

**AP19578884 “Increase of wear resistance and improvement of tire punching machine tool design” – p.m. Musayev M.M.**

**Relevance:** Global integration of domestic and foreign manufacturers has led to an increased use of foreign equipment in the domestic industry. One example is busbar punching machines. These machines, along with their technological and tooling equipment, are mainly produced and supplied by Russian and Chinese manufacturers.

It has been revealed that the tool used for punching holes in Busbars wears out quickly and frequently fails. The worn-out tool is replaced by a new one purchased from foreign manufacturers. The high tool consumption significantly increases production costs and negatively affects the cost-effectiveness of the final product.

Research findings confirmed that the tool used for busbar punching has a short service life and high failure rate. The necessity of replacing it frequently with imported tools leads to high expenditures and inefficiencies.

This pressing issue highlights the need to develop a technology that enhances the wear resistance of the busbar punching tool design. Scientific research aimed at solving this problem is highly relevant.

***Project Goal:***

The main objective of the project is to enhance the wear resistance and improve the design of the busbar punching machine tool.

***Expected and Achieved Results:***

As a result of this project, a technology to improve the wear resistance of the working part of the Busbar punching tool will be developed. A prototype of the improved busbar punching tool will be designed and manufactured.

Based on the project results, the following publications and intellectual property outcomes are expected:

- Two (2) articles and/or reviews in peer-reviewed scientific journals indexed in the Web of Science Science Citation Index Expanded database and/or in journals with a CiteScore percentile of at least 35 in the Scopus database;

- Two (2) articles or reviews in peer-reviewed foreign or domestic journals recommended by the Kazakhstan Committee for Quality Assurance in Science and Higher Education (KOKSNVO);

- One (1) patent of the Republic of Kazakhstan for a utility model;

- One (1) certificate of state registration of copyright;

- One (1) monograph.

Based on the research, recommendations will be developed for applying the technology to improve the wear resistance of the working part of the Busbar punching tool, as well as for manufacturing a new tool design.

A PhD dissertation by D.S. Kasymbabina and two master's theses in the specialty "Mechanical Engineering" will be defended under the project.

***Work Completed in 2025:***

As part of the 2025 calendar plan, work was carried out to improve the design of the busbar punching machine tool. An analysis of existing tool designs was conducted, and their main structural and technological shortcomings were identified. It was found that the most critical factor affecting operational efficiency is the rapid wear of the cutting elements.

Taking these problems into account, an improved tool design using reliable and wear-resistant materials was developed.

Based on the conducted studies and design solutions, a combined structure of the busbar punching tool was created, with the working part made of U10 steel. This design ensures both high hardness and operational accuracy.

Work was also carried out to modernize and restore the tool design. In cases of significant wear or damage to the working part, a restoration method involving hardfacing was applied. For

this, wear-resistant flux-cored wire ESAB OK Tubrodur 35GM was considered, providing high hardness and resistance to abrasive wear. The restoration process confirmed the effectiveness of this approach.

To verify the performance characteristics of the new design, the production of a prototype and subsequent testing were proposed.

Work on this section of the calendar plan is ongoing. Currently, digital models of the new tool designs are being developed, and preparations for prototype testing are underway. Specialized software such as Deform 3D and Ansys is being used to analyze thermal loads and stress distribution under real operating conditions. The resulting data will be used to optimize the tool design, enhance its strength, and extend its service life.

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### ***List of publications***

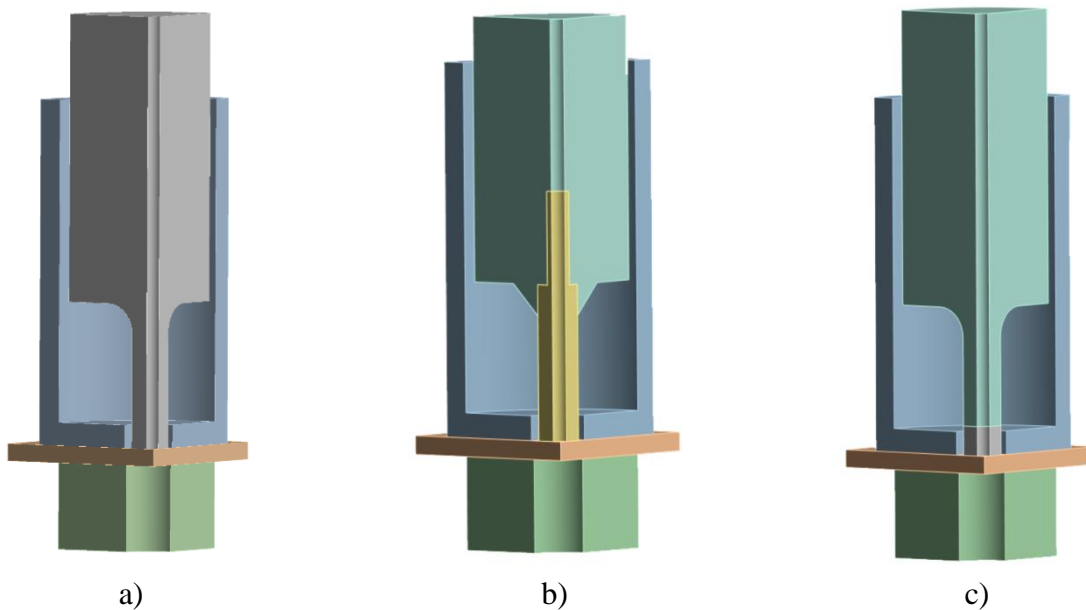
1. Mussayev, M., Sherov, K., Kassymbabina, D., Abdugaliyeva, G., Donenbayev, B., Kardassinov, S., Karsakova, N., Tussupova, S. Research of wear and increasing wear resistance of the working part of busbar punching tools by surfacing method // Journal of Applied Engineering Science, 2024, Iss. 22, Vol. 3, pp. 654-664

2. Мусаев М.М., Доненбаев Б.С., Шеров К.Т., Касымбабина Д.С., Аман И.М. Шинатескіш білдектердің құралдарының тозу сипатын зерттеу және талдау // Наука и техника Казахстана, – Павлодар: Изд-во «Toraighyrov University», 2023. — №2. – С. 48-56.

3. Мусаев М.М., Шеров К.Т., Касымбабина Д.С., Абдугалиева Г.Б., Бобеев А.Б. Металлографическое Исследование Образцов Из Материала Шинопробивного Инструмента Наплавленных Проволокой Esab Ok Tubrodur 35gm // Наука и техника Казахстана, – Павлодар: Изд-во «Toraighyrov University», 2024. - №3. – С. 52-65

4. Свидетельство №37787 о внесении сведений в госреестр прав на объекты, охраняемые авторским правом. Шинатескіш білдектердің құралдарының тозу сипатын зерттеу және талдау / Касымбабина Д.С., Мусаев М.М. Опубл. 04.07.2023 г.

5. Свидетельство о государственной регистрации прав на объект авторского права № 50538, 17.10.2024



**Figure 1** – Finite element model: a – initial model; b – assembled (composite) model; c – model restored by surfacing (welding deposition) method

***Information for Potential Users:***

The potential consumers of the developed technology are domestic industrial enterprises that operate punching machines. The developed technology for enhancing the wear resistance of the working part of the busbar punching tool, as well as the combined design of the busbar punching tool, possess a high level of commercialization potential.

***Field of Application:***

Mechanical processing sector of mechanical engineering.

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