American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 01 Pages: 37-41
SJIF IMPACT FACTOR (2021: 5. 705) (2022: 5. 705) (2023: 7.063)
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

OSCAR PUBLISHING SERVICES

Journal Website: https://theusajournals.com/index.php/ajast



Research Article

# DEVELOPMENT OF A MATHEMATICAL MODEL OF THE EFFECT OF LITHIUM ON THE WEAR RESISTANCE PROPERTIES OF ALUMINUM-LITHIUM ALLOYS

Submission Date: January 01, 2024, Accepted Date: January 05, 2024,
Published Date: January 09, 2024
Crossref doi: https://doi.org/10.37547/ajast/Volume04Issue01-07

**Tursunbaev Sarvar**
Tashkent State Technical University, Tashkent, Uzbekistan

**Turakhodjaev Nodir**
Tashkent State Technical University, Tashkent, Uzbekistan

**Saidxodjaeva Shohista**
Tashkent State Technical University, Tashkent, Uzbekistan

**Turaev Anvar**
Tashkent State Technical University, Tashkent, Uzbekistan

**Mardonova Mashhura**
Tashkent State Technical University, Tashkent, Uzbekistan

## ABSTRACT

In this research paper, the authors investigated the wear resistance of one of the mechanical properties, studying the change in its wear resistance as a result of the action of lithium fluoride on aluminum alloys. Based on the results obtained, a dependence graph was developed, on the basis of which a mathematical model of the effect of lithium on the edibility property was developed.

## KEYWORDS

Aluminum, lithium, mathematical model, lithium fluoride, mechanical properties.

## INTRODUCTION

Abrasive wear resistance is one of the most common types of wear resistance. This type of wear resistance is found in the mining industry, agriculture, drilling equipment and tools, working bodies and chassis of

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 01 Pages: 37-41
SJIF IMPACT FACTOR (2021: 5.705) (2022: 5.705) (2023: 7.063)
OCLC – 1121105677
Publisher: Oscar Publishing Services

road construction and transport equipment, crushing, mixing and processing equipment, etc. In this article, a mathematical model of the results of increasing the causticity of aluminum alloy due to lithium fluoride has been developed.

## MATERIALS AND RESEARCH

In the experiments, lithium fluoride compound was added in an amount of 5%, 10%, 15% relative to the weight of the charge. To develop a dependency graph, the sample was first filled without the addition of lithium fluoride. In the research work, a resistance furnace was used to cast the samples. The edibility of the cast samples was determined in experiments on a device with a diamond disc. The cast samples were processed on a lathe to the required dimensions. The masses of the samples were measured in the device before and after the test. Based on the results obtained, a dependency graph was developed (Fig.1).

The wear resistance was tested on the basis of mass loss. Let's build a mathematical model of the effect of these two parameters on each other using a graph of the dependence of the amount of lithium fluoride in an aluminum alloy on the lost masses. First, we will build a mathematical model for research conducted on the AK7 alloy.

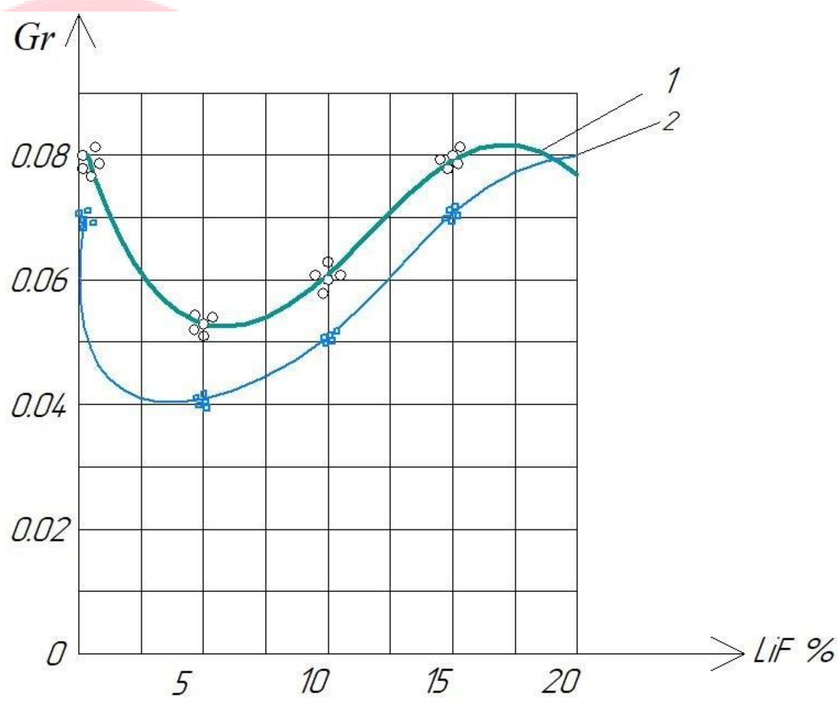


**Figure 1. The effect of lithium fluoride content on the wear resistance of 1-AK7, 2-D16.**

## RESULTS

$\eta$=LiF amount in percentage;
$y$= lost mass (gramm);
$f(\eta)=y$.

