ELASTIC HYSTERESIS



A dissertation submitted to Mahatma Gandhi University

In partial fulfillment of the requirement for the award of the degree

BACHELOR OF SCIENCE IN PHYSICS

Submitted by

SANJAY Y DAS

Reg.No:170021035022

DEPARTMENT OF PHYSICS

S.N.M COLLEGE

MALIANKARA

(2017-2020)

DEPARTMENT OF PHYSICS

S.N.M COLLEGE MALIANKARA

CERTIFICATE

This is to clarify that the project record entitled "**ELASTIC HYSTERESIS**" is a bonafide record of project work carried out by **SANJAY Y DAS** with **Reg.No:**170021035022**, Department of Physics,S.N.M College, Maliankara** in partial fulfillment of the requirements for the award of **the Degree of Bachelor of Science in Physics** under **Mahatma Gandhi University** Kerala during the year 2017-2020.

Staff in charge

Head of the Department

Internal Examiner

External Examiner

DECLARATION

I **SANJAY Y DAS** declare that the project record entitled "**ELASTIC HYSTERESIS"** is bonafide work done by me as under the guidance of Mr.SUNIL KUMAR, Department of Physics, S.N.M College Maliankara and this project have not formed the basis for the award of any degree or other similar title or recognition of any university to the best of my knowledge and belief.

SANJAY Y DAS

B.sc Physics

Final Year

ACKNOWLEDGEMENT

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Thanking once again each and everyone who is related to our project.

SANJAY Y DAS

B.sc Physics

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ABSTRACT

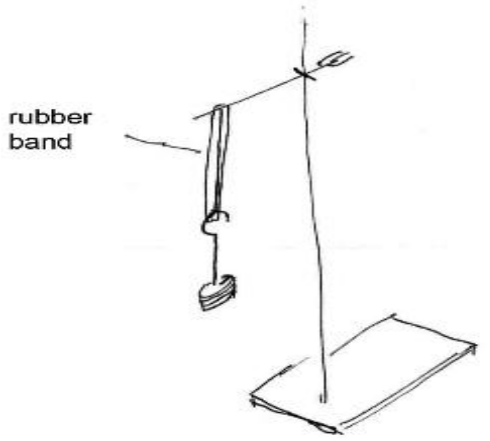
The main aim of this project is to find the Elastic Hysteresis curve of various types of rubber bands.

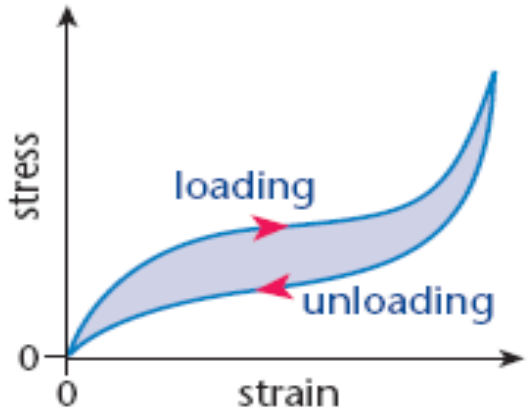
When you stretch a rubber band and then let it go, you can notice that the band does not behave like a spring. A rubber band made of latex and rubber, does not return to its exact original shape after being stretched. This is an example of a phenomenon called hysteresis. By studying the relationship between the rubber band during stretching and un-stretching as weights are added or removed, you can determine the amount of work done on the rubber band, the amount of energy (in joules) lost by the hand and plot a hysteresis curve.

INTRODUCTION

When a deforming force is applied on a body,then the strain does not change simultaneously with stress, rather it lags behind the stress. The lagging of strain behind the stress is defined as elastic hysteresis. Elastic hysteresis was one of the first type of hysteresis to be examined. The effect can be demonstrated using a rubber band with weights attached to it. If the top of a rubber band is hung on a hook and small weights are attached to the bottom of the band one at a time, it will get longer. As more weights are loaded into it, the band will continue to extend because the force the weights are exerting on the band is increasing. When each weight is taken off, or unloaded, the band will get shorter as the force is reduced. As the weights are taken off, each weight that produced a specific length as it was loaded on to the band now produces slightly longer length as it is unloaded. This is because the band does not obey Hooke's law perfectly. Materials such as rubber exhibit a high degree of elastic hysteresis.

