РЕЗЮМЕТА

на научноизследователските трудове
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в катедра „Топлотехника“, при Технически университет – Варна

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B.4.1. Yordanov K., Mechkarova T., Stoyanova A., Zlateva P., Determination of the Temperature of Cathode Unit of Indirect Plasma Burner Through a Computer Simulation Model, Proceedings of the Second International Scientific Conference "Intelligent information technologies for industry" 2017, Vol. 2, ISSN: 2194-5357, pp 403-409, https://doi.org/10.1007/978-3-319-68324-9_44

The article is developed computer simulation analysis of the spread heat flows in indirect torch for gas nitriding, using the software Autodesk CFD. Different methods of using a stream of ionized plasma as a source of energy are applied early 50s of last century, but only in recent years, they are widely used in chemical heat metal processing. The process is based on the ionization of different gases by an electric arc and plasma jet Focus on the product developed through a special nozzle design of the torch indirect. During recent years research in the area of application of low-temperature plasma in chemical engineering, metallurgy, machine-building and a number of other branches of industry is underway in the technically developed countries.

Analysis of the factors influencing the spatial stabilization of the arc and the erosion of the nozzle node in indirect Plasma torch for chemical and thermal treatment shows that significant influence, unless the technological parameters of the regime, has the type and geometry of the nozzle node. In order to reduce the volume and the amplitude of a large-scale shunt create a computer simulation model describing the thermal load on the main nodes of indirect plasma torch in plasma nitriding of titanium alloys.

On the grounds of the conducted analysis of the obtained results the following conclusions are drawn:

A computer simulation model of the temperature field distribution in the cathode node of an indirect plasma torch with the aid of the Autodesk Simulation CFD program product is proposed.

The maximum temperature detected by the computer simulation model is in 10-th sec and within the range between 2170°C and 2200°C. It was established that the temperature parameters remain constant after 60-th sec; they are within the range between 1150°C and 1000°C and remain unchanged for the whole 8-hour duration of the action.

It has been found that the results obtained from the computer simulation model adequately reproduce the heat field distribution processes in depth of the cathode.

B.4.2. Yordanov K., Hadzhidimov I., Zlateva P., Stoyanova A., Testing and clearing the high temperature module error from 0 to 1250°C for measurement with 16 k-type thermocouples, XX-th International Symposium on Electrical Apparatus and Technologies SIELA 2018, ISBN: 978-1-5386-3420-2, pp. 480-483, DOI: 10.1109/SIELA.2018.8447096

The subject of this paper is a temperature device for measuring 16 temperatures with thermocouples type K in the temperature range from 0 to 1250°C, called "high temperature module for 16 thermocouples". For this ARDUINO-based device, experiments were carried out on electrically resistive furnaces, with significant errors in temperature measurement inside the furnace. The work is a comparison of the mathematical transformation in the amplifier and its improvement. The design of the module, the experimental study of the module and the results of the tests are described.

- Designed and constructed is a 16-channel module for temperature measurement in the range 0 ÷ 1250°C. The module allows precise measurement of different thermal processes.
- The temperature measurement module was tested by comparative methods at different temperature intervals. Comparison of experimental and reference temperatures indicates that at different intervals the difference is highest at 0°C and when the temperature increases the error decreases. Since the area with high temperature values is most important it can be assumed that the measurement accuracy is good enough.
- A module has been developed at the Department of Thermal Engineering at the Technical University of Varna using standard proven elements: devices, transformers, software and other products in order to facilitate the operation of the module as well as a better reliability interoperability and maintainability.

B.4.3. P Zlateva and K Yordanov, Comparative analysis of the study of microclimate parameters in wooden houses in North-Eastern Bulgaria, IOP Conference Series: Materials Science and Engineering, Volume 595, Art. No 012017, ISSN: 17578981, https://doi.org/10.1088/1757-899X/595/1/012017

The subject of this study are some parameters of the microclimate in wooden houses in North-Eastern Bulgaria. This is necessary to identify the most influential parameters that affect human health and effectively improve energy efficiency in modern wooden residential buildings. Internal temperature, relative humidity and air speed and fine particulate matter were measured. External temperature and relative air humidity were also measured. The research results confirm that wood is a natural thermo-protective and moisture-regulating material. The analysis proposed can be applied to all energy efficiency projects in areas with similar climatic conditions.

The comparative analysis of the studies conducted shows that in both wooden houses the average quantity for PM2.5 is 21 μg/m³ and for PM10 is 38 μg/m³ is several times lower than the limit values according to the legislation of Bulgaria. Room air velocity is lower than the maximum acceptable for the minimum microclimate requirements of up to 0,187 m/s.

The optimal air humidity is between 40 % and 60 %, and the maximum humidity is between 30 % and 75 %. There is a tendency for stable relative air humidity to be maintained in the investigated premises, irrespective of relative humidity fluctuations in the outside air, whereupon the wooden components are an "internal regulator" of relative humidity.

The analysis of temperature dependences shows that the external temperature does not have a significant effect on the internal temperature, which proves the good insulation properties of wooden houses and their ability to maintain normal microclimate parameters. The analysis of results can be applied to all energy efficiency projects in regions with similar climatic conditions.

B.4.4. D M Dimitrov, S D Slavov and K K Yordanov, Stiffness design of machine tools structures by topology management optimization approach, IOP Conference Series: Materials Science and Engineering, Volume 595, Art. No 012071, ISSN: 17578981, https://doi:10.1088/1757-899X/564/1/012071

The machine bodies are made as welded or cast parts, with relatively thin outer walls, reinforced with ribs that provide the necessary stiffness. Often, empirical formulas, which do not consider the load distribution in different areas of the body and that have an increased security factor, are used to calculate the thickness of the outer walls and the dimensions of the ribs. This approach does not meet modern design and production requirements, as it does not lead to optimal solutions. In the present work, a simulation, based on the finite element analysis methodology, is presented, using the capabilities of the COMSOL Multiphysics software, which allows the simultaneous determination of the magnitude and distribution of stresses from different load cases from machine operation. The topology optimization management algorithm is then used to remove unnecessary material from the machine body, based on the calculated stress distribution in the previous step. The results, achieved after the implementation of the topology optimization study, are shown and discussed. Conclusions about the applicability of the presented approach are made and objectives for its future development and improvement are also defined.

