WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 6, June, 2022

EVALUATION OF THE EFFICIENCY AND OPERABILITY OF PARTS AND ASSEMBLIES MADE OF ENGINEERING HETEROCOMPOSITE POLYMER MATERIALS

Ziyamuxamedova U. A.
Doctor of Technical Sciences, Professor,
Tashkent State Transport University, YEOJU Technical institute in Tashkent

Miradullaeva G. B.
PhD, Tashkent State Transport University,
YEOJU Technical institute in Tashkent.

Nafasov J. H.
Senior Lecturer of the Department of Materials Science and Mechanical Engineering, Tashkent State Transport University
E-mail: nafasovz@mail.ru

Abstract

This article discusses the issues of evaluating the effectiveness and operability of parts and assemblies made of engineering polymer materials. By regulating stress relaxation, it is possible to predict the durability of polymer materials, to most accurately assess their efficiency and operability.

Keywords. Composite polymer material, viscoelasticity, tribotechnical, export-oriented engineering materials. nitron fibers, gas chemistry.

1 Introduction.

The production of polymer materials is one of the most rapidly developing industries in our country. Polymer materials have turned from substitutes into irreplaceable materials used in many fields of technology and in the production of household items. Modern mechanical engineering, tractor construction, instrument engineering, electrical engineering, construction machinery, chemical industry, agriculture, etc. cannot exist without the use of polymer materials.

Such a wide application is determined by the variety of properties of polymers, depending on their chemical structure. High technical indicators of machine parts and mechanisms in industry are determined, as is well known, by a rational and optimal choice of materials, manufacturing technology and design. Depending on the operating conditions, these machines and mechanisms have different reliability and durability.

The development of domestic and world science and technology testifies to the enormous and increasing importance of composite materials. Their use will increase the reliability and durability of parts in conditions of friction and wear, reduce the mass of materials and energy consumption, as well as the cost of machines and mechanisms.

The main directions of economic and social development of the Republic of Uzbekistan provide for the radical modernization of machinery and technology in mechanical engineering [1], in which the use of polymer materials plays a significant role, allowing to reduce the material intensity of structures, labor costs, save energy, improve the quality, reliability and durability of products.

The solution of the above tasks requires in-depth research to determine and predict the durability of polymer materials, taking into account relaxation processes, depending on temperature, environment, deformations and other factors. The processes of interaction of polymer materials with the environment under the conditions of external factors are among the most difficult tasks of polymer materials science [2].

Currently, the Government of the Republic of Uzbekistan pays close attention to the development of mechanical engineering and the development of import-substituting and export-oriented engineering materials using local material and energy resources. As an example, we can cite the creation in the shortest possible time in Asaka in 1996 of the Uz DAEWOO automobile plant, in Kashkadarya in 2001 of the Shurtan gas chemical Complex (SHGHK), in Tashkent in 2011 of General motors, which successfully operate and make a huge contribution to the economy of the republic.

In our country, the production of polymers and plastics based on them began in the 80s of the twentieth century. Currently, plastics are produced in many cities of the republic: caprolactam – in Chirchik, polyethylene of various brands – in Kashkadarya region, nitron fibers – in Navoi and furan resins - in Ferghana.

Currently, SHGHK produces various grades of polyethylene granules [3] used for the national economy and in the machine-building industry (Table.1) and products are produced whose name and volume of production are given in Table 2.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 6, June, 2022

Table 1 Brands of polyethylene produced in SHGHK

Low density polyethylene	Medium density polyethylene	High density polyethylene	
F-Y720	R-0333	F-Y240	I-0754
F-Y920	WC-Y734	P-Y242	B-Y456
F-0120	F-Y336	P-Y342	P-Y456
F-0220	WC-Y434	F-Y346	I-0760
F-0320	P-Y337	O-Y446	B-Y460
I-0525	R-0338	R-0448	I-2560
I-1625		B-Y250	I-1561
		O-Y750	O-Y762

Table 1

№	Name of goods	Productivity per year, (thousand tons)
1	Polyethylene granules	125
2	Liquefied gas	100
3	Gas condensate	100
4	Sulfur (granules)	125

Currently, the following products are manufactured in SHGHK:
- Pipes and fittings (made of polypropylene);
- Aluminum composite panels;
- Details for drip irrigation and other details.

2.Methods

The main local raw material source for machine-building polymer parts can be polyethylene granules of various brands (Table.1). However, in order to ensure the required durability of machine-building parts, it is necessary to conduct a complex of physico-mechanical and tribotechnical studies in order to develop scientific and technical recommendations for their rational use.

