Explore Inspirational Education

PARTYSAFE

LESSON: Stress & Strain

OBJECTIVE: To introduction to Stress & Strain

Materials

12" balloon, balloon pump

Instructions

1. Use a balloon to show its relaxed state, and stretched state, and the point at which it starts becoming stretched by hand
2. Measure the balloon size in its uninflated state
3. Use a balloon pump, start inflating the balloon from its relaxed state
4. As the balloon approaches near 12 inches, measure the balloon again to calculate stress
5. The balloon becomes more difficult to inflate as the strain increases

Calculation

Stress = force / cross sectional area
Strain = elongation / original length
Size of balloon before inflation = 10 cm
Size of balloon after inflation = 30 cm
Strain = 30 cm / 10 cm = 3

Calculate how much strain the balloon can undergo before it pops?

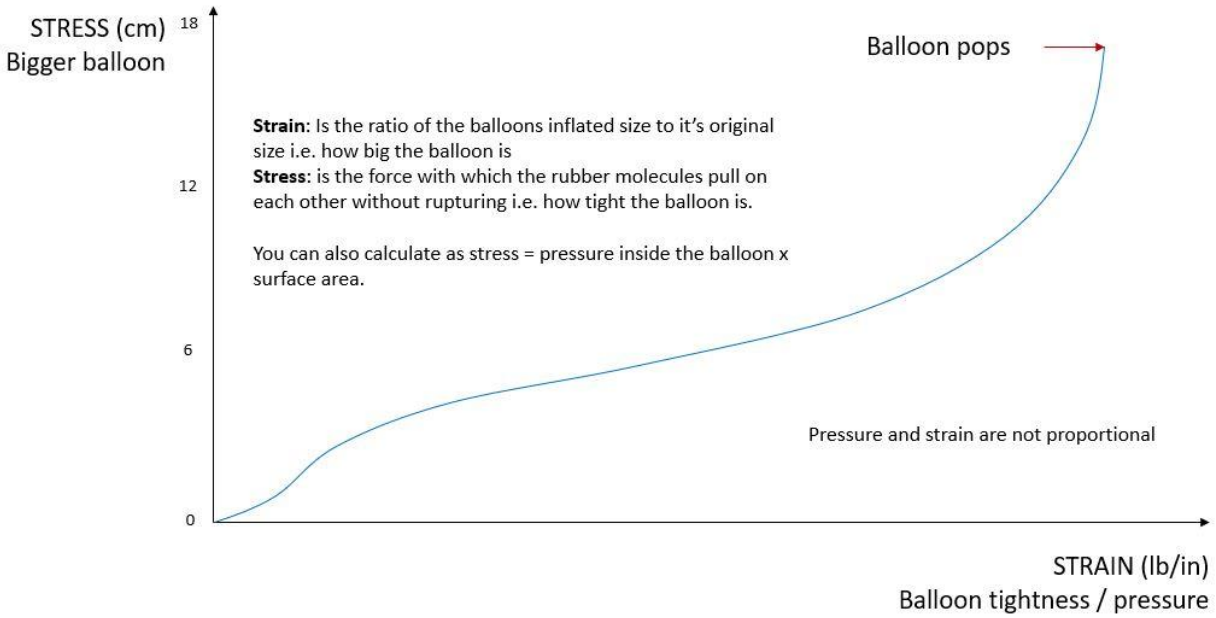
Conclusion

Stress and strain are very important characteristics used to measure the strength and elasticity of materials.
Strain: Is the ratio of the balloons inflated size to its original size i.e. how big the balloon is
Stress: is the force with which the rubber molecules pull on each other without rupturing i.e. how tight the balloon is. This can also be represented as stress = pressure inside the balloon x surface area.

1. An uninflated balloon can be considered to have a stress of 0
2. As the strain increases, so does the stress but at varying rates
3. High levels of strain are possible at low pressures with soft latex rubber balloons
4. High levels of stress can occur at low strain levels if rubber is less elastic.
5. As the balloon starts to inflate, the balloon is initially limp and starts to experience an increase in stress although it experiences little strain. This is the first part of the graph.
6. As the balloon is inflated further, the curve settles out almost flat since the stress (pressure) is near constant whilst the balloon is increasing in strain (size). The near

constant stress is due to the elasticity of the balloon, with the tightness level remaining near constant. Strain increases much more rapidly than stress.

7. If you feel the balloon during the inflation, it will eventually start to feel like it's tightening. The increase in strain slows down (size) and the stress rapidly increases (tightness & pressure of the balloon). Stress starts to increase much more rapidly than strain.
8. When the balloon pops, the latex balloon reaches its elastic limit. Pressure increases stress.
9. If you de-inflate the balloon before it pops, the balloon returns to near its original shape due to the forces of the latex polymer.
10. When the balloon pops, you have overcome the forces of the latex polymer and broken its bonds. As the balloon inflates, the thickness of the rubber decreases.



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