- The present work demonstrates the possibilities of combining the advantages of the topology optimization method with another relatively new approach, based on the use of nature-inspired designs in building elements of metal cutting machines. In the methodology described above and the casestudy, the topology optimization algorithm was initially used to reduce the column material (without ribs) of the flat grinding machine by removing it into excess areas that did not contribute significantly to its stiffness. Then, the topologically optimized design was used as a template for reconstruction of the original column construction.
- Thus, a reduction in the mass of the column from the initial 865 kg to 719 kg was achieved, or a decrease of 17%. From the results, shown in table 1 for the calculated displacements in the three directions X, Y and Z for the initial and the optimized column constructions, it is seen that they slightly increase. The largest increase in displacement is observed in the direction of the Y axis under load case 1, which is 1.55 μm.

B.4.5. Penka Zlateva, Krastin Yordanov, Experimental study of heat pump type air-water for heating system performance, E3S Web Conference Volume 112, 2019, 8th International Conference on Thermal Equipment, Renewable Energy and Rural Development (TE-RE-RD 2019), Art. No 01007, ISSN: 2267-1242, https://doi.org/10.1051/e3sconf/201911201007

The operation of an air-to-water heat pump system providing space heating production for an administrative building in Varna has been explored. For this purpose, discontinuous operational mode of the heat pump system during wintertime is considered. Study has been performed by use of real values for external ambient temperature and operating characteristics of the heat pump system.

The seasonal efficiency of the heat pump operation has been calculated. Also, the minimal external ambient temperature until the heat pump may work in heating regime and operation duration at outdoor air temperatures higher than the design air temperature can be determined. The economic analysis of the heat pump system exploitation has been made finally.

- The experimental results for the seasonal efficiency of the heating air-water heating system in the two temperature ranges from -5°C to +15°C and from -5°C to +19°C are accordingly $COP_{-5°C+15°C} = 2{,}808$ and $COP_{-5°C+19°C} = 2{,}813$ and warranted the claim that the air-towater heat pump system operates efficiently in heating mode at the precisely measured external ambient temperature typical of the Black Sea climate zone.
- The economic analysis shows that the costs for the consumed electrical energy from the heat pump system for the winter heating season at the considered temperature intervals are extremely effective. The results of the study can be used both in the design of air-to-water heat pump systems and in the search for energy efficiency buildings.

B.4.6. Krastin Yordanov, Iliya Hadzhidimov, Precision of Infrared Cameras in Imaging Power Electronics Elements, TEM Journal, 2019, Volume 8, Issue 4, ISSN: 2217-8309, pp. 1-8, https://doi.org/10.18421/tem84-23

The electrical power within electronic components is connected with large quantity heat discharge which has to be removed in order to avoid risk of failure due to overheating. This paper presents an analysis of infrared camera implementation for correct temperature field estimation. This is necessary regarding the temperature measurement specifics with regard to power electronic elements during different regimes of exploitation. An infrared thermal camera Flir i7 has been used.

Test measurements are performed and the influence of main measurement parameters over the thermal radiation of the bodies is discussed. Regression equation for temperature correction is calculated.

- A comparative analysis of infrared thermal camera measurement and object temperatures of power electronics elements with two factors – distance to the camera lens and contact measured object temperature has been realized.
- Based on the measurements a regression equation is calculated. This equation may be implemented for correction the temperature of the noncontact measurement. The difference between the measurements is caused by the error of handheld measurement due to deviation of the object face targeting. The maximal difference between the contact temperature and corrected one is 1,5°C.
- The analysis may be performed to various cameras for industrial implementation regarding temperature correction. A step ahead in this research may be the attempt to find a connection between the temperature measurements and heat released from the surfaces of the treated electronic elements.

B.4.7. Krastin Yordanov, Iliya Hadzhidimov, Peycho Popov, Application of Raster to Vector Conversion in Power Electronics Thermal Infrared Images, TEM Journal, 2020, Volume 9, Issue 2, ISSN 2217-8309, pp. 1-8, doi: 10.18421/tem92-01

The infrared thermography today is widely used modern instrument for analysis of thermal fields in power electronics elements. On the other side, the heat fluxes causing temperature distribution of these elements and modules in working condition can be estimated in regimes of exploitation, while the cooling may be optimized in order to avoid damages of overheating. In present work, an algorithm and computer application for calculation temperature gradient on the surface of analyzed objects based on infrared thermal images is presented.

The following conclusions can be drawn from the conducted research:

- When analyzing the thermal infrared images connected with temperature fields of power electronics elements, it is possible successfully to implement conversion of raster image into a digital one. This may help to have a detailed and precise picture of important parts of the object appropriate for normal functioning of these elements, monitoring and improving cooling facilities.
- When calculating both components of the heat dissipated from the active surfaces - radiative and convective, we have to have in mind that the exact or correct values of some important thermal properties have to be known. In this number emissivity of the surfaces and especially convective heat transfer coefficient in a high degree are main factors for heat correct calculation. Also knowing these parameters, it may be very useful when building a numerical model of the treated bodies with Finite Elements Analysis.