It should be noted that products made of polymer and composite materials are used in almost all sectors of the economy of the republic and are widely used in mechanical engineering, in particular automotive, instrument making and tractor construction, as well as in everyday life in the manufacture of consumer goods, while the durability of parts and assemblies of machines made of polymer materials is of particular importance.

It is known that the durability of machine-building polymer materials is determined by the empirical formula [1]:

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 6, June, 2022

$$\tau = \tau_0 \exp\left[\frac{(u_0 - \gamma\sigma)}{kT}\right] \quad (1)$$

Where, τ_0 – constant close to the period of the thermal vibrations of atoms (10^{-12} - 10^{-13} c), u_0 – energy of chemical bonds; γ – structural factor; σ – voltage; k – Boltzmann constant; T – absolute temperature.

However, this formula did not take into account the durability of polymer materials under stress relaxation conditions, taking into account vibration, friction and wear. We have obtained the durability equations of polymer materials operating under stress relaxation conditions taking into account vibration, friction and wear [4].

Stress relaxation in the presence of friction and wear is described by the equation [2]:

$$\sigma_{изн} = \sigma_t - E_0 A\left[t_n - \gamma^a \int_0^t e^{-\gamma(1+a)(t-\tau)} \tau^n d\tau\right] \quad (2)$$

where, σt – equilibrium stress; E0 – is the instantaneous modulus of elasticity; A, n – are the constants of the material; γ, a – are the parameters of the relaxation core; t – is the experiment time ; τ – is the relaxation time.

As a result of substituting equation (2) into equation (1), we obtain

$$\tau = \tau_0 \exp\left[\frac{U_0 - \gamma(\sigma_t - B)}{kT}\right] \quad (3)$$

where,

$$B = E_0 A\left[t_n - \gamma^a \int_0^t e^{-\gamma(1+a)(t-\tau)} \tau^n d\tau\right] \quad (4)$$

Coefficient of linear viscoelasticity.

To obtain the range of performance of a polymer material, the values of □*o*, *uo*, io and □ are determined experimentally.

Studying the influence of structural, technological and operational factors on stress relaxation, it is possible to evaluate the durability of machine-building polymer materials for a wide range of technological and operational factors.

3. Conclusions

Summarizing, we note that by regulating stress relaxation, it is possible to predict the durability of polymer materials, to most accurately assess their efficiency and operability.

References

1. Atomic and vacancy ordering in carbide ζ -Ta 4 C 3– x (0.28< x and phase equilibria in the Ta-C system / AI Gusev, AS Kurlov, VN Lipatnikov // Journal of Solid State Chemistry. - 2007. - V.180. - P. 3234-3246.
2. Storms, EK The Refractory Carbides / EK Storms. - New York: Academic Press, 1967. - 61 p.
3. The strength fracture of sintered tungsten carbide-cobalt alloys in relation to composition and particle spacing / J. Gurland // Trans Metall Soc. - 1963. - V. 227. -P. 1146-1149.
4. Brandles, EA Smithels Metal Reference Book / EA Brandles. - Boston: Butterworths, 1983. - 1800 p.
5. ZIYAMUKHAMEDOVA, U., MIRADULLAYEVA, G., RAKHMATOV, E., NAFASOV, J., & INOGAMOVA, M. (2021). Development of The Composition of a Composite Material Based On Thermoreactive Binder Ed-20. Chemistry And Chemical Engineering, 2021(3),
6. Nurkulov, F., Ziyamukhamedova, U., Rakhmatov, E., & Nafasov, J. (2021). Slowing down the corrosion of metal structures using polymeric materials. In E3S Web of Conferences (Vol. 264, p. 02055). EDP Sciences.
7. Ziyamukhamedova, U., Rakhmatov, E., & Nafasov, J. (2021, April). Optimization of the composition and properties of heterocomposite materials for coatings obtained by the activation-heliotechnological method. In Journal of Physics: Conference Series (Vol. 1889, No. 2, p. 022056). IOP Publishing.
8. Ziyamuxamedova, UA, Miradullaeva, GB, Nafasov, JH, & Azimov, SJ (2022). RESEARCH OF RHEOLOGICAL PARAMETERS AND SELECTION OF COMPOSITIONS FOR APPLICATION ON WORKING SURFACES OF STRUCTURAL MATERIALS OF LARGE TECHNOLOGICAL EQUIPMENT. Web of Scientist: International Scientific Research Journal, 3(5), 1720-1727.
9. Urazbaev, T. T., & Nafasov, J. H. Samborskaya, NA, Researcher. Транспорт Шёлкового Пути, 54.
10. Urazbayev, T. T., Nafasov, J. H., & Azimov, S. J. (2022). Ti-Al SYSTEM COMPOUNDS TO CREATE A COMPOSITE TOOL MATERIAL. Web of Scientist: International Scientific Research Journal, 3(5), 1772-1782.

