INVESTIGATION OF PHYSICAL AND CHEMICAL PROPERTIES OF CAOUTCHOUC

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ABSTRACT

Rubber has existed since ancient times, and some plant fossils date back three million years. It is interesting to know that over 400 types of latex plants produce a different percentage of rubber. Trees like Hua, Sapphire and Balata, in particular Brazilian air tree (Hevea brasiliensis) has the largest share in the production of rubber base materials in the world . Among its producing lands is the United States. Rubber is a white syrup that comes from rubber trees, also called latex or elastomer. This material has many applications in industry and in this article we intend to examine its.properties carefully.Physical and chemical natural rubber.

Key Words : *Caoutchouc, Lastomer, Physical Properties , Chemical Properties*

1. Introduction

Have you ever thought which properties in Caoutchouc have effect on its usage?

By studying and examining the physical and chemical properties of Caoutchouc, we found rubber is one of the most essential materials in it. Due to its excellent elasticity, rubber is used in the manufacture of a different products including hospital supplies, home appliances and toys.

2. Research Methodology

The physical properties of Caoutchouc in six samples and the chemical properties of Caoutchouc in three samples have been studied, and we discuss the importance of each according to their application in industry.

2.1. Physical Properties

2.1.1. Electrical conductivity

This critical percentage of the additive in which the polymer (elastomer in this study) changes is called permeability or penetration. The higher the permeability, the lower the electrical resistance and the higher the electrical conductivity in the material. The penetration rate for soot in different experiments is 16%. As a result, due to the low permeability of the soot, the rubber has little electrical conductivity.

2.1.2. Strength

Strength is the amount of the force a material can withstand.

Strengths			
Tensile strength	Yield strength	Flexural strength	Compressive strength

Tensile strength: The maximum stress that an object can withstand when stretch from the sides. Tensile Strength or UTS (Ultimate tensile strength), Equals the maximum load divided by the initial cross-sectional area of the sample.

$$s_u = \frac{P_{max}}{A_o}$$

Tensile strength determination is simple and repeatable and useful for purposes such as characterization and product quality control. Caoutchouc molecules have a high tensile strength due to its stretch and being the chain. Gaps in the chains and disordered arrangement of the chains may be the reason for this particular behavior in the tires. The more vacancies there are, the more room for chain mobility. The more disordered the chains are, the greater the ability to repel and revert to their initial state after the force is applied.

Adding sulfur	Adding soot
Increased strength	Increased strength and elasticity

2.1.3. Hardness

It is defined as the ability of a material to withstand the permanent deformation or penetration to its surface. Material hardness is measured by Hardness meter (Fig. 1).

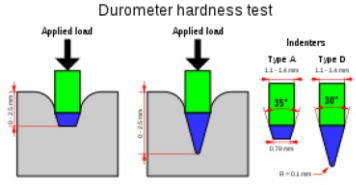

Fig. 1: Hardness meter

Hardness meter of Rubber (Durometer) are usually used to measure the hardness of rubber, elastic polymer materials. In the durometer, such as metal hardness meter, gauges and various units are used, the most commonly used are shore A and shore D. Shore A is used for softer plastic materials and shore D is used for harder specimens (Fig. 2).

Fig. 2: Hardness meter of shore A
Usage: Rubbers hardness measurement

This tool is for materials such as elastomers, rubber, leather, PVC, silicone, Teflon, neoprene and more.

2.1.4. Elasticity

Tensile properties have a reversible (elastic) deformation of the environment and materials, and are also called viscoelastic. The elasticity of the environment cause the rebound forces to be created by any part of the environment that has shifted from its equilibrium state. Adding carbon soot to the raw rubber increases its elasticity.

2.1.5. Damping

In physics this property reduces the amplitude of oscillations in oscillator systems, especially in the consonant oscillator. In general, the part that lowers something's energy is called a damper. (Reduces its oscillation).

Damping				
Radiation damping	Hysteresis damping	Friction damping	Viscose interior damping	External viscous damping

2.1.6. Viscose Interior Damping

This damping is due to the adhesion of the material and is proportional to the speed. As the building's natural frequency increases, the damping ratio increases. Internal viscosities can easily and routinely be involved in dynamic analysis . This damping is the most popular type of Damping.

