INTERNATIONAL JOURNAL OF POLITICAL SCIENCES AND ECONOMICS
Impact Factor (research bib) - 9,78
https://ijmri.de/index.php/ijpse , German international journals company
ISSN 2751-9708

TECHNOLOGY FOR OBTAINING RUBBER FROM NATURAL AND CHEMICAL RAW MATERIALS AND MANUFACTURING PARTS

Rakhmatjon Makhammadovich Tadjikuziyev
Senior Lecturer, Department of Mechanical Engineering Technology, Fergana Polytechnic Institute (or Fergana State Technical University), Fergana, Uzbekistan
E-mail: rahmatjontadjikuziev@gmail.com

Saida Rakhmatovna Mamatqulova
Senior Lecturer, Department of Light Industry Engineering, Fergana State Technical University, Fergana, Uzbekistan
E-mail: saida.mamatqulova.1989@gmail.com

Abstract: In our country, the production of spare parts for automobiles and equipment using a combined method of metal and non-metal materials has been steadily developing year by year. This article highlights the successful application of rubber and other non-metal products in the national economy, as well as their critical importance in the machine-building and automotive industries. It also discusses ongoing extensive research on new models of technological processes in these fields.
Keywords: Rubber, component, caoutchouc, special, elasticity, soft, vulcanizer, ingredient, chemical resistance, dielectric properties, density, compound, accelerator, activator, conductive, plasticizer, filler, reinforcing agent, antioxidant, pigment, raw material, urethane, concentrate, hydroxide, acids, oxides, machine-building, automotive industry, light industry, tire, hose, pipeline, insulation, nitrile, butadiene, isoprene rubbers, natural, synthetic.

Composition, Properties, and Applications of Rubber Products

Rubber is a product obtained by processing caoutchouc at high temperatures with vulcanizing agents and other special additives.The main component of rubber is caoutchouc, which includes natural rubber (NR) and synthetic rubber (SR).

Natural rubber is obtained from the milky latex of certain rubber-producing trees and a few herbaceous plants by treating the latex with vinegar or formic acid. The density of natural rubber ranges from 0.915 to 0.930 g/cm³. A distinctive property of rubber is its high elasticity. Certain types of soft rubber can stretch up to ten times their original length[1].

This property is explained by the structure of caoutchouc, whose macromolecules consist of linear or slightly branched zigzag and spiral polymer chains. In addition to elasticity, linear rubbers exhibit high wear resistance and low resistance to organic solvents at elevated temperatures. These properties make them unsuitable for practical use without vulcanization[2].

Rubber, vulcanizing agents, and other ingredients impart valuable properties to rubber compounds. Rubber possesses high elasticity and resistance to tearing and abrasion; it is impermeable to gases and water, chemically resistant, has valuable dielectric properties, low density, and other characteristics. For example, at 20°C, rubber made from "Nairit" chloroprene rubber exhibits tensile strength of 20 to 26 N/mm², elongation at break of 600 to 700%, and residual elongation after break of 12%.

Preparation of Rubber Compounds

In rubber production, vulcanizing agents (such as sulfur or thiuram), accelerators, fillers, plasticizers, antioxidants, dyes, and other additives are mixed with rubber. These additives

INTERNATIONAL JOURNAL OF POLITICAL SCIENCES AND ECONOMICS
Impact Factor (research bib) - 9,78
https://ijmri.de/index.php/ijpse , German international journals company
ISSN 2751-9708

typically constitute 65% or more of the total compound, with the remainder being rubber. Vulcanization is applied to improve elasticity and prevent loss of plasticity[3].

The amount of sulfur introduced into the rubber determines whether the product is soft or hard rubber. Soft rubber contains about 1.3% sulfur and has high elasticity, while hard rubber (ebonite) contains 30–35% sulfur, producing hard materials with high impact resistance. Before vulcanization, all additives including sulfur are considered components of the rubber compound. These additives cause chemical and physical changes in the rubber, modifying hardness, strength, and resistance to wear, oils, oxygen, chemical solvents, heat, and cracking. Different rubber formulations are used for various applications.

Accelerators and Activators

When used with sulfur, certain reactive substances called accelerators reduce vulcanization time and improve the physical properties of rubber. Inorganic accelerators include lead-based compounds such as lead oxide, lime, and magnesium oxide. Organic accelerators are more active and are essential components of nearly all rubber compounds. They are typically added in small amounts (0.5 to 1.0 parts per 100 parts of rubber). Most accelerators are fully effective only in the presence of activators like copper oxide and require organic acids such as stearic acid. Modern rubber formulations usually contain copper oxide and stearic acid[4].

Plasticizers and Softeners

Plasticizers and softeners are used during rubber compound preparation to reduce viscosity and processing temperature. They also aid in dispersing the compound's components, preventing swelling or melting of the rubber. Common softeners include stearic and paraffin substances[5].

Antioxidants

Like vulcanization accelerators, antioxidants are complex organic compounds added in concentrations of 1–2 parts per 100 parts of rubber to prevent increases in hardness and brittleness. Exposure to air, ozone, heat, and light are primary causes of rubber aging. Some antioxidants protect rubber from damage caused by bending and heat.