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 01 Pages: 37-41
SJIF IMPACT FACTOR (2021: 5.705) (2022: 5.705) (2023: 7.063)
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

$$\begin{cases} 625\eta_1 + 25\eta_2 + 5\eta_3 = 0.04 \\ 1000\eta_1 + 1000\eta_2 + 10\eta_3 = 0.05 \\ 3375\eta_1 + 225\eta_2 + 15\eta_3 = 0.07 \end{cases} \qquad (1)$$

Let's reduce the 1st system of equations to a matrix form and find the unknowns using Kramer's method to solve a complex system of linear equations. The determinant of the matrix, originally constructed using a system of equations, definesΔ.

$$\Delta = \begin{vmatrix} 625 & 25 & 5 \\ 1000 & 100 & 10 \\ 3375 & 225 & 15 \end{vmatrix} = -562500 \qquad (2)$$

Solving the 2nd matrix, we define the following values of the unknowns,

$$x_1 = \frac{\Delta_1}{\Delta} = \frac{-10}{-562500} = \frac{1}{56250}$$
$$x_2 = \frac{\Delta_2}{\Delta} = -\frac{575/2}{562500} = -\frac{23}{45000}$$
$$x_3 = \frac{\Delta_3}{\Delta} = \frac{-9375/2}{-562500} = \frac{1}{120}$$

Having solved the above system and determined the unknowns, the function that expresses that the wear resistance of the alloy depends on the amount of lithium fluoride included in the alloy will look like this:

$$\varphi(\eta) = (1.78 \cdot 10^{-3})\,\eta^3 - (5.1 \cdot 10^{-4})\eta^2 + (8.3 \cdot 10^{-4})\eta \qquad (3)$$

In this order, we also calculate for D16 brand alloys.

$$\begin{cases} 625\eta_1 + 25\eta_2 + 5\eta_3 = 0.05 \\ 1000\eta_1 + 1000\eta_2 + 10\eta_3 = 0.06 \\ 3375\eta_1 + 225\eta_2 + 15\eta_3 = 0.075 \end{cases} \qquad (4)$$

$$\Delta = \begin{vmatrix} 625 & 25 & 5 \\ 1000 & 100 & 10 \\ 3375 & 225 & 15 \end{vmatrix} = -562500 \qquad (5)$$

$$x_1 = \frac{\Delta_1}{\Delta} = \frac{-45/4}{-562500} = \frac{1}{50000}$$
$$x_2 = \frac{\Delta_2}{\Delta} = -\frac{1575/4}{562500} = -\frac{7}{10000}$$
$$x_3 = \frac{\Delta_3}{\Delta} = \frac{-12375/2}{-562500} = \frac{11}{1000}$$

After solving the system in the same above order and identifying the unknowns, the function representing the dependence of the amount of lithium fluoride included in the alloy with liquid fluidity for the D16 brand alloy is as follows:

$$\varphi(\eta) = (2 \cdot 10^{-5})\,\eta^3 - (7 \cdot 10^{-4})\eta^2 + (11 \cdot 10^{-3})\eta \quad (6)$$

## CONCLUSION

It should be noted that from the derived functions, the degree of LaGrange polynomials can be generated by making them large enough based on data in tables and graphs. This is seen from the quotient value in front of the highest degree of the variable in polynomials, which allows us to obtain sufficient data in finite case.

Also, these functions make it possible to determine further results without experimentation, based on the results of the initial experiment.

