conditions.
- Current setups lack an efficient method to directly convert **impact energy into tensile loading**, crucial for replicating real-world scenarios, especially in **automobile crashes**.

Technology Category / Market

Categories: Automobile & Transportation | Aerospace & Defense Technologies

Industry: Materials Science and Engineering

Applications: Dynamic Material Behavior Analysis, Crashworthiness Testing Safety, Impact Testing, Materials R&D

Market: Tensile Testing Machine Market was valued nearly **US$ 444.05 Mn. in 2022**. It is expected to reach at **US$ 569.56 Mn By 2029;** estimated to grow at a **CAGR of 3.62%** in the time period from **2022 to 2029**.

Technology

The instant technology disclosure refers to the detailed outline of the **apparatus, methodology, and outcomes of high strain rate tensile testing**, contributing valuable insights in the fields of Materials Science And Engineering.

Research Lab

Prof. Velmurugan R;
Department of Aerospace Engineering

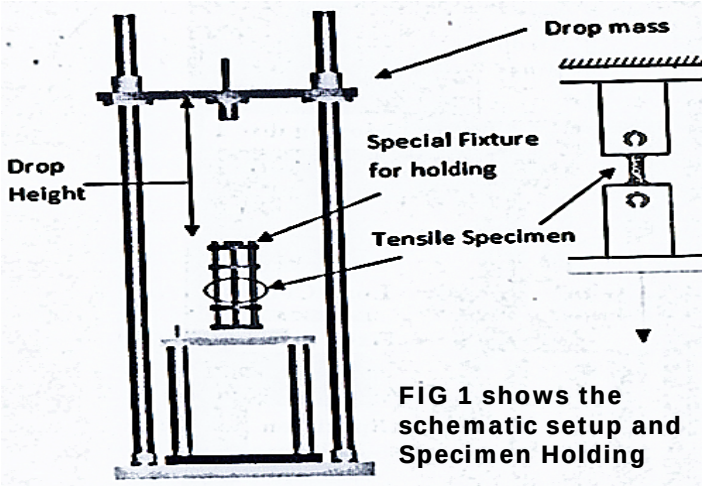

FIG 1 shows the schematic setup and Specimen Holding

Key Features / Value Proposition

User perspective:-

- Precise assessment of material responses under **dynamic loading conditions**.
- Applicability across various industries, including **automotive and aerospace**, offering a broad range of testing capabilities.
- Streamlined testing process with a **direct conversion of impact energy to tensile loading**, saving time and resources.

Industrial perspective:-

- Facilitates the design of **crashworthy structures** by providing crucial insights into material behavior under **high strain rates**.
- **Cost-Efficiency**: Optimizes material selection and design processes**, reducing the need for extensive physical testing and iterations**.
- Addresses the limitations of existing setups, bridging gaps in medium **strain rate** testing and offering a more direct and versatile solution for more comprehensive material assessment.

Technology perspective:-

- Unique capability to efficiently **convert impact energy into tensile loading** for a more realistic simulation of real-world scenarios.
- Provides in-depth understanding of material behavior under **dynamic conditions**, contributing to the development of **advanced materials.**

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

High Strain Rate Tensile Testing Set-up By Impact Loading

IITM Technology Available for Licensing

Invention Disclosure

Apparatus Description:

- Explanation of the key components, such as the **drop mass tower, guide rods, hoist, and dynamic load cell.**
- Details on the **fixture design**, including the **first and second moving discs, fixed discs, and holders for securing the test specimen.**

Methodology:

- Step-by-step procedures for conducting **high strain rate tensile testing** using the disclosed apparatus.
- Description of how the **drop mass** is released at **different heights** to achieve varying strain rates. Insights in the measurements taken, including **impact velocity & load-time history**.

Materials Tested:

- Identification of materials subjected to **testing**, such as **epoxy or glass/epoxy composites**.
- Other polymer-reinforced composites or metals, broadening the applicability of the technology.
- Mention of the strain rates applied during the **experiments**, providing a context for results.

Results and Observations:

- Addressing the need for **understanding material behavior** under **high-speed impacts**, especially in industries like automotive and aerospace.
- Presentation of findings from the experiments, including **stress-strain responses** and changes in material properties under **different strain rates**.
- Highlighting the apparatus's ability to reveal differences in material behavior under **dynamic and quasi-static conditions, crucial for comprehensive analysis.**

Discussion on Tensile Properties:

- Interpretation of the observed trends in **tensile modulus, tensile strength, and failure strain** at varying strain rates.
- Possible explanations for the observed changes, such as the **influence** of the **viscoelastic nature** of the **polymeric matrix.**

TRL (Technology Readiness Level)

TRL-4: Validated in Laboratory

Intellectual Property

IITM IDF No.: 1325 | IP No.: 468932 (Granted)

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719