Technological Process of Rubber Product Manufacturing

The manufacturing process involves several key operations:

a) Plasticizing the rubber (dividing into small pieces and passing through rollers to achieve uniform plasticity) and preparing the rubber compound by mixing powdered components (vulcanizing agents and additives) using special rubber mixers or mills.

b) Processing the raw rubber into semi-finished products and calendaring (using special three- or four-roll calenders to form smooth-profile sheets and strips); continuous pressing or extrusion (using extruders) to produce sheets, tubes, rods, corners, cords, automobile and bicycle inner tubes, etc.; molding in special metal molds using hydraulic presses to produce gaskets, shock absorbers, tires, rubber-metal products, and others; compression molding and other methods.

c) The final step is vulcanization — thermal treatment of the accepted rubber raw material at a specified temperature regime (typically 140–155°C). This involves chemical and physical changes where linear polymer chains form a network, enhancing mechanical strength, hardness, elasticity, dielectric properties, chemical resistance, and temperature stability[6].

Many small products are vulcanized in metal molds placed between parallel hydraulic press plates. The press plates are hollow to allow steam circulation for indirect heating; heat is transferred through the metal mold. Many products are vulcanized by heating in air or carbon dioxide. Rubber fabrics, clothing, rainwear, and rubber shoes are vulcanized this way, typically in large horizontal steam vulcanizers. Dry heat vulcanized rubber compounds contain lower amounts of sulfur to prevent surface sulfur bloom.

INTERNATIONAL JOURNAL OF POLITICAL SCIENCES AND ECONOMICS
Impact Factor (research bib) - 9,78
https://ijmri.de/index.php/ijpse , German international journals company
ISSN 2751-9708

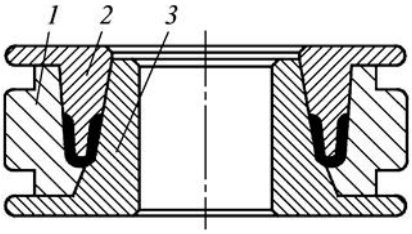

Figure 1. Press Mold for a Seal (Manjet)

Raw rubber is prepared by mixing with precisely dosed ingredients in rolls or mixers. The prepared compound is processed on calenders into sheets of specified thickness. Then, blanks for parts are cut (stamped) from the sheets or molded using stamping machines. Parts are formed by pressing under hydraulic presses at pressures of 1.5–2.0 MPa. Some rubber products (such as shock absorbers, stoppers, seals, etc.) can be obtained by hot pressing in molds. The design of molds for rubber products is similar to thermoplastic molds[7].

Figure 1 shows a direct press mold used for manufacturing rubber seals (manjets). Before pressing, the unvulcanized ("raw") rubber compound is placed into the cavity formed by removing the punch. The mold parts create a gap between parts 1 and 3, which serves simultaneously as the matrix and the loading chamber. Then, the compound is covered by punch 2 and placed into a hydraulic press that applies pressure to the mold. Under pressure, the rubber compound is shaped into the product and, after technological exposure at a specified temperature, the product is removed from the mold. The pressing temperature is 140–155 °C. During pressing, shaping and vulcanization of parts occur simultaneously. After shaping, high-strength parts (e.g., V-belts) undergo additional vulcanization in special devices called packages[8].

Cold pressing is used for parts made of ebonite compounds (such as components for lead-acid batteries and the chemical industry). After pressing, the parts (zakotovkas) are sent for vulcanization. Ebonite compound consists of rubber and a large amount of sulfur (up to 30%). Crushed waste from ebonite production is used as filler.

Long products are manufactured using extrusion machines (profiles, pipes, cords). Rubber injection molding resembles plastic extrusion.

Complex-shaped parts are produced by injection molding under pressure. The rubber compound is injected into the mold through a special nozzle at temperatures of 80–120 °C, significantly reducing vulcanization time.

References

1. R .M.Tadjikuziyev, "Texnologik jixozlarni ta'mirlash va ishlab chiqarish texnologiyasi asoslari", AB., Farg'ona, 2023 y., 348 b.
2. R.M.Tadjikuziyev, "Texnologik jihozlarni o'rnatish, texnik xizmat ko'rsatish va ta'mirlash tizimlari", AB., Farg'ona, 2023 y., 322 b.
3. R.M. Tadjikuziyev.(2022) TECHNOLOGY OF REPAIR OF PRESS MOLDS FOR PRODUCTION OF MACHINE PARTS FROM STEEL COILS, ALUMINUM ALLOYS. American Journal Of Applied Science And Technology
ISSN – 2771-2745
4. M. Tadjikuziyev. (2022)Analysis of Pollution of Automobile Engines Operating in the Hot, High Dust Zone of Uzbekistan. Eurasian Journal of Engineering and Technology ISSN: 2795-7640
5. Raxmatovna.M.S.(2022).Research on the development of norms of time spend on the technological process of sewing and knitting production; basic raw materials, their composition

and properties.Innovative Technologica: Methodical Research Journal, 3(03), 28-32. ISSN:2776-0987, Volume3, Issue5,May,2022.7
6. Raxmatovna.M.S.(2021). The description of perspective fashion trends in men's clothing. Innovative Technological:Methodical Research Journal,2(10),15-20.
7. Mamatqulova, S., & Tadjikuziyev, R. (2020). Метод оцінки рівня кваліфікації ремонтних оботників підприємства автомобільного обслуговування. Λόгοσ. Мистецтво Наукової Думки, (10), 41-44.
8. Tadjikuziyev, R. M. (2022). Technology of repair of press molds for production of machine parts from steel coils, aluminum alloys. American Journal Of Applied Science And Technology, 2(04), 1-11.