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Container Hardness Test

Testing the hardness of packaging containers is essential to ensure durability and resistance to crushing. This test measures the force required to deform and crush the container, simulating stress during transport and storage, which helps in assessing container quality and performance.

Background:

- The crush test evaluates the mechanical strength of containers by measuring hardness, work done, recoverable deformation, and recoverable work done. These parameters provide insights into the container's ability to withstand compression and recover after load removal.

Equipment:

- CTX Texture Analyzer with 50 kg load cell
- Components: Compression Top Plate (TA-CTP), Fixture Base Table, Base Plate
- Software: Texture Pro for automatic calculation of results

Settings:

- Test Type: Compression
- Pre-Test Speed: 1 mm/s
- Test Speed: 2 mm/s
- Post-Test Speed: 2 mm/s
- Target Distance: 25 mm
- Trigger Load: 30 g

Sample Preparation:

- Condition the containers to room temperature prior to testing for consistent results.

Procedure:

1. Attach the compression top plate to the instrument.
2. Place the fixture base table and base plate securely on the instrument base.
3. Center the inverted container on the base plate and lower the compression top plate to approximately 1 cm above the container surface.
4. Align the container to the top plate, then tighten the fixture base to prevent movement.
5. Begin the test, compressing the container to the target distance.

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Observations:

- Figure 1: Force vs. Time graph shows the force required to crush the container.
    - The initial peak represents the maximum force needed to initiate deformation, indicating container hardness.
    - A second peak occurs as the container compacts, showing further structural breakdown under compression.
- Figure 2: Load vs. Distance graph illustrates the work done to crush the container and its recoverable deformation.
    - Work done (area under the graph) measures the energy needed to deform the container.
    - Recoverable deformation reflects the height recovered when the compression load is removed, indicating elasticity.
    - Recoverable work done is calculated as the work performed by the container against the compression force as it returns to its starting height.

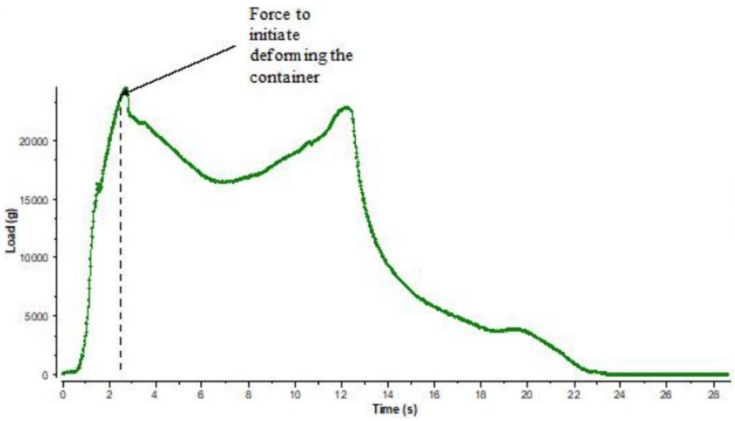

Figure 1

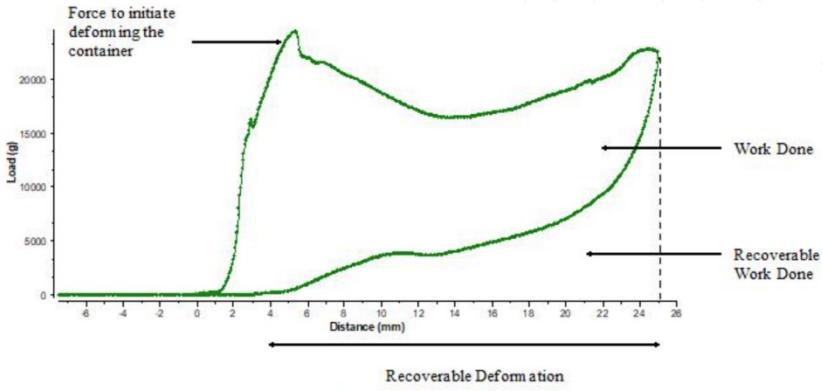

Figure 2

Results:

- Hardness: 24,450 g
- Work Done: 4,266.9 mJ
- Recoverable Deformation: 21.93 mm
- Recoverable Work Done: 1,116.2 mJ

Discussion:

The test results indicate the container's strength, with the initial peak load reflecting hardness and the work done representing the energy needed to deform the container. The recoverable deformation and work done values provide insights into the container's ability to regain shape after compression. Using a percentage deformation method can standardize comparisons between containers of varying heights, offering a consistent approach to assessing container durability.