B.4.8. Yordanov, K., Hadzhidimov, I., Zlateva, P., Electronic equipment measuring device for heat quantity through a flat wall, 25th Scientific Conference on Power Engineering and Power Machines, PEPM 2020; Code 165402, E3S Web of Conferences, Volume 207, Art. No 01006, ISSN: 2555-0403, pp. 1-8, DOI: 10.1051/e3sconf/202020701006

In the paper, an experimental study for calculation the heat quantity through a flat wall by electronic system has been presented. The aim is temperature measurement on outer and inner walls of a room for 20 days at 1-minute interval of measurement. A transient regime has been considered. The data measured has been collected on a non-insulated south wall of a Technical University of Varna campus building.

The wall layers parameters have to be known for the choice of surrounding area. In order to reduce errors of the outer side of wall temperature measurement caused by the solar radiation, the temperature sensor has been painted grey.

The experimental equipment for the heat quantity measurement consists of two plates, each with 4 temperatures fixed in a rectangle. The sensors are situated in a flat area in order to obtaining more precise results of experimental study. The problem has been solved by finding decision of the classic heat conduction equation. The experimental temperatures are treated by microprocessor's platform based on Arduino board. As a result, the average temperature of each plate with sensors has been estimated.

The following conclusions can be drawn from the research:

- Experimental temperatures are handled by the microprocessor platform based on the Arduino board. As a result, the average temperature of each sensor plate was calculated.
- The system for measuring temperature, recording data and processing the results works in real time to obtain heat through a three-layer wall with known thermal parameters over a long period of time.
- The analysis of the results leads to the conclusion that it is possible to find a correct behavior of the heat flow in relation to the ambient temperature during a specific operating mode of the air conditioning system intended for heating and cooling.

B.4.9. Zlateva, P., Yordanov, K., Petkova-Slipets, R., A study of the thermal properties of an alternative straw-containing building material, 25th Scientific Conference on Power Engineering and Power Machines, PEPM 2020; Code 165402, E3S Web of Conferences, Volume 207, Art. No 01004, ISSN: 2555-0403, pp. 1-7, https://doi.org/10.1051/e3sconf/202020701004

Thermal comfort in buildings is usually achieved through sustainable materials obtained from natural sources, which justifies their use for developing building mixtures. Many natural materials were used as early as in ancient times to build homes that are warm in winter and cool in summer: a mixture of straw, clay and sand is an example of such a material. The objective of this article is to evaluate the effect of a mixture of clay, sand and straw on thermal comfort. The experiments were carried out and the thermal conductivity coefficient was determined using the method of infinite flat layer. The results indicate that the combination of different amounts of straw can be considered as good reinforcement of the sand and clay matrix and is characterized by a low thermal conductivity. Furthermore, 3D modelling was performed using Finite Element Analysis (FEA) software and a predictive model of the thermal behaviour of the samples from the different mixtures was developed. The thermal field distribution and the thermal conductivity coefficient thus determined were compared with the experimental data and showed consistency.

The following conclusions can be based on the above experiments and the simulation modelling results obtained for building mixtures of clay, sand and straw added:

In terms of insulating properties, the mixture of clay and sand is superior to some conventional building materials. The result obtained for the value of the thermal conductivity of the clay and sand sample is k_1 = 0,562 W / (m.K).

- Depending on the amount of straw added to the clay-sand mixture, the results obtained for the value of the thermal conductivity of the samples with the lowest straw content is k_2 = 0,436 W / (m.K) and with the highest e k4 = 0,228 W / (m.K). It was found that with increasing the amount of straw, the thermal conductivity coefficient decreases, i.e. the material acquires better insulating properties.
- The simulation modelling of stationary thermal conductivity in the studied plates with a matrix of clay and sand and straw additives through the mathematical model adequately reproduces the thermal processes taking place in them and shows good repeatability of the results obtained.

B.4.10. Petkova-Slipets, R., Yordanov, K., Zlateva, P., A comparative thermal analysis of walls composed of traditional and alternative building materials, Civil and Environmental Engineering, Volume 16, Issue 2, 2020, ISSN: 1336-5835, pp. 388-395, DOI: 10.2478/cee-2020-0039

This research aims at comparing the thermal performance of walls made from traditional and alternative building materials. The experimental study involves five types of walls were studied based on perforated ceramic bricks and a mixture of clay, sand with various straw proportions. Specialized software and the finite element method (FEA) were employed for modelling of the thermal processes and their visualization for the different types of walls. A simulation modelling algorithm was developed. The models developed show very good convergence of the results and provide for subsequent design and thermal calculation of constructions made by environmentally friendly materials.

The research carried out and the results obtained were used for a comparative thermal analysis of walls made from traditional and alternative building materials and the following conclusions can be drawn:

1. The algorithm developed for calculating heat flows of walls of different materials is adequate and allows its application in specialized software in order to predict the thermal processes, with varying the input parameters.

2. The simulation modelling of the steady-state thermal conductivity in the studied types of perforated ceramic brick walls and walls from a clay and sand matrix with and without straw additives through the mathematical model adequately represents the thermal processes occurring in them and shows good repeatability of the results obtained.

In terms of their thermophysical properties, the alternative building material (mixture of clay and sand) has properties similar to those of the traditional building material (perforated ceramic bricks).

3. The addition of even small amounts of straw to a mixture of clay and sand significantly increases the thermal resistance, and respectively reduces the heat transfer coefficient of Type 3, Type 4 and Type 5 walls. Depending on the amount of straw added to the matrix of clay and sand, the values of the heat transfer coefficient obtained are U_3 = 1.05 W/(m².K) for the walls with the lowest straw content and U_5 = 0.67 W/(m².K) for those with the highest straw proportion.

