

SECTION 7.

AUTOMATION AND APPLIANCES MAKING

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MODELING OF THE THERMAL MODE OF HEATING THE WORKING AREA OF THE AUTOMATED BANKNOTE WRAPPER

The relevance of research related to the modeling of the thermal mode of heating the working area of an automated banknote packer is due to several key factors. First, the banknote packaging process requires high precision and reliability to ensure the safety and security of securities. Heating of the working area can affect the quality of packaging, causing deformation of materials or even damage to banknotes, which requires a detailed analysis of thermal regimes. Secondly, the automation of the banknote packaging process involves the use of complex mechanisms and electronics, which can also be sensitive to temperature changes. The development of optimal thermal regimes allows to increase the reliability and durability of these systems, reducing the risk of failure due to overheating or uneven heat distribution. Thirdly, given the high value and sensitivity of banknotes, it is important to ensure the stability and controllability of their storage and processing conditions. Modeling thermal regimes helps predict and prevent possible problems related to thermal effects, as well as optimize the operating parameters of the automated packer to increase its efficiency. In addition, the research data have a significant impact on the economic efficiency of banking institutions and other organizations that handle large amounts of cash. Optimizing thermal regimes helps reduce equipment maintenance and repair costs, as well as reduces the likelihood of losses due to damage to banknotes.

The UNA 001 banknote packer is a modern automated device designed for fast and reliable processing and packing of banknotes into stacks. This device is characterized by high performance, ensuring continuous operation for a long time with minimal maintenance needs. YHA 001 is equipped with a modern control and management system, which allows you to precisely adjust the packaging parameters according to the user's requirements.

The UNA 001 banknote packer was chosen for the research, the general view of which is presented in Figure 1.a, and the developed 3D model in CAD Unigraphics NX 7.5 is shown in Figure 1.b.



a) general view of the UNA 001 banknote packer;
 b) a 3D model of the UNA 001 banknote wrapper was developed

Fig. 1. General view of the UNA 001 banknote packer

For a more detailed modeling of the heating process of the working area during the welding of packaging tape, a detailed assembly of the UNA 001 banknote wrapper was developed, which is presented in Figure 2.

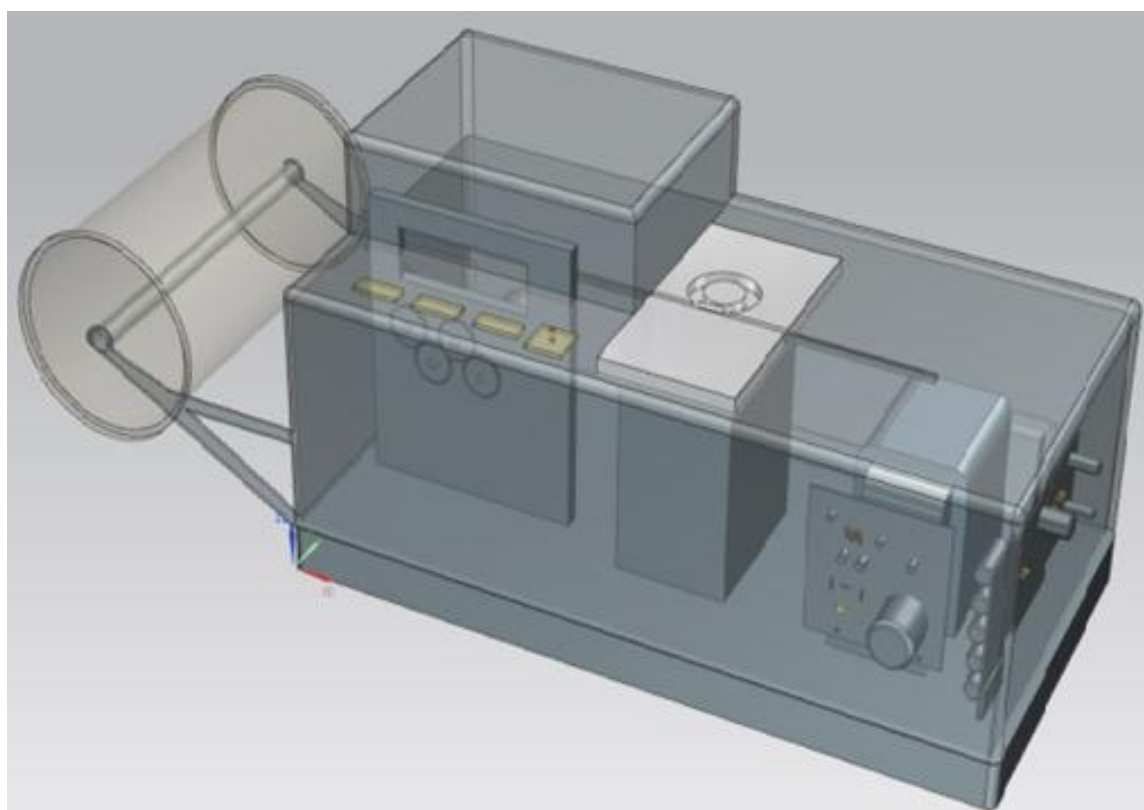
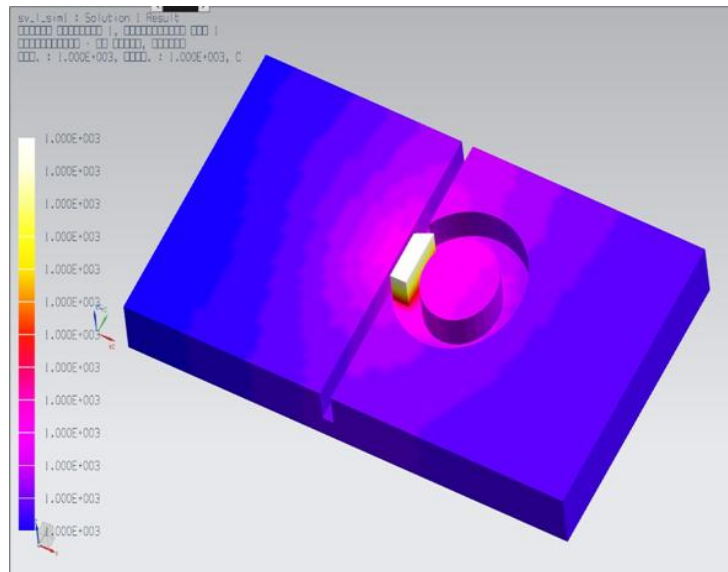
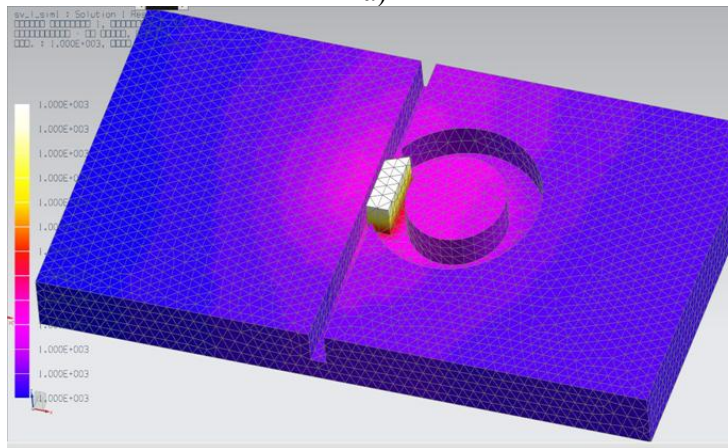