Internal viscosity damping in rubber is high. That is, due to its oscillation due to the high viscosity between the particles the internal oscillation ends very quickly.

2.1.7. Failure Resistance

Rubber is highly resistant to wear and tear. In fact, it can be said that rubber performance is high and works well for a long time. This is due to soot, sulfur and other substances added to improve natural rubber.

3. Chemical properties

Caoutchouc is Polymers composed of the isoprene organic compound with partial impurities of other organic compounds and water. Like other polymers, it consists of long molecular chains. It is insoluble in water and soluble in alcohol and ether.

Chemical name: Polyisoprene Hydrocarbon Chemical formula: (C_5H_8)

Molecular weight: 2×10^5 - 4×10^5

It is an elastomer (an amorphous polymer which is also called rubber).

amorphous polymer	
Thermoplastic	Elastomer

Whether an amorphous polymer is thermoplastic or elastomer depends on the glass transition temperature or it's Tg. This is the temperature at which the polymer becomes soft, flexible and hardened under the glass. If an amorphous polymer has a Tg below room temperature, that polymer can be an elastomer because it is soft and rubber at room temperature. If the amorphous polymer has a Tg above room temperature, it will be a thermoplastic polymer because it is hard and glassy at room temperature. Thus, in general, it can be said that amorphous polymers below Tg are thermoplastic and above it are elastomer.

The Tg of Caoutchouc is very low at about -70 degrees Celsius. As a result, according to the text above, the rubber at room temperature is soft and elastically.

4. Elastomers' properties

1- flexibility 2-The property of wasting energy 3-Resistance to adverse conditions such as: abrasion, solvents, oils, ozone, acids and alkalis without penetration of water and air.

5. Thermal Behavior

From the scientific point of view, the most useful part of polymers is based on their thermal behavior. (Also called thermodynamic response).

Polymers and their thermal behavior	
Thermoset	thermoplastic

- thermoplastic: There are substances that are fully reacted or polymerized. These materials become soft when exposed to heat, and pressure causes them to flow and can form and, after cooling, stabilize their shape. Incomplete and scrap forms can also be re-melted and reshaped. Due to heat and pressure they become soft and flow to become hardened by the cold and take the form of mold, and this cycle can be repeated several times without reducing the polymer properties .

-thermoset: They are substances that do not fully react and do not fully polymerize and are complemented by effective factors such as reaction heat. Products made of these materials have a lattice structure and do not soften with warming, so they cannot be reprocessed and re-fabricated. These polymers react with warming. Cross links are made in them and converted to solid polymers. These polymers are usually available in powder, liquid or pre-polymer molds and are formed by heat and pressure .

According to the text above, the rubber has a very good thermal behavior, also called the "Goss Joule" effect, and is a thermoplastic (meaning it is liquid at high temperature and can shaped with pressure) . In this effect, unlike other materials due to rapid deformation, it has a temperature rise that is also called "anthropic elasticity" .

6. Swelling Against the Solvent

Rubber is swollen by some solvents such as benzene, gasoline, carbon tetrachloride and some vegetable and mineral oils. The intermolecular bonds of the raw rubber when exposed to these broken materials form a granular or gel-like solution. But if there are cross links in the material, they prevent the rubber from swelling. In fact, it can be said that the volcanization improves the resistance of the rubber to the solvent. It also reduces the elasticity of the rubber after a while (rubbers dry).

7. Discussion and Analysis

Due to the role and application of natural rubber in industry, it can be said that the most important physical property of rubber is its elasticity (enhanced by sulfur and soot). The good thermal behavior of the rubber has the highest efficiency in its chemical properties. In general, the physical properties of tires are more important than their chemical properties .

Due to the high strength, toughness and tensile strength of many materials with similar properties, depending on its application, it is often in a position to be highly resistant to these three factors.

Also considering other properties mentioned, tires are the

natural rubber in industry are eliminated during the manufacturing process. Natural rubber is also used in the manufacture of glasses and shoes because of its easy shaping properties .

8. Conclusion

The highest consumption (more than 60%) of this material is in the manufacture of tire types. As mentioned earlier, rubber has many applications in a variety of industries including aircraft manufacturing, hospital equipment, toys and home appliances due to its elastic properties.

References

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