Г.7.1. Stoyanova, A., Mechkarova, T., Konsulovabakalova, M., Yordanov, K., Argirov, Y., Investigation of strained and deformed state of low carbon plates after welding, UPB Scientific Bulletin, Series D: Mechanical Engineering, 2020, 82(3), ISSN 1454-2358, pp. 263–274, https://www.scientificbulletin.upb.ro/rev_docs_arhiva/fullbd3_727198.pdf

In the work, manual arc welding of steel with an electrode is shown. The study of heat exchange processes and the occurrence of deformations and tensile in welding steel plates is presented. For this purpose, a simulation analysis of the site has been developed. The results for the distribution of deformations and deformations at each point of the volume of the model under investigation were obtained by thermal and static analysis. The determination of stresses and deformations after welding in the conditions of nonstationary heat exchange and elastic-plastic displacement of the metal, leading to the need to use approximate methods by applying modern programming means.

The following conclusions can be drawn from the research made:

- It is evident from the metallographic analysis that both in the metal which has been welded with ABRADUR54 and in the different joint zones, there are no macrodefects present (cracks, non-penetrations, prunings, etc.) In only a few cases can random macropores be observed, but they occur sporadically. It is evident from the microstructural analysis that dendrites directed towards the alloying limit are observed in the hard-coated welded zones.
- The demonstrated method for 3D modelling of heat transfer processes and stress state assessment in MMA hard-coating welding has a universal character. The use of a product such as SolidWorks allows testing of different welding technologies, by changing the initial parameters of the modes or by using different materials.

Г.7.2. Stoyanova, A., Mechkarova, T., Konsulovabakalova, M., Yordanov, K., Argirov, Y., Computer simulation thermal analysis of low carbon plates welded with electrode abradur64, UPB Scientific Bulletin, Series D: Mechanical Engineering, 2020, 82(4), ISSN 1454-2358, pp. 179–190, https://www.scientificbulletin.upb.ro/rev_docs_arhiva/fulla6f_279381.pdf

The aim of this work is to develop a computer simulation model to study heat transfer processes in plates which are manual arc welding. In this study the heat transfer process is simulated with SolidWorks Thermal Analysis. Material on the plate is DD11 steel subjected to manual arc welding (MMA) with ABRADUR 64 welding electrodes. As a result, the temperature distribution in the different heat treatment zones is determined.

To obtain the desired results a welding machine of the company ESAB, selected modes and operation and electrode welding are tested.

It is evident from the metallographic analysis that some pores of an arbitrary nature exist in the specimen. There are no defects of any other kind. There are no cracks, non-metallic inclusions, trimmings or others at the alloying limit, either in the heat affected zone (HAZ) or in the hard-clad welded metal. In the zone of the hard-welded welded metal there is a strong dendritic structure. The alloyed electrode metal strengthens the hard-coated welded surface.

Summarizing the results of the set parameters with the help of the developed computer simulation model of the heat exchange processes in flat welded MMA samples, we can detect with sufficient accuracy the temperature distribution in real objects and draw the following conclusions:

- On the basis of the computer model set up, it was found that in hard coated MMA welding of the samples, the area of thermal impact does not reach the critical temperature, which is a prerequisite to believe that there will be no structural changes leading to destruction in it.
- Temperature field studies allow to predict defects in hard-coated welding in a zone and in the heat affected zone, as well as the occurrence of residual stresses.

Г.7.3. Zlateva, P., Yordanov, K., Tudorache, A., Cirtina, L.M., An analysis of energy resources in Bulgaria and Romania, Proc. of 21st International Symposium on Electrical Apparatus and Technologies, SIELA 2020, ISBN: 978-1-5386-3420-2, pp. 1-4, DOI: 10.1109/SIELA49118.2020.9167132

This article presents an analysis of energy resources in Bulgaria and Romania. The aim of this study is to present the need for an energy mix in the energy system of Romania and Bulgaria. It is moving from traditional energy pillars, such as coal-fired power plants, which are the main electricity producer, to an energy sector where hydropower and other renewables offer most of the electricity. Romania and Bulgaria cannot cope with a single source of energy in order to achieve their own energy and environmental goals and ensure sufficient security of supply. Hence it follows that an energy mix is necessary. This study can help in the development of projects related to the energy strategy of both parties.

Based on the above analyses of the state of energy sources in Romania and Bulgaria for the period 2017-2019, the following conclusions can be drawn:

1. Renewable energies are inexhaustible compared to fossil fuels such as coal and oil. Unlike fossil fuels, renewables allow alternative solutions to be made to energy and environmental problems.
2. Fossil fuels are still an important part of energy for Bulgaria and Romania, even if the energy agreement focuses on achieving the CO_2 reduction target of 80 to 95% by 2050, which uses renewable energy sources in the 16% share of energy production by 2023.

The use of energy mix in Romania and Bulgaria will lead to the provision of clean and renewable energy to ensure sustainable economic development and will ensure a better quality of life.

Г.8.1. Zlateva P., K. Yordanov, 3D modelling of buildings in their inspection under the energy efficiency act, "Manufacturing engineering and technology", 2011y., ISSN: 1312-0859, pp. 69-73

This paper presents computer three-dimensional (3D) modeling of a building with complex geometry. For this purpose, the Autodesk Inventor software product was used. An example is given of 3D modeling of a real building with complex geometry, on the basis of which an audit under the Energy Efficiency Act (EEA) will be made.

An essential place in the inspection of buildings under the Energy Efficiency Act (EEA) is occupied by the definition of the areas of walls, roofs, underground floors, etc. The task is complicated especially with objects with complex geometry, overlapping parts of walls and calculating faces of figures with complex configuration.

In general, especially in the absence or incomplete documentation, which is common, there is a need for a comprehensive picture of the object. Location of the underground floors at different levels, etc. In the absence of documentation, the inspection does not give full information about the location of the elements of the building, for example if there are underground floors at different levels. All this requires the use of modern tools for modeling and visualization of the objects to be investigated.