PRINCIPLE





ELASTIC HYSTERESIS

When a deforming force is applied on a body, then the strain does not change simultaneously with stress, rather it lags behind the stress. The lagging of strain behind the stress is defined as ELASTIC HYSTERESIS. This is the reason why the values of strain for the same stress are different while increasing the load and while decreasing the load.

HYSTERESIS LOOP

The area of the stress – strain curve is called the hysteresis loop and is numerically equal to the work done in loading the material and then unloading it.

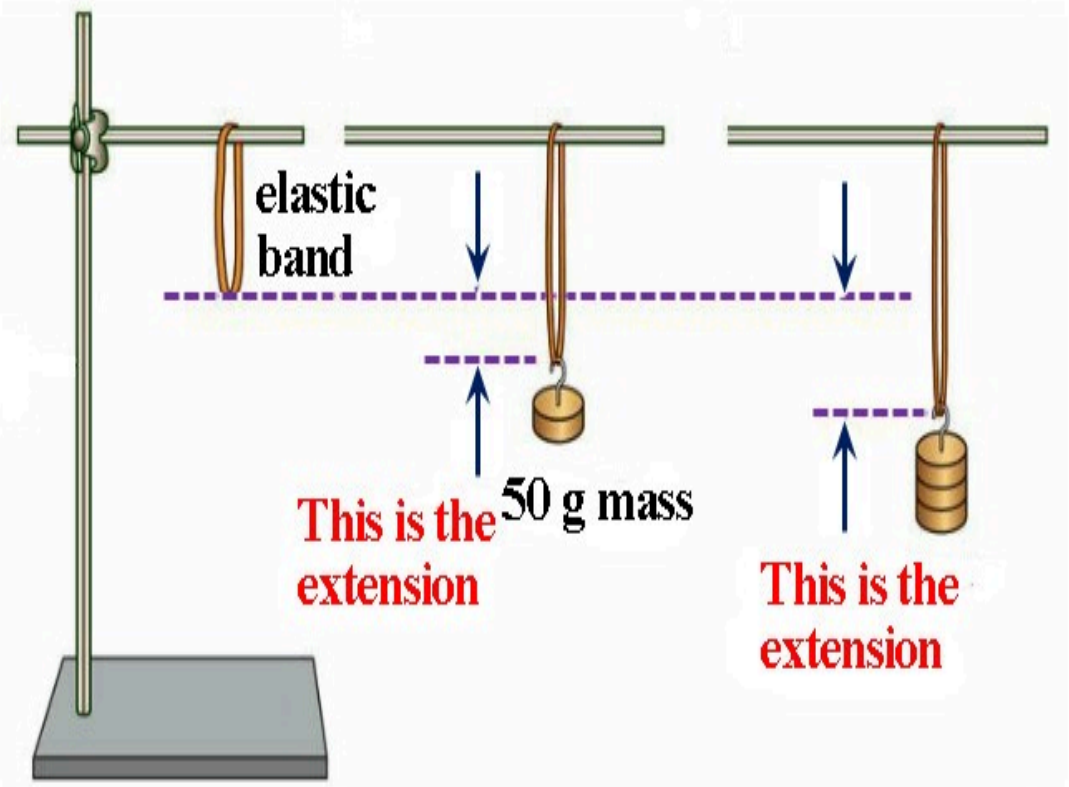
MATERIALS REQUIRED

- Retort stand and clamp
- Mass hanger plus masses (100 g)
- Meter rule
- Selection of rubber bands

PROCEDURE

1. **Rubber bands provide an interesting contrast to springs. On stretching, they do not obey Hooke's law very precisely. On unloading, they show hysteresis**
2. **The experiment must be done with care. Hang a rubber band or length of elastic vertically and attach weights to the lower end. The load must be increased in even steps; as the load is increased, care must be taken to ensure that the rubber is not allowed to slacken. Then the load must be gradually reduced, again ensuring that the rubber does not slacken too much and that it is not stretched more as the load is removed. Unless these precautions are taken, the non -Hookean behavior may not show up. The rubber stretches slowly at first, then roughly linearly, then more and more slowly as it becomes stiffer.**
3. **If we plot a graph of extension against load, the points will appear to fall close to a straight line. Then we get an S curve.**