11. Тоиров, О. Т., Турсунов, Н. К., Кучкоров, Л. А., & Рахимов, У. Т. (2021). Исследование причин образования трещины в одной из половин стеклоформы после её окончательного изготовления. Scientific progress, 2(2), 1485-1487.
12. Kayumjonovich, T. N. (2022). RESEARCH AND IMPROVEMENT OF STEEL REFINING MODES IN INDUCTION FURNACES IN ORDER TO IMPROVE THE PRODUCTS QUALITY. *Web of Scientist: International Scientific Research Journal*, *3*(5), 1713-1719.
13. Кучкоров, Л. А., & Турсунов, Н. К. (2021). Исследование состава формовочных и стержневых смесей для повышения механических свойств. *Scientific progress*, *2*(5), 350-356.
14. Мухаммадиева, Д. А., Валиева, Д. Ш., Тоиров, О. Т., & Эркабаев, Ф. И. (2022). ПОЛУЧЕНИЕ ПИГМЕНТА НА ОСНОВЕ ОСАДКОВ ЭЛЕКТРОХИМИЧЕСКОЙ ОЧИСТКИ ХРОМАТСОДЕРЖАЩИХ СТОКОВ. *Scientific progress*, *3*(1), 254-262.
15. Тоиров, О. Т. У., Турсунов, Н. К., & Кучкоров, Л. А. У. (2022). Совершенствование технологии внепечной обработки стали с целью повышения ее механических свойств. *Universum: технические науки*, (4-2 (97)), 65-68.
16. Азимов, Ё. Х., Рахимов, У. Т., Турсунов, Н. К., & Тоиров, О. Т. (2022). Исследование влияние катионов солей на реологический статус геллановой камеди до гелеобразования. *Oriental renaissance: Innovative, educational, natural and social sciences*, *2*(Special Issue 4-2), 1010-1017.
17. Kayumjonovich, T. N. (2022). DEVELOPMENT OF A METHOD FOR SELECTING THE COMPOSITIONS OF MOLDING SANDS FOR CRITICAL PARTS OF THE ROLLING STOCK. *Web of Scientist: International Scientific Research Journal*, *3*(5), 1840-1847.
18. Kayumjonovich, T. N., & Zokirov, R. V. (2022). THE METAL REFINING PROBLEM AND TECHNICAL SOLUTIONS FOR THE ACTIVE SLAG FORMATION IN INDUCTION FURNACES. *Web of Scientist: International Scientific Research Journal*, *3*(5), 1755-1760.
19. Тоиров, О. Т., Кучкоров, Л. А., & Валиева, Д. Ш. (2021). ВЛИЯНИЕ РЕЖИМА ТЕРМИЧЕСКОЙ ОБРАБОТКИ НА МИКРОСТРУКТУРУ СТАЛИ ГАДФИЛЬДА. *Scientific progress*, *2*(2), 1202-1205.
20. Тен, Э. Б., & Тоиров, О. Т. (2020). Оптимизация литиковой системы для отливки «Рама боковая» с помощью компьютерного моделирования. In *Прогрессивные литейные технологии* (pp. 57-63).

21. Турсунов, Н. К., Санокулов, Э. А., & Семин, А. Е. (2016). Исследование процесса десульфурации конструкционной стали с использованием твердых шлаковых смесей и РЗМ. *Черные металлы*, (4), 32-37.
22. Рахимов, У. Т., Турсунов, Н. К., Кучкоров, Л. А., & Кенжаев, С. Н. (2021). Изучение влияния цинка Zn на размер зерна и коррозионную стойкость сплавов системы Mg-Nd-Y-Zr. *Scientific progress*, *2*(2), 1488-1490.
23. Tursunov, N. K., Semin, A. E., & Sanokulov, E. A. (2017). Study of dephosphoration and desulphurization processes in the smelting of 20GL steel in the induction crucible furnace with consequent ladle treatment using rare earth metals. *Chernye Metally*, *1*, 33-40.
24. Семин, А. Е., Турсунов, Н. К., & Косырев, К. Л. (2017). Инновационное производство высоколегированной стали и сплавов. Теория и технология выплавки стали в индукционных печах.
25. Tursunov, N. K., Semin, A. E., & Sanokulov, E. A. (2017). Research of dephosphorization and desulfurization processes in smelting of 20GL steel in an induction crucible furnace with further processing in a ladle using rare earth metals. Chern. Met, 1, 33-40.
26. Tursunov, N. K., & Ruzmetov, Y. O. (2018). Theoretical and experimental analysis of the process of defosphoration of steel used for parts of the mobile composition of railway transport. Journal of Tashkent Institute of Railway Engineers, 14(2), 60-68.