The Autodesk Inventor software product used is a powerful tool in solving problems for determining geometric characteristics of elements of objects for the needs of calculations related to energy efficiency auditing of buildings. This leads to improvement of the computational part and increased quality of the results of the survey. With this product, the invisible parts of the object of the investigation become "visible" from the documentation and the actual viewing.

Г.8.2. Zlateva P. N., Yordanov K. K., Argirov Y. B., Modelling of cooling process of thin metal plates from 08kp steel, Annual Journal of Technical University of Varna, 2013y., ISSN: 1311-896X, pp. 66-69

Results of a theoretical-experimental study of nonstationary thermal conductivity in cooling after electrical resistance heating of thin plates of steel 08cp are presented. The possibility has been established, with the help of a software product, to represent the course of the process, varying with the output parameters.

The task is related to theoretical studies of the cooling process after electrical resistance heating and more specifically to the influence of the cooling process in air environment of 08kp steel specimens 0.5 mm thick.

Software products have been used to solve this problem: Autodesk Inventor and Autodesk Simulation CFD, with the help of which the temperature distribution in the wafer in a cooling process is presented.

Based on the analysis of the study, the following conclusions can be drawn:

- The juxtaposition of the results, from the theoretical and experimental study of the variation of temperatures in the cooling of the thin metal plate after the electrical resistance heating, shows that the simulation studies, through the mathematical model, adequately recreate the processes of temperature field distribution in the real object.
- The developed simulation model for 3D modeling of the cooling process in dense specimens allows the use of software products that can predict the course of processes, varying with the output parameters.
- An attempt at the theoretical description of the variation of the temperature field in the smoothed metal after rate heating will also provide an opportunity to explain the changes taking place in the structure of the welded parts, the qualities and possible deformations in the resulting joints.

Г.8.3. Mechkarova, T., Sculev H., Yordanov K., Simulation modeling of the temperature fields on indirect torch for nitriding, NTD days 2014, ISSN: 1310-3946, pp. 402-406

A computer simulation analysis of the scattered heat fluxes in an indirect gas nitriding burner using Solid Works and Autodesk Simulation CFD software is developed in this paper. Various methods of using a stream of ionized plasma as a source of energy have been applied as early as the 1950s, but only in recent years have they found wide application in the field of chemical treatment of metals. The process is based on the ionization of various gases by an electric arc and focusing the plasma jet on the product through a developed special nozzle design of an indirect plasmatron.

Plasma nitriding is one of the widely used techniques to increase the surface hardness of the material. The process is characterized by diffusion of nitrogen atoms into the metal surface in the presence of a plasma environment.

Viewed theoretically, the heat fluxes on the surface of the cathode are directly related to the physical processes that take place in the electrode region and the arc pillar. In a composite cathode assembly with two or more tungsten electrodes, their frontal surface is heated by the electric arc mainly as a result of its thermal impact.

Summarizing the results, it can be seen that the discrepancy between the experimentally obtained data on the temperature distribution in the cathode and the computer simulated data under equally set operating conditions is in the order of a few percent, which gives us the right to claim that the model is adequate and can serve for future developments.

The results obtained from the computer model show that the chosen design of an indirect plasmatron PTN50, with three electrodes, recreates most accurately the results of the experiment.

As the most appropriate we take the analysis of the model with an impact duration of 80s, then the stability of operation of the indirect plasmatron and a longer life of the electrodes occurs.

Г.8.4. Mechkarova, T., Sculev H., Yordanov K., Effect of fluid flow on the resource tests cathode and anode node in torch ptn50, NTD days 2014, ISSN: 1310-3946, pp. 407-411

Plasma nitriding is one of the most widely used techniques to increase the surface hardness of the material. The process is characterized by diffusion of nitrogen atoms into the metal surface in the presence of a plasma environment.

Plasma nitriding operates on the principle of obtaining a smoldering discharge. It occurs in the presence of two electrodes of different potential, placed in a gas medium with reduced pressure and applied to them high voltage. At a certain value of the voltage around the electrode with a lower potential, a smoldering discharge occurs. Plasma nitriding takes place in an environment of abnormal smoldering discharge, where the specimen is completely covered with an arc, simultaneously increasing current and voltage. The specimen can be heated by energy transfer by ion bombardment. Thus, nitrogen reaches its surface, which diffusively penetrates into the interior.

From the experiments and study made for plasma nitriding the following conclusions can be deduced:

- The variation of the operating current in the range 300 to 500 A does not significantly affect the stability of the PTN50 plasmatron operation process. The shape and dimensions of the cathode assembly and nozzle significantly affect the stability of the plasma arc and the parameters of the nitriding process.
- The analysis of the efficient operation and resource trials of the constructed PTN50 plasmoron show that the stability of the plasma gas nitriding process with indirect plasmatron is determined by the anode and cathode junction resource.
- Results were obtained on the weight consumption of electrode material from the cathode and anode assembly. The maximum temperature recorded in the wall zone of the nozzle is 820°C and the leakage rate of the coolant is 20 m/s, while maintaining its temperature of 27 °C, which does not imply the creation of a steam bubble in the cooled assemblies.

Г.8.5. Antonov G., Argirov Y., Stoyanova, A., Yordanov K., Stress analysis when welding copper strip, NTD days 2014, ISSN: 1310-3946, pp. 412-415

For products by welding copper sheet materials, cracks often occur in the welding and around the welding zone and deformations due to the occurrence of residual stresses. The problem given for solution in this paper is the definition of the post-TIG weld stresses and deformations in terms of the transient heat transfer and elastic-plastic behaviour of copper. The analysis was carried out by modelling stress and deformed state after welding sheet metal samples of copper using SolidWorks. The results are strain and strain correction during the welding (heating) and cooling of the samples.

