TIRE MANUFACTURING TECHNOLOGY

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Abstract: This article describes the step-by-step tire manufacturing processes. The process begins with the acceptance of rubber and other materials based on State Standards or Enterprise standards. Then, natural rubber is subjected to a decrystallization process, as this process converts the rubber's crystalline structure into an amorphous state, improving its workability. After decrystallization, the rubber undergoes plasticization and granulation processes. During the plasticization process, the rubber's viscosity decreases and its plasticity increases due to mechanical and thermal treatment. This process is carried out using rollers and screw plasticizers. In the plasticization process performed in rollers, a reduction in the rubber's molecular mass and oxidation are observed, which improves the quality of the rubber. The temperature and rotational speed of the rollers play a crucial role during the process. After plasticization, the rubber is briefly stored, and its technological properties are analyzed. This article highlights the important stages of material processing technology in tire manufacturing.

Keywords: Tire, rubber, decrystallization, granulation, plasticization, screw plasticizer, viscosity, amorphous structure, molecular mass, oxidation, moisture.

Introduction: Main the general process of tire manufacturing.Tire manufacturing is a complex and multi-stage process that involves various materials and precise control over different physical and chemical properties. The production of tires ensures that the final product meets safety, durability, and performance standards required for vehicles. This document provides a detailed explanation of the tire manufacturing process, from raw material acceptance to rubber preparation and subsequent processing stages. Raw material acceptance and storage.The raw materials used in tire manufacturing include rubber (natural and synthetic), fabric, steel, carbon black, sulfur, and various chemical additives. These materials must meet specific quality requirements as outlined by State Standards or individual company specifications. Upon arrival at the tire manufacturing plant, these materials are inspected for compliance with required standards.Rubber, one of the essential components, is stored under controlled environmental conditions. Typically, rubber is kept in storage containers or racks at temperatures ranging from 10 to 15°C. Additionally, the relative humidity in the storage area should not exceed 70-75% to maintain the integrity of the raw materials. Proper storage conditions are crucial to prevent premature degradation or hardening of rubber, which could affect processing and final product quality[1]. Crystallization of natural rubber and Its effects. Natural rubber, when delivered to tire plants, is often in a crystallized state. This crystalline structure is a result of rubber being stored at lower temperatures during transportation. If rubber is used in this crystallized form, it can lead to processing difficulties, such as reduced elasticity and increased resistance to mechanical operations. Furthermore, the presence of crystallized rubber can cause malfunctions in processing equipment, leading to inefficiencies and potential product defects. Decrystallization process. To ensure smooth processing, the rubber must be converted from its crystallized state to an amorphous state. This transformation is achieved through a heating process known as decrystallization. The rubber is subjected to controlled heating, raising its temperature within a range of 40 to 90°C. The heating process disrupts the ordered crystalline structure, making the rubber more flexible and suitable for further processing. There are two primary methods for carrying out the decrystallization process:

Chemical Composition of Glass. Table 1

Component	**Soda-lime glass (%)**	**Lead glass (%)**	**Quartz glass (%)**	**Borosilicate glass (%)**
SiO_2 (silica)	70-75	60-65	~99	80-85
Na_2O (sodium oxide)	12-15	10-15	-	4-5
CaO (calcium oxide)	10-12	5-10	-	2-3
Al_2O_3 (aluminum oxide)	1-3	2-5	-	2-3
B_2O_3 (boron oxide)	-	-	-	10-15

K_2O (potassium oxide)	0-2	3-5		1-2
PbO (lead oxide)		20-30	-	

Explanation:

Soda-lime glass: The most commonly used glass type, applied in windows, bottles, and containers.

Lead glass (Crystal glass): Has high brightness and density, often used for luxury tableware and decorative items.

Quartz glass: Highly resistant to high temperatures, used in scientific equipment and special optical systems.

Borosilicate glass: Heat-resistant, widely used for laboratory equipment and cookware (e.g., Pyrex).

In this method, rubber is placed in chambers where it is exposed to controlled steam heating. The batch process ensures uniform heating and allows precise control over the decrystallization conditions. Continuous steam chambers: This method involves the continuous feeding of rubber through a system of steam chambers, allowing for a more efficient and automated approach to decrystallization. This technique is commonly used in large-scale tire manufacturing facilities. By transitioning the rubber to an amorphous state, manufacturers can improve its workability, ensuring a more consistent material for further stages of tire production. Significance of rubber processing in tire manufacturing. The preparation of rubber is a critical step in tire manufacturing, as it affects the overall quality and performance of the final product. Properly decrystallized rubber ensures better blending with other materials, enhances moldability, and improves vulcanization efficiency. Additionally, maintaining optimal processing conditions prevents mechanical failures, reduces waste, and enhances production efficiency. Glass manufacturing is a multi-step technological process, with primary raw materials such as sand, soda, lime, and other additives used. Initially, these materials are mixed in measured proportions to prepare the mixture. The prepared raw material is melted in furnaces at high temperatures (1400-1600°C)[2].. When the melt reaches a liquid glass state, various additives can be added to alter the color or properties of the glass. In the next stage, the liquid glass is cooled and either poured into molds or stretched into ribbon form[3]. Glass products cast into molds are sent for a cooling process and are slowly cooled down. This process, called "annealing," reduces the internal stresses of the glass and increases its strength. Several methods are available for shaping glass: pressing, blowing, and stretching. Each method depends on the type of product being made and its required properties. Shaped products then undergo additional processing, such as grinding, polishing, or coating[4]. Quality control plays an essential role during the process. The optical properties, strength, and dimensions of the finished product are tested using specialized equipment. These steps allow for the production of high-quality products that can be adapted for various applications[5].

Conclusion:Glass manufacturing is a high-precision and technologically complex process that encompasses various stages, from preparing the raw material mixture to shaping the finished product and conducting quality control. By shaping and cooling the liquid glass at high temperatures through various methods, strong and durable products are produced. Finished glass products are widely used in construction, household appliances, optics, medicine, and other fields[6]. Furthermore, the innovative technologies applied during the manufacturing process allow for the enhancement of the glass's quality and properties. Therefore, glass production is a vital sector of the economy, and its development contributes to the creation of advanced products in various industries.

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