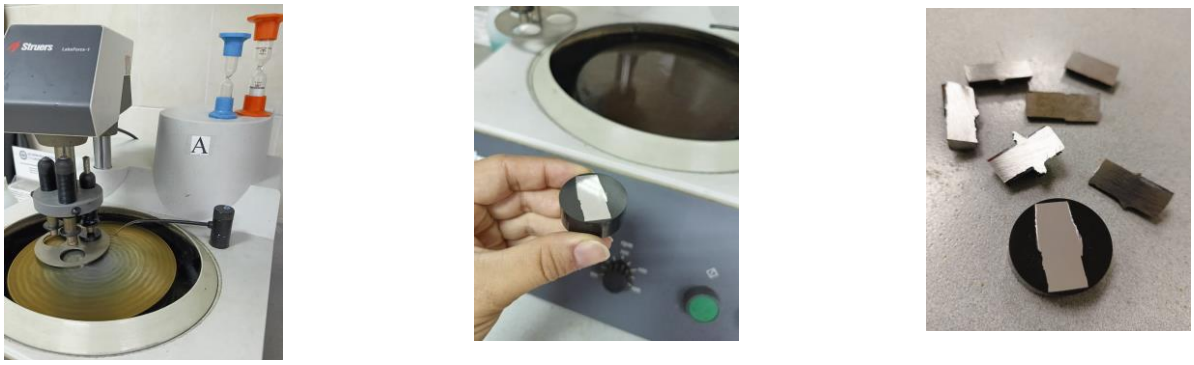
AP19174909 «Improving the quality of contact butt welding of reinforcing rods and heterogeneous cylindrical workpieces by optimizing modes» - sc.s. Yesirkepova A.B.

Relevance: development of technological capabilities of the butt welding method of joints.

The aim of the project is to improve the quality of contact butt welding when joining various metal workpieces.

Expected and achieved results:

Metallographic examination (control) of welded joints obtained by butt welding (melting) of base metal and various materials was performed. Slots were made from various samples made by butt welding in various modes.



a) b) c)

a) the process of hardware grinding; b) step-by-step grinding to a mirror state; c) finished samples

Figure 1 – The process of making a slot from various

When joining various metal blanks, the structures of the welded samples were studied using metallographic studies and defects were identified: white spots, metal burns, the presence of oxides, clogging of non-metallic compounds, microscopic cracks, bubbles and other structural defects.

The method of sample preparation for the study includes a series of steps, at each of which, depending on the type of abrasive used, a certain amount of material is mechanically removed from the sample surface. The preparation method usually includes the following steps: 1) surface leveling; 2) fine grinding; 3) diamond polishing; 4) oxide polishing.

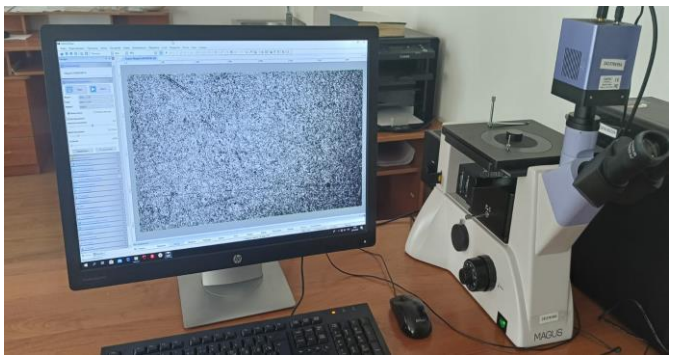
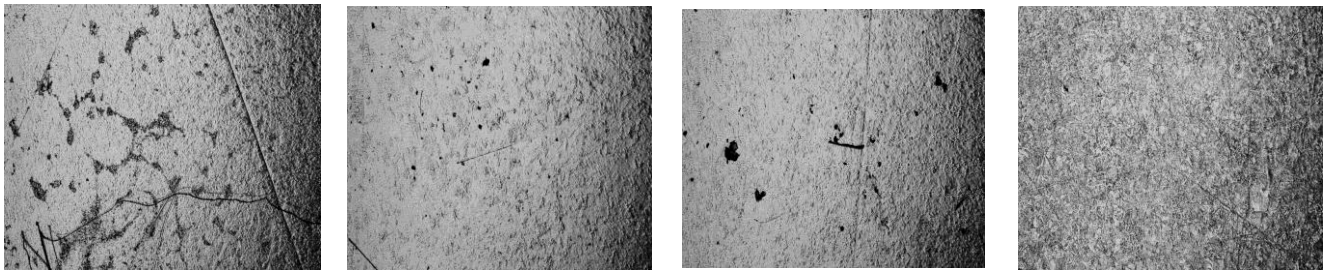


Figure 2 – MAGUS optical microscope

After making the slot, the microstructure of the sample was examined using a MAGUS optical

microscope and defects were detected in some samples: white spots, metal burns, the presence of oxides, blockages with non-metallic compounds, microscopic cracks, bubbles and other structural defects.



a) b) c) d)

a) mottled; b) pores; c) microcracks, non-metallic inclusions; d) without defects

Figure 3 – Microscopic analysis of various welded samples

Metallographic studies allow:

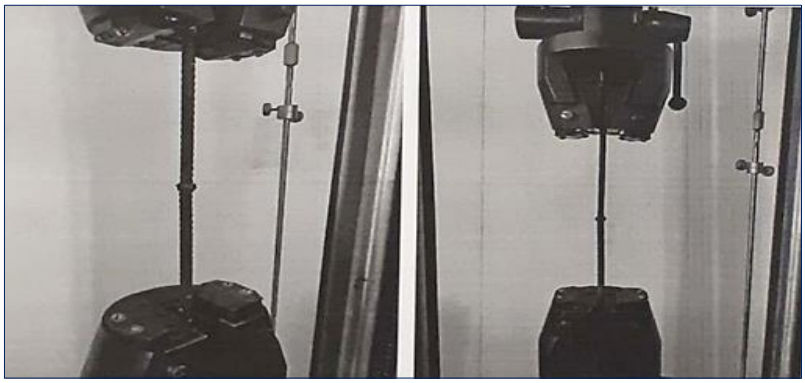
- Evaluate the quality of materials by identifying cracks, pores or inclusions that can significantly affect the strength characteristics.
- Determine the structure, evaluate their mechanical and physical properties.
- To study the behavior of the material during operation, including its changes after heat treatment, cooling and other technological processes.