FIGURE


elastic
band
This is the
extension
50 g mass
This is the
extension

OBSERVATIONS

SAMPLES	TRIAL NO.	LOAD	ON LOADING		ON UNLOADING	
			SCALE READING	EXTENSION [l] cm	SCALE READINGS	EXTENSION [l] cm
SAMPLE 1	1	W0	4.7	0.5	4.7	1.4
	2	W0+50	5.2	1.4	6.1	2.9
	3	W0+100	6.1	3.4	7.6	4.8
	4	W0+150	8.1	5.2	9.5	6.3
	5	W0+200	9.9	6.8	11	6.8
	6	W0+250	11.5		11.5	

SAMPLES	TRIAL NO.	LOAD	ON LOADING		ON UNLOADING	
			SCALE READING	EXTENSION [l] cm	SCALE READINGS	EXTENSION [l] cm
SAMPLE 2	1	W0	6.7	0.7	6.7	1.7
	2	W0+50	7.4	1.7	8.4	2.4
	3	W0+100	8.4	2.4	9.1	3.2
	4	W0+150	9.1	2.9	9.9	3.5
	5	W0+200	9.6	3.7	10.2	3.7
	6	W0+250	10.4		10.4	

SAMPLES	TRIAL NO.	LOAD	ON LOADING		ON UNLOADING	
			SCALE READING	EXTENSION [l] cm	SCALE READINGS	EXTENSION [l] cm
SAMPLES 3	1	W0	4.2	0.2	4.2	0.3
	2	W0+50	4.4	0.4	4.5	0.6
	3	W0+100	4.6	0.7	4.8	1.2
	4	W0+150	4.9	1.2	5.4	1.3
	5	W0+200	5.4		5.5	
	6	W0+250	5.6	1.4	5.6	1.4

SAMPLES	TRIAL NO.	LOAD	ON LOADING		ON UNLOADING	
			SCALE READING	EXTENSION [l] cm	SCALE READINGS	EXTENSION [l] cm
SAMPLE 4	1	W0	6.1		6.1	
	2	W0+50	7.1	1	7.6	1.5
	3	W0+100	7.6	1.5	8.3	2.2
	4	W0+150	8.4	2.3	9.4	3.3
	5	W0+200	9.9	3.8	11	4.9
	6	W0+250	12.1	6	12.1	6

SAMPLES	TRIAL NO.	LOAD	ON LOADING		ON UNLOADING	
			SCALE READING	EXTENSION [l] cm	SCALE READINGS	EXTENSION [l] cm
SAMPLES 5	1	W0	5.7	0.8	5.7	1.4
	2	W0+50	6.5	2	7.1	2.7
	3	W0+100	7.7	3.8	8.4	4.4
	4	W0+150	9.5	6.4	10.1	7.4
	5	W0+200	12.1	9.4	13.1	9.4
	6	W0+250	15.1		15.1	

INFERENCE

Certain elastic materials follow one curve (path) on stretching when the stress is increased and follow another path while regaining its original configuration. This particular behavior of the elastic material is called elastic hysteresis. The work evolved during regaining its original configuration is less than the work done in the body while stretching. Elastic hysteresis occurs whenever a plastic (inelastic) deformation occurs. A plastic deformation results from the displacement of defects, such the dislocations that are always present in real materials.

APPLICATIONS

In the construction of various structures like bridges, columns,pillars, beams, etc. Knowledge of the strength of the materials used in the construction is of prime importance.

While constructing a bridge, a load of traffic that it can withstand should be adequately measured beforehand. Or while constructing a crane used to lift loads, it is kept in mind that the extension of the rope does not exceed the elastic limit of rope. To overcome the problem of bending under force the elastic behavior of the material used must be considered primarily.

In vehicles, a lot of unwanted vibrations take place due to its motion on the road. Elastic hysteresis in materials such as rubber is used to damp the vibrations as well as act as spring as suspensions in small vehicles. Hysteresis makes the rubber lose energy and hence damp the unwanted vibrations.

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