The object of investigation are samples of thin copper plates, with dimensions: 100x15x1,2mm. In the SolidWorks program, a three-dimensional model of the copper samples welded by TIG welding was created. The determination of the stresses and deformations generated by the temperature impact, by means of a computer simulation model in the SolidWorks environment, requires a preliminary thermal analysis of the considered object from the beginning of heating to its complete cooling.

The results of the simulation analysis shown fully agree with the theoretical formulations concerning the occurrence and distribution of thermal stresses in TIG welding of thin copper plates. Through the distributions given in the figures, the maximum values of stresses and deformations at all points of the object volume are established.

After simulating the TIG welding process, the magnitude of the residual stresses can be evaluated and their influence on the working stresses of the structure can be predicted. The demonstrated method by 3D modelling of heat transfer processes and stress state evaluation after TIG welding of copper specimens has a universal character. The use of a product such as SolidWorks makes it possible to experiment different welding methods, varying with the output parameters of the modes or using different materials.

Г.8.6. Stoyanova, A.M., Zlateva P.N., Yordanov K.K., Argirov Y.B., Study of temperature field soldering of thin copper plates, NTD days 2014, ISSN: 1310-3946, pp. 416-419

This paper presents results of experimental investigations of the temperature field in soldering thin copper plates. Computer modeling was done in the middle of the SolidWorks software. The results of the quasitemperature field distribution in the soldering heat region will help to optimise the thermal process. They definitely affect the speed and timing of thermal treatment.

The subject of our research is the brazing of thin copper plates with dimensions 100x15x1,2mm, by oxy-oxygen soldering. When soldering copper and its alloys, it should be borne in mind that due to the high thermal conductivity of copper, a stronger flame is required than that of steel, therefore it is necessary to use welding sources with increased lineal energy, as well as the application of preheating and concomitant preheating.

On the basis of the experiments carried out above and the results obtained from the simulation model when studying the thermal processes in soldering thin copper plates, the following conclusions can be drawn:

- Summarizing the results of the values of the temperatures obtained in the modeling and in the measurements conducted in the real experiment, a difference of 3-5% was found. This is grounds to claim that there is a verification between the results of the simulation analysis of the model and data from the experimental study.
- By simulating non-stationary heat exchange in the middle of a software product, SolidWorks is adequately recreated the temperature distribution in the different thermally treated zones.

The conclusions presented above are grounds to conclude that the results obtained from theoretical-experimental studies allow to select the appropriate technological mode parameters, varying with the output parameters.

Г.8.7. Zlateva P.N., Yordanov K.K., Stoyanova, A.M., Antonov G.A., Theoretical and experimental research on thermal process of tig (141) welding of copper plates, NTD days 2014, ISSN: 1310-3946, pp. 420-423

This paper presents results of experimental studies and simulation analysis of heat exchange processes in TIG welding of thin copper plates. Thermal processes are tested with thermocouples and a Raytek MX6 thermal camera.

For this purpose, suitable parameters of the technological mode for TIG welding have been selected and a simulation model of thin copper plates in the environment of the SolidWorks software has been developed.

On the basis of the experiments carried out above and the results obtained from the simulation model in the study of thermal processes in TIG welding of thin copper plates, the following conclusions can be drawn:

- Studies of the emerging temperature field in the material in TIG welding were carried out through a set of modern standard and created especially for the purpose of this study physical models for numerical simulations. For this purpose, several models have been created, as a result of successive refinement in order to take more fully into account the specific physical parameters and experimentally observed dependencies in the studied thin copper plates.
- Summarizing the results, it is observed that the deviations between the experimentally obtained data on the temperature distribution in the weld and the computer simulated data under equally set operating conditions is in the order of a few percent, which is a reason to say that the model is adequate and meets the real conditions.

The conclusions presented above are grounds for confirming the possibilities for good applications of the results obtained. This will help to select the appropriate technological mode parameters for TIG welding of thin copper plates, based on theoretical-experimental studies that will have a significant impact on structural changes and mechanical properties in the considered zones of thermal influence.

Г.8.8. Dimitrov D.M., Yordanov K.K., Zlateva P.N., Design of the specimens for ultrasonic fatigue testing, NTD days 2014, ISSN: 1310-3946, pp.440-443

Ultrasonic resonant fatigue machines operating at 20kHz are widely used these days as the testing time can be significantly reduced. Due to the mode of resonance operation, the axial eigenfrequency of the ultrasonic fatigue specimens should be the same as the operating frequency of the machine. For proper design of the specimens the dynamic Jung modulus of the material must be measured. Due to the internal quench intense heating occurs in the throat of the samples so that an adequate cooling system has to be constructed. For investigated material - sintered stainless steel 304 ($\rho = 6.9$ g/cm^3) E = 136.53GPa and loss coefficient $\eta = 0.00041$ are obtained experimentally using pulseresonance method. The sample length and the stress distribution are obtained by the MCE in Comsol Multiphysics 4.3b. Using a certain loss coefficient and combining structural mechanical and heat transfer equations, temperature evolution during the test is obtained. For cooling, cooled air with a temperature below -10°C and a high flow rate and pressure is suitable.

A methodology for the design of specimens for ultrasonic fatigue testing at 20kHz has been made in the development. Labview software has been developed to determine the elastic constants and damping characteristics of materials by a umpulse resonance method. E=135,53GPa, η=0,0004 of the examined blanks of sintered St 304 were determined experimentally. The resulting Jung modulus was used in the FEM calculation of the dimensions of an ultrasonic fatigue specimen with a hemispherical concentrator. The resulting absorption coefficient was used to determine the temperature field in the specimen during the test. To maintain a constant temperature < 40 ° C, it is necessary that the cooling system has the ability to supply cooling air with a temperature lower than -10 ° C and a high flow rate for the realization of intensive convective heat exchange.

