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Comprehensive Study Of Physical, Mechanical And Thermal Properties Of Low Molecular Weight Polyethylene

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ABSTRACT.

In this study, the physical, mechanical and thermal properties of low molecular weight polyethylene (QMPE) were comprehensively investigated. During the research, the density, viscosity, crystallinity degree, as well as mechanical and thermal characteristics of the material were evaluated. The obtained results showed that QMPE possesses high elasticity, good flowability and sufficient thermal stability. This confirms the possibility of its effective application in industrial and technological processes.

Keywords: *low molecular weight polyethylene, QMPE, physical properties, mechanical properties, thermal stability, FTIR analysis*

INTRODUCTION

Polymer materials are widely used in modern industry, and their physicochemical and mechanical properties determine the efficiency of various technological processes. Polyethylene-based materials, particularly low molecular weight polyethylene (QMPE), are of special interest due to their chemical stability and high processability.

QMPE is composed of repeating $-\text{CH}_2-$ units, which provide structural stability to the polymer chain.

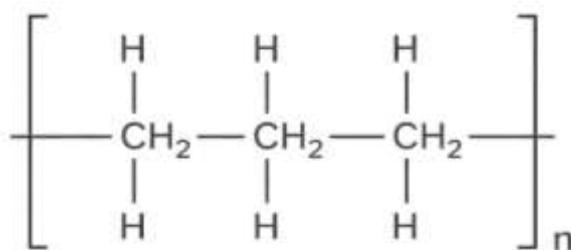


Figure 1. Structural formula of QMPE

A comprehensive study of the physical, mechanical, and thermal properties of this material is essential for determining its potential applications in various technological fields.

RESULTS AND DISCUSSION

A sample of QMPE obtained under industrial conditions was selected as the object of the study. The physical properties of the material were analyzed, and its density was found to be in the range of 0.91-0.95 g/cm³, while the molecular weight ranged from 2000 to 10000 g/mol. The low viscosity values indicate good flowability of the material, and the degree of crystallinity confirms the presence of a balance between amorphous and crystalline phases.

Table 1. Main physical properties of QMPE

Property	Value	Unit
Density	0.91-0.95	g/cm ³
Molecular weight	2000-10000	g/mol
Melting temperature	100-115	°C
Viscosity	0.1-0.5	Pa·s
Crystallinity	45-65	%

As can be seen from the table, QMPE is characterized by low density and good flowability. Mechanical analysis showed that QMPE possesses high elasticity. In particular, the elongation at break ranges from 200% to 600%, indicating good resistance to deformation.

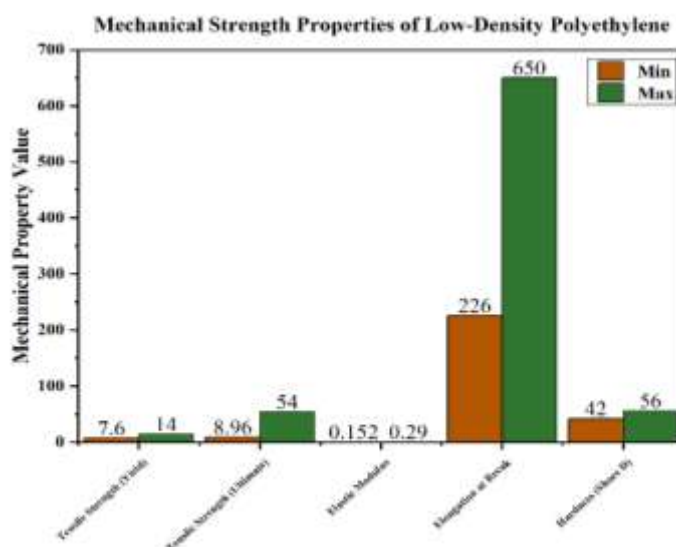


Figure 2. Mechanical properties of QMPE (minimum and maximum values)

The graphical results clearly demonstrate the balance between the elasticity and strength properties of the material.

Thermal analysis revealed that the melting temperature of the material lies in the range of 105-115 °C, while thermal decomposition begins at temperatures above 330 °C.

