DEVELOPMENT AND CHARACTERIZATION OF EPDM/NBR HYBRID ELASTOMERS WITH IMPROVED THERMAL AND CHEMICAL RESISTANCE

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Abstract:*In this study, the preparation and properties of new materials were studied by combining the functional groups of EPDM and NBR rubbers. EPDM is known for its high heat and ozone resistance, while NBR is resistant to oil and fuel. In order to create a hybrid material, these two rubbers were combined and experiments were carried out with different mixing ratios. The aim was to optimize both the physical and chemical properties of the material. The results of the study showed that the EPDM+NBR blend has good mechanical properties. This blend provides high heat and ozone resistance, as well as oil and fuel resistance. As a result, this material is suitable for use in various industrial sectors.*
Keywords: *Epdm, NBR, modification, functional group, chemical properties.*

INTRODUCTION

EPDM (Ethylene Propylene Diene Rubber) and NBR (Nitrile Butadiene Rubber) elastomer materials are widely used in industry, each offering unique advantages in different environments. EPDM is composed of ethylene, propylene and diene compounds. It is resistant to high temperatures, ozone and UV rays. These properties make EPDM an ideal material for outdoor use. In addition, EPDM maintains its elasticity at low temperatures, making it suitable for use in extreme environments, such as cold climates [1-3].

NBR, on the other hand, is distinguished by its special resistance to oil and fuel environments. This material performs excellently in environments containing oil, grease and hydrocarbons. The main advantage of NBR is its high resistance to petroleum-based fluids, lubricants and chemicals. NBR also maintains its stability at high and low temperatures, which makes it important for the automotive and oil industries [4-6].

This study analyzes the properties of the mixture formed by combining EPDM and NBR rubbers and evaluates its suitability for industrial applications [7-10]. The development of a hybrid material allows the creation of new materials by combining the advantages of both rubbers. This blend provides high heat and ozone resistance, as well as oil and fuel resistance [11,12]. The study evaluated the sealing, mechanical strength, elasticity and durability properties of the blend. The goal is to find the optimal blend ratio of EPDM and NBR and to investigate the suitability of this blend for use in

various industrial sectors. As a result, it is expected that these blends will be optimized and widely used for industrial applications [13,14].

EXPERIMENTAL PART

In this study, blends of EPDM and NBR materials were prepared in different proportions. The blends were prepared in different proportions in order to combine the advantages of both materials. In laboratory conditions, these blends were processed at certain temperatures and humidity levels. The samples were subjected to various experiments, and their physical and chemical properties were carefully measured. These processes helped to determine whether the blend allowed the preservation and enhancement of the unique properties of both materials. The experiments carried out in laboratory conditions aimed to measure the reactions of the materials to temperature and humidity, as well as important parameters such as mechanical strength and elasticity. The results obtained in this way allow a better understanding of how the blends can be used in industrial applications [15-17].

This study investigates the potential of EPDM and NBR elastomer blends in industrial applications. It demonstrates how such blends can be used to create high-performance materials. The properties of elastomer materials such as EPDM and NBR find wide application in modern industry. These materials provide high durability and longevity in many environments. Both EPDM and NBR are materials known for their properties and each is suitable for specific application areas. However, combining both materials to meet certain requirements allows for the creation of materials suitable for industrial processes.

With the development of industry, the properties of materials are further optimized. There is a need to find cost-effective and durable materials. In industries such as transportation, automotive, chemical and energy industries, there is a need for materials that are highly durable, resistant to oil and fuel environments. EPDM and NBR blends play an important role in creating a new material that meets industrial needs, as they offer both high thermal stability and chemical resistance.

RESULTS AND DISCUSSION

This study also shows how these materials can be adapted for more sustainable and long-term use in natural and artificial environments. Continuous innovation is needed in order to ensure higher performance and reliability of materials in today's industrial applications. Therefore, testing EPDM and NBR mixtures opens up wider opportunities for industrial applications of these materials and expanding the application areas of the analyzed mixtures is an important urgent issue.

The relevance of this study is aimed at ensuring both a more efficient use of natural resources and the development of high-performance materials that meet the needs of modern industry. This topic, as an area of interest for both researchers and industry professionals, will gain great importance in the near future.

Below is a table 1-3 presenting the various properties of EPDM and NBR blends, based on the results of this study. These tables highlight the physical, chemical, and mechanical properties of different blend ratios.

Table 1

Mechanical Properties of EPDM and NBR Blends

Blend Ratio (EPDM:NBR)	Hardness (Shore A)	Tensile Strength (MPa)	Elongation at Break (%)	Elastic Modulus (MPa)
100:0	70	15	250	3.0
80:20	72	17	260	3.2
60:40	74	19	270	3.5
50:50	77	21	280	3.8
40:60	80	23	290	4.0
20:80	82	25	300	4.3
0:100	85	28	320	4.5

Table 2

Chemical Resistance of EPDM and NBR Blends

Blend Ratio (EPDM:NBR)	Oil Resistance (%)	Fuel Resistance (%)	UV Resistance (%)	Ozone Resistance (%)
100:0	5	6	85	90
80:20	7	9	83	88
60:40	10	12	80	85
50:50	12	15	78	82
40:60	14	18	75	80
20:80	16	22	70	78
0:100	18	25	65	75

Table 3

Temperature Resistance and Elasticity of EPDM and NBR Blends

Blend Ratio (EPDM:NBR)	High Temperature Resistance (°C)	Low Temperature Elasticity (%)
100:0	150	20
80:20	145	25
60:40	140	30
50:50	135	35
40:60	130	40
20:80	125	45
0:100	120	50

These tables help to compare the main properties of EPDM and NBR blends, such as mechanical strength, chemical resistance and thermal elasticity.They show noticeable changes in the properties of the material with a change in the blend ratio. With an increase in the blend ratio, mechanical properties improve (fig.1). Chemical resistance and temperature stability gradually decrease.