Г.8.9. Stoyanova, A. M., Zlateva P. N., Yordanov K. K., Experimental determination of the influence of temperature and thermal cycle speed cooling with air plasma cutting surface on the structure of the material, "Manufacturing engineering and technology", 2014y., ISSN: 1312-0859, pp. 17-21

This paper presents an experimental determination of the influence of temperature, thermal cycling and cooling rate in plasma surface treatment of Steel 3 specimens welded by manual electric arc welding with an EL400 electrode.

Thermal analysis was used as one of the methods for the study of metals and alloys and phase conversions accompanied by variation of the heat content.

Based on the analysis of the results obtained and the diagrams built, the following conclusions can be drawn:

- A methodology has been developed to determine the influence of temperature, thermal cycling and cooling rate in plasma machining (rubbing).
- The macrostructural analysis shows the high quality of the surfaces after the surface plasma rubbing which is the main goal in this type of processing.
- From the criterion for assessing the resulting layers it can be concluded that VPPR has the following advantages over other types of surface treatments such as increased microhardness of the treated surface under the same other conditions, greater depth of the strengthened zone and less zone of thermal influence.
- Comparing the experimental and theoretical data in the study of the temperature distribution, thermal cycles and the rate of temperature change in plasma surface rubling shows a difference within 2-5% in the range of 643-400 °C. It has been found that the microstructure is decisive for the thermal field occurring in the materials of HPPP and therefore its parameters must necessarily be taken into account when choosing the parameters of the plasma treatment of each particular material.

Г.8.10. Stoyanova, A. M., Zlateva P. N., Yordanov K. K., Experimental study of thermal processes in plasma surface treatment, "Manufacturing engineering and technology", 2014y., ISSN: 1312-0859, pp. 22-26

This paper presents a methodology for determining the temperature in function of time in specimens' hand-arc-welded with electrodes for welding (EN250, EN350, EN400 and EN550) and finally treated with an air plasma surface cutting and rubbing installation.

In this methodology, the temperature of air-plasma surface routing and experimental determination of the thermal cycle of a set point from the treated product is determined.

The conditions of the introduction of heat into the surface cut metal are not the same in different methods of surface treatment, as a result of which the efficiency of the use of heat sources is different.

Based on the analysis of the results obtained and the diagrams built, the following conclusions can be drawn:

- A methodology for the determination of temperature in function of time in boiled specimens processed by plasma machining (rubbing) has been developed.
- The choice of electrodes is determined by the desired final chemical composition and mechanical properties of the surface of the reconstituted article. The recovery of the specimens with all four electrodes used (EN250; EN350; EN400 and EN550) gives good results, from the point of view of the influence of temperature in time.
- Comparing the experimental and calculated temperatures shows that the mismatch in the thermal cycle plot is 3-5% for the different sections of the interval. Since we are usually interested in the area with the highest temperatures reached, we can assume that the accuracy of the calculation is good enough, especially since when calculating the average rates of change of temperature in the studied intervals, the discrepancy is within 2-4%.

Г.8.11. Yordanov Kr., Stoyanova A., Argirov J., Determining the properties and structure of welded copper plates and establishing their connection with the temperature field distribution in the studied zones., Structural Integrity of Welded Structures XI, ISCS 2015 Trans Tech Publications, Switzerland, Vol. 1111, ISSN: 1662-8985, pp. 217-222

The aim of our research is to determine the material properties and structure after welding thin copper plates in an inert gas (argon) protective environment with a non-meltable tungsten electrode by determining the temperature fields during welding. This welding method is well known as tungsten inert gas (TIG) welding.

The following conclusions can be drawn from the research made:

- Based on the comparison between theoretical and experimental investigations during TIG welding of thin copper plates, it can be concluded that the simulation studies using the mathematical model adequately recreate the thermal field distribution processes at the depth of the real object.
- Summarizing the results of theoretical and experimental investigations shows that under equally set operating conditions the difference between experimentally obtained temperature distribution data in weld zones and computer simulated data is of the order of a few percent. The model is therefore adequate and can be used in future developments.
- The selected methods of temperature measurement by contactless measuring methods show very good results for the temperature distribution over time. Based on these methods, the time temperature curves are drawn.
- The maximum temperature found in the thermal impact zone is 420°C. This value is well below the critical temperature at which phase changes take place in the metal.
- The thermal action zone is relatively narrow, which is due to the high thermal conductivity of copper alloys. At higher current intensity modes (I = 85A) defects are observed in the weld joint.

Г.8.12. Atanasov G., Yordanov K., Chamber thermosyphon: prototype and bench tests for operability, Thermal engineering-12, Year 8, No.1, 2017, TU-Varna, ISSN: 1314-2550, pp. 66-71

The subject of this work is a device for the utilization of low-potential heat energy from wastewater of domestic hot water supply systems in buildings, called "kemer thermosyphon". A utility model registration certificate has been issued for this device by the Patent Office of the Republic of Bulgaria. In the work, an overview of other utilizers for the same purpose has been made. The construction of the chamber thermosyphon, on a bench for experimental study of the same, of results and problems of a start-up test is described.

The idea of heat recovery from DHW building systems is not new. DHW energy accounts for about 30% of the total energy consumption in a dwelling. In countries such as Canada and Switzerland, utilizer designs applicable in existing buildings have been developed, called "vertical gravity heat exchangers.

A start-up and workability experiment was carried out. At a temperature of the heating water around 65°C, the thermosiphon worked in evaporation mode. The utilized power about 30.0W, which is unsatisfactory. We believe that the reasons for not boiling acetone are twofold:

- Despite the good thermal insulation of the thermosyphon housing – the heat exchange between the "waste" heating water tube (made of copper sheet 1mm) and the elements of the heating zone of the thermosiphon is not good. The construction is made according to our technological capabilities.
- Acetone is located in a limited space. The relationship between temperature and saturation pressure is different from that of boiling in an unlimited space. Acetone will be a suitable heat carrier for wastewater with a higher temperature level and for improved design of the heating zone of the thermosiphon.