## REFERENCES


1. Tursunbaev, S., Turakhodjaev, N., Turakhujaeva, S., Ozodova, S., Hudoykulov, S., & Turakhujaeva, A. (2022, August). Reduction of gas porosity when alloying A000 grade aluminum with lithium fluoride. In IOP Conference Series: Earth and Environmental Science (Vol. 1076, No. 1, p. 012076). IOP Publishing.
2. Cunat, P. J. (2004). Alloying elements in stainless steel and other chromium-containing alloys. Euro Inox, 2004, 1-24.
3. Sarvar, T., Nodir, T., Shoxista, S., Ruslan, Z., & Sharofuddin, M. (2022). The effect of lithium fluoride compound on slag decomposition in the process of casting aluminum prepared details. Asian Journal Of Multidimensional Research, 11(7), 46-50.
4. Ma, Z., Zhong, T., Sun, D., Qian, B., Turakhodjaev, N., Betsofen, S., & Wu, R. (2023). Microstructure and Anisotropy of Mechanical Properties of Al-3Li-1Cu-0.4 Mg-0.1 Er-0.1 Zr Alloys Prepared by Normal Rolling and Cross-Rolling. Metals, 13(9), 1564.
5. Yang, Z., Ji, P., Wu, R., Wang, Y., Turakhodjaev, N., & Kudratkhon, B. (2023). Microstructure, mechanical properties and corrosion resistance of friction stir welded joint of Al–Mg–Mn–Zr–Er alloy. International Journal of Materials Research, 114(1), 65-76.
6. Turakhodjaev, N., Odilov, F., Tursunbaev, S., & Kuchkorova, M. (2021). Development of technology for increasing endurance when crushing the working parts of shredders (crushers) in conditions of increased friction. Техника и технологии машиностроения, 71-76.
7. Yang, W. A. N. G., ZHANG, S., WU, R. Z., TURAKHODIAEV, N., HOU, L. G., ZHANG, J. H., & BETSOFEN, S. (2021). Coarsening kinetics and strengthening mechanisms of core–shell nanoscale precipitates in Al–Li–Yb–Er–Sc–Zr alloy [J]. Journal of Materials Science & Technology, 61(2), 197-203.
8. Turakhodjaev, N., Tursunbaev, S., Hudoykulov, S., & Ozodova, S. (2022). Effect of LiF compound on gas porosity in aluminum alloy. In Техника и технологии машиностроения (pp. 13-17).
9. Турсунбаев, С. А. (2019). Особенности обработки деталей из магнитотвердых материалов. ТЕХНИКА И ТЕХНОЛОГИИ МАШИНОСТРОЕНИЯ, 23-27.
10. Saidova, M., Alimova, F., Tursunbaev, S., Kulmuradov, D., & Boltaeva, M. (2023, December). Influence of the shape of the disc slots of the seeder on the suction force of the vacuum for precise sowing of seeds. In IOP Conference Series: Earth and Environmental Science (Vol. 1284, No. 1, p. 012014). IOP Publishing.

11. Tursunbaev, S., Turakhodjayev, N., Mardanokulov, S., & Tashbulatov, S. (2023). Influence of germanium oxide on the mechanical properties of aluminum alloy. Eurasian Journal of Engineering and Technology, 16, 91-94.
12. Тураходжаев, Н. Д., Ташбулатов, Ш. Б., Турсунбаев, С. А., Турсунов, Т. Х., & Абдуллаев, Ф. К. (2020). Исследование анализа извлечения меди и алюминия из шлаков в дуговой печи постоянного тока. In Техника и технологии машиностроения: материалы IX Междунар. науч.-техн. конф.(Омск, 8–10 июня 2020 г.).–Омск: Изд-во ОмГТУ (pp. 68-70).
13. Tursunbaev, S., Turakhodjaev, N., Odilov, F., Mardanokulov, S., & Zokirov, R. (2023). Change in wear resistance of alloy when alloying aluminium alloy with germanium oxide. In E3S Web of Conferences (Vol. 401, p. 05001). EDP Sciences.
14. Tursunbaev, S., Turakhodjaev, N., Turakhujaeva, S., Ozodova, S., Hudoykulov, S., & Turakhujaeva, A. (2022, August). Reduction of gas porosity when alloying A000 grade aluminum with lithium fluoride. In IOP Conference Series: Earth and Environmental Science (Vol. 1076, No. 1, p. 012076). IOP Publishing.
15. Tursunbaev, S., Ashirbaev, A., Xalimov, M., & Tashimov, N. (2023). The effect of the amount of lithium in aluminum lithium alloys on the property of fluidity. In E3S Web of Conferences (Vol. 417, p. 04010). EDP Sciences.
16. Tursunbaev, S., Turakhodjaev, N., Odilov, F., Mardanokulov, S., & Zokirov, R. (2023). Change in wear resistance of alloy when alloying aluminium alloy with germanium oxide. In E3S Web of Conferences (Vol. 401, p. 05001). EDP Sciences.
17. Tursunbayev, S., Turakhodjayev, N., Mardanokulov, S., Zokirov, R., & Odilov, F. (2023). The effect of lithium on the mechanical properties of alloys in the Al-Li system. In E3S Web of Conferences (Vol. 390). EDP Sciences.
18. 18. Ma, Z., Zhong, T., Sun, D., Qian, B., Turakhodjaev, N., Betsofen, S., & Wu, R. (2023). Microstructure and Anisotropy of Mechanical Properties of Al-3Li-1Cu-0.4 Mg-0.1 Er-0.1 Zr Alloys Prepared by Normal Rolling and Cross-Rolling. Metals, 13(9), 1564.