Fig. 2. Detailed assembly of the 3D model of banknote packer UNA 001

In the course of modeling the temperature distribution on the welding elements, the following results were obtained, presented in Figures 3a and 3b. As can be seen from the results obtained, heating the welding zone to 137.5 C0 ensures welding of the polyethylene tape for packing banknotes and does not affect the temperature regime of the entire banknote packer.



a)



b)

- a) the result of modeling the heating of the working area in the NX Nastran solver;
 b) the result of modeling the heating of the working area with visualization of KE;

Fig. 3. Results of modeling the heating of the working area of the UNA 001 banknote wrapper

Conclusions. The simulation results confirmed that this temperature provides a reliable and durable connection of the packaging tape without overheating other elements of the device. This allows you to maintain stable operation of all mechanisms and prevents possible overloads and damage. Thus, optimizing the thermal conditions of the welding zone not only improves the quality of banknote packaging, but also extends the life of the automated packaging machine, reducing the need for frequent maintenance. The study confirmed that maintaining a temperature of 137.5°C is key to efficient and safe operation of the packaging machine. In addition, these operating conditions help save energy and improve the overall productivity of the packer. As a result, the proposed thermal mode settings can be recommended for use in production environments, ensuring high quality packaging and reliable operation of automated systems.

References:

1. Popa, Alexandru, and Leonard Domnișoru. "On advanced global strength analysis of a pleasure yacht by user's procedures implemented in FEMAP/NX Nastran." Annals of "Dunarea de Jos" University of Galati. Fascicle XI Shipbuilding 46 (2023): 19-30.

2. Attar, H., & et al.. (2022). Control System Development and Implementation of a CNC Laser Engraver for Environmental Use with Remote Imaging. *Computational Intelligence and Neuroscience*, 2022, Article ID 9140156, <https://doi.org/10.1155/2022/9140156>.
3. Al-Sharo, Y., Abu-Jassar, A., Lyashenko, V., Yevsieiev, V., Maksymova, S. A Robo-hand prototype design gripping device within the framework of sustainable development, *Indian Journal of Engineering*, 20 2023 e37ije1673. <https://doi.org/10.54905/diss.v20i54.e37ije1673>.
4. Lyashenko, V., Abu-Jassar, A.T., Yevsieiev, V., Maksymova, S. Automated Monitoring and Visualization System in Production, *Int. Res. J. Multidiscip. Technovation*, 5(6) 2023 09-18. <https://doi.org/10.54392/irjmt2362>.
5. Nevliudov Igor, Maksymova Svitlana, Yevsieiev Vladyslav, & Klymenko Oleksandr. (2023). Using Mecanum Wheels for Radio Shuttle. *Multidisciplinary Journal of Science and Technology*, 3(3), 182–187.
6. Shuttle-Based Storage and Retrieval System 3d Model Improvement and Development / I. Nevliudov, V. Yevsieiev, S. Maksymova, O. Klymenko, M. Vzheshniewski // V International Conference on Natural Science and Technologies (ICONAT 2023), 1st-3th June 2023. – Sunny Beach-Bulgaria. – P. 15.
7. Yevsieiev V. (2023) Development of a program for modeling the control of a mobile manipulation robot in the unity environment / Yevsieiev V., Starodubcev N. // *Scientific Collection «InterConf»*, (141), P. 331-334.
8. Yevsieiev V. Some aspects of the development of the BEAM robot control scheme / V. Yevsieiev // In IV International Scientific and Theoretical Conference, Singapore, Republic of Singapore. - P. 79-81.
9. Yevsieiev, V. Comparative Analysis of the Characteristics of Mobile Robots and Collaboration Robots Within INDUSTRY 5.0. / V. Yevsieiev, D. Gurin // In the VI International Scientific and Theoretical Conference, September 8, 2023. Chicago, USA. P.92-94.