As a result of the analysis of the macro-and microstructure of the grinders, it was found that 95% of the sample, the weld (the sample turned on in optimal welding modes) did not show cracks, melts and unconnected defects, holes and bubbles, as well as slag and other inclusions. Based on the results of the study, an article has been prepared and is currently being reviewed for publication in the Scopus Database journal.

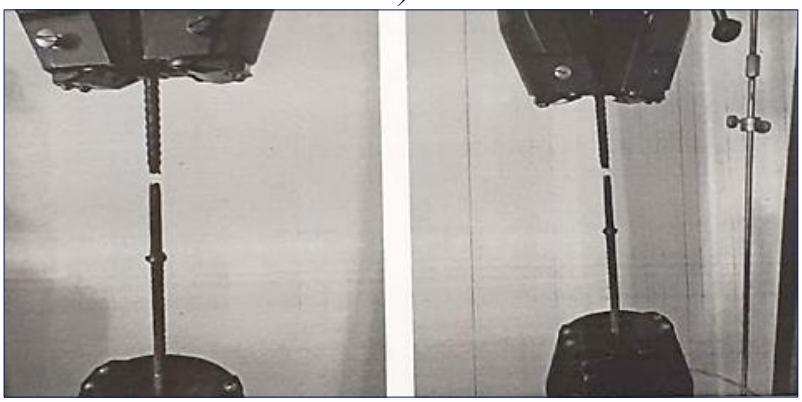
Figure 4 – Testing of connected samples on a bursting machine

After that, the connected samples were tested on a bursting machine. Modeling of the stretching process in order to determine the strength of the weld also showed a high strength (weld) joint.

The results of experimental studies have shown the high quality and wide technological capability of contact butt welding. It is established that there are no discrepancies in the results of experimental, test and computer studies.



а)



б)

Figure 5 – The process of testing welded samples

Optimal modes of contact butt welding of various metal workpieces have been established. Optimization of contact butt welding modes for various metal workpieces using the MATLAB software package. Optimal modes of contact butt welding of various metal workpieces were determined. Response surfaces were constructed to determine the optimal mode of contact butt welding: the total installation length (for both workpieces); the amount of draft allowance for two workpieces; specific power; melting current density and sludge; melting rate; precipitation rate; specific precipitation pressure. As a result, optimal modes of contact butt welding of various metal workpieces have been established to ensure high quality and strength of the joint.
A metallographic study (control) of the base metal and welded joints obtained by contact butt welding (reflow) from various materials was performed. The slots were prepared from various samples connected by contact butt welding in various modes.
As a result of the analysis of the macro and microstructure of the grinders, it was found that cracks, imperfections and non-fusion, fistulas and pores, as well as slag and other inclusions were not detected in the weld (of the sample connected under optimal welding conditions).

Expected results

A method of contact butt welding will be developed, which differs from the existing ones in versatility, productivity, high precision and quality of welding, as well as wide technological capabilities. A database will be created for selecting welding mode parameters depending on the material and diameter of the metal workpieces to be joined.

Domestic machine-building and construction enterprises are considered as potential consumers of the proposed method of contact butt welding.

The Research Group

Yessirkepova Aiym Bakytbekovna - (Scopus Author ID 57219115360, Researcher ID Web of Science HGD-3044-2022, ORCID 0000-0003-4524-5135) *https://www.scopus.com/authid/detail.uri?authorId=57219115360*

Sherov Karibek Tagayevich (Scopus Author ID 55330253200, ORCID 0000-0003-0209-180X),

https://www.scopus.com/authid/detail.uri?authorId=55330253200

List of publications:

1. Есиркепова А.Б., Шеров к. т., Ахмедов х. и. Арматураларды түйістіретін дәнекерлеуді өнертану кәсібі. "XV Сағынов оқулары. Білім, ғылым және өндіріс интеграциясы " 3-бөлім. – Қарағанды: ҚарМТУ баспасы, 2023. – Б. 164-166. https://www.kstu.kz/wp-content/uploads/2023/06/Sbornik-2023-CHast-3.pdf

2. Есиркепова А.Б., Шеров. Арматура өзекшелерін түйістіріп біріктіру тәсілдерін эксперименттік зерттеу. Труды Международной научно-практической конференции «Развитие машиностроительной отрасли и подготовка высококвалифицированных кадров новой формации» приуроченной 60-летнему юбилею д.т.н., профессора НАО «Казахский агротехнический исследовательский университет имени С. Сейфуллина» Шерова Карибека Тагаевича, - Астана: Изд-во КазАТУ, 2025. - С.198-200.

Expected publications:

- 2 articles in journals with at least 50 percentiles On impact factor in the Web of Science database or CiteScore in the Scopus database, in 2025;
- 1 article in journals and (or) other domestic peer-reviewed scientific publications recommended by the CCSC in 2025.

Information for potential users:

The project studies the welding processes of various metal workpieces by butt welding.

Scope of application: Machine-building and construction industries.

Date of information update: 01.07.2025