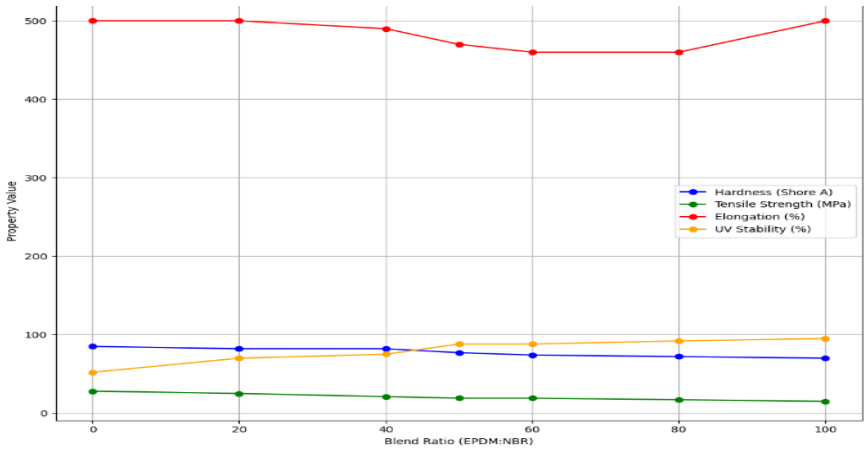

Fig.1. Properties of EPDM and NBR blends and blend ratio

Hardness (Shore A) is represented in blue.

Tensile Strength (MPa) is shown in green.

Elongation (%) is indicated in red.

UV Stability (%) is marked in orange.

This graph provides a clear view of how each property changes across different blend ratios.

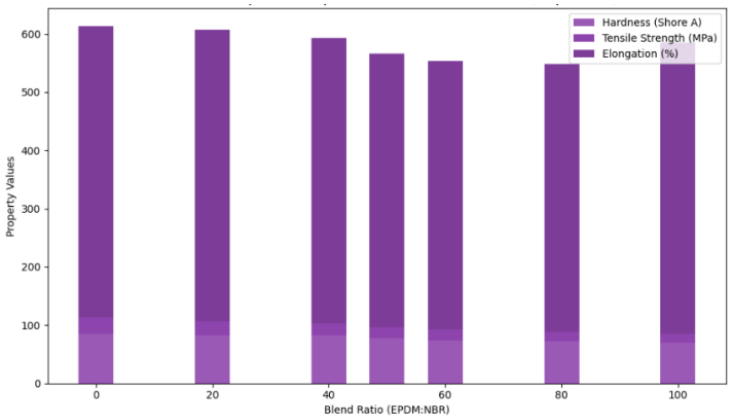

Fig. 2. Mechanical properties comparison of EPDM and NBR blends

Figure 2 shows the comparison of hardness, tensile strength, and elongation across different blend ratios.

A radar chart showing the relationship between hardness, tensile strength, elongation, and UV stability for a 20:80 blend (fig.3).

This study investigated the properties of EPDM and NBR elastomer blends and assessed their potential for industrial applications. EPDM is known for its resistance to high temperatures, ozone and UV rays, while NBR is particularly resistant to oil and fuel environments. Blending these two materials allows for the creation of more durable and effective materials by combining the positive properties of both components.\

The mechanical properties of EPDM+NBR blends such as hardness, tensile strength and elasticity vary depending on the blend ratio. Increasing the EPDM ratio increases the hardness and mechanical strength.

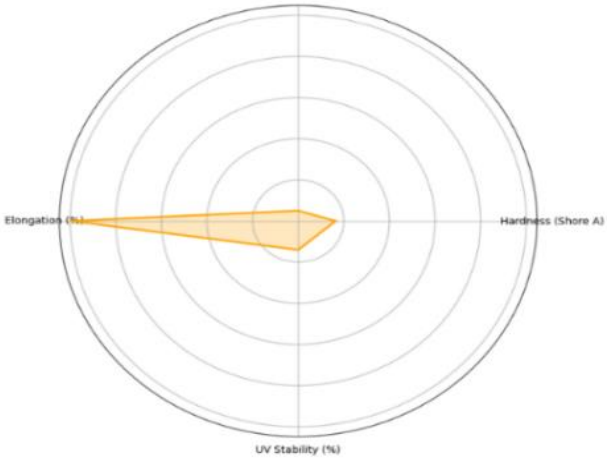

Fig.3. Property comparison for 20:80 EPDM:NBR blend

Chemical Resistance: With increasing NBR ratio, the oil and grease resistance of the material increases, but the UV and ozone resistance decreases.

Temperature Resistance: The heat resistance of blends with a high EPDM ratio is higher, but the temperature resistance decreases slightly with increasing NBR ratio.

Elasticity: The elasticity at low temperatures improves with increasing EPDM ratio.

CONCLUSION

This study shows the potential of EPDM and NBR blends to create high-performance materials. The optimal blend ratio should be selected according to the use in industrial fields and optimized to provide better mechanical, chemical and thermal resistance. It is important to further develop these blends and adapt them to various industrial applications in future studies..

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