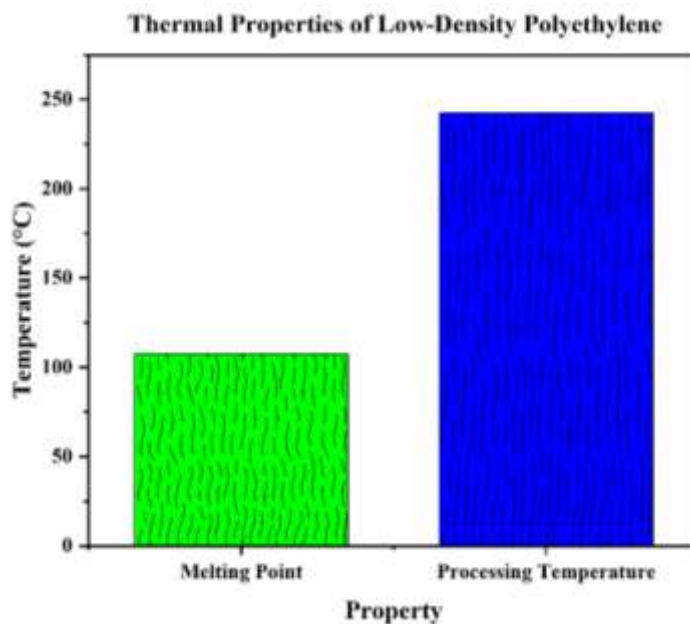


Figure 3. Thermal properties of QMPE

These results indicate that the material is stable over a wide temperature range.

Infrared (FTIR) spectroscopy results showed that C-H bonds dominate in the material structure, while the presence of certain oxygen-containing functional groups was also identified.

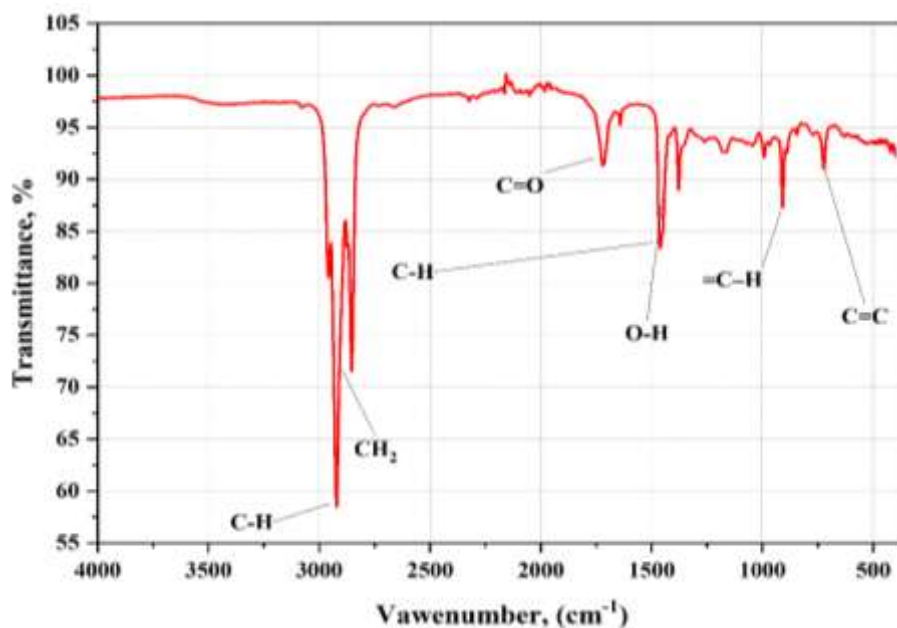


Figure 4. FTIR spectrum of QMPE

Spectral analysis plays an important role in determining the structural characteristics of the material.

CONCLUSION

The obtained results indicate that QMPE possesses a balanced combination of physical, mechanical, and thermal properties. The material is characterized by high elasticity, good processability, and adequate thermal stability.

Therefore, QMPE can be effectively applied in the polymer industry, packaging technologies, and various engineering applications.

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