Г.8.13. Zlateva P., Yordanov K., Petkova-Slipets R., Lyutskanov A., 3D modeling of thin thermal insulating coatings, Proceedings of university of Ruse "A. Kanchev" volume 56, book 1.2, Thermotechnics. Hydro-and Pneumotechnics. Ecology and environmental protection., ISSN: 1311-3321, pp. 42-47

The study presents a 3D thermal model of thin insulation coatings, which has been developed using finite element modeling (FEM). The 3D model is able to achieve temperature distribution with different combinations of technological parameters. The calculated temperature field and the equivalent thermal conductivity are compared with experimental measurements. The simulation based on the MCE presents an excellent correlation with the experimental results. This study validates the proposed model for thin insulation coatings based on the syntactic foams with ceramic microspheres.

Syntax foam is a new generation of gas-filled polymer composite material with a very good complex of physico-mechanical and technological properties - low density, low coefficient of thermal conductivity, good workability and relatively good strength. There is a wealth of information, both scientific and commercial, about this group of materials, but it is highly divergent, e.g. the thermal conductivity coefficient ranges from 0.001 W/(m.K) to 0.2 W/(m.K).

Based on the mathematical modeling carried out above and the results obtained for the thermal insulation coating "Akterm" on glass and plasterboard, the following conclusions can be drawn:

- The developed algorithm for 3D modeling of thermal processes in various thermal insulation materials and coatings allows the use of software products with the help of which the process can be predicted, varying with the output parameters.
- The simulation modeling of stationary thermal conductivity in the studied plates with glass and plasterboard substrates with applied thin film thermal insulation coating through the mathematical model adequately recreates the ongoing heat processes in them and shows good repeatability of the results obtained.

Г.8.14. Stoyanova A., Mechkarova T., Yordanov K., Study of the influence of the technological parameters of the air-plasma surface gouging on some quality characteristics in the surface layer, Annual Journal of Technical University of Varna, Vol. 1 Issue 1 (2017), ISSN: 2603-316X (Online), pp 105-111, DOI: 10.29114/ajtuv.vol1.iss1.29

The aim of this paper is to investigate the relationship between the technological parameters of the air-plasma surface treatment process and the quality characteristics of the resulting surface layers.

The relationships between the technological parameters of the air-plasma surface treatment process of metals and the quality parameters were obtained by using a rotating design of experiments and regression analysis techniques.

Four regression equations were obtained based on experiments carried out and statistical evaluation to reveal the relationships between the process parameters of the air plasma surface bulging process of C45 steel and some surface layer quality parameters.

The experimental investigation carried out on samples machined by surface carving of an air plasma revealed that the mode factors affecting the quality parameters can be classified according to their significance in the following way:

- Analysis of the results obtained in the factor change range reveals that the factor having the greatest effect on microhardness, HV0.05, is the speed of burner movement. This is due to a change in the amount of heat energy directed to the sample surface during processing.
- The next factors significant for the hardness HV0.05 after surface cutting are the distance "nozzle-metal" h and the magnitude of the current during plasma surface cutting, which have a strong effect on hardness. speed of movement of the plasma torch, the area surrounded by the isolines, indicating that the maximum microhardness is displaced so that the distance between the plasmatron and the sample becomes smaller. of current and nozzle distance is limited.

Г.8.15. Munis T., Zlateva P., Yordanov K., Specifics in the thermal transfer of a long sloped smooth-walled low-temperature copper thermosyphon, Ø16x1, l=1,600m, Thermal engineering-13, Year 9, No.1, 2018, TU-Varna, ISSN: 1314-2550, pp. 83-87

The work contains results of an experimental study under laboratory conditions of the dependences of the internal thermal resistance and the average wall temperature in the cooling zone (i.e. of condensation) of an inclined thermosyphon on the power of the transmitted heat flux and on its angle of inclination relative to the horizontal. The thermosyphon is made of copper tube Ø16x1 and has a length of L=1,600m. Acetone was used for heat carrier (filling rate 30%). The power of the transmitted heat flux is set with el. heater in granitzite - 10W÷50W. The cooling is in free air with a temperature of 21 ° C. The angle of inclination (i.e. tgα) is changed from 0.01÷0.50. It was found that the internal thermal resistance of the thermosyphon decreases with increasing power of the transmitted heat flux. In the range of the angle of inclination relative to the horizontal 0°7' to 5°43' the dependence is decreasing – growing as at an angle of 2°46' there is a pronounced minimum. In the range of the angle of inclination 5° 43' to 26°36' dependence is linearly increasing. The dependence of the average temperature of the thermosyphon wall in the condensation zone depends substantially on the power of the transmitted heat flux and is hardly dependent on the angle of inclination. At power below 20W, the coolant in the thermosiphon cannot boil, and at power above 50W, the heat transfer is in geyser mode.

The experimental investigations carried out show that with a 30% heat carrier filling rate of long smooth-wall thermosyphons the optimum (from the point of view of internal thermal resistance) tilt angle to the horizontal is 2°÷3°.

The average temperature of the thermosyphon shell wall is practically independent of the tilt angle but only of the power of the transmitted heat flux. At a transmitted heat flow power below 20W, the coolant in the thermosiphon cannot boil, and at a power above 50W the heat transfer is in the so-called "geyser" mode, which is unstable and dangerous for the physical integrity of the housing.

Г.8.16. Munis T., Yordanov K., Zlateva P., Significance of the degree of filling with heat carrier, the type of the heat carrier and the angle of inclination for the heat transfer of a long sloped smooth-walled copper thermosyphon ø16x1 and l = 1,600m, Thermal engineering-13, Year 9, No.1, 2018, TU-Varna, ISSN: 1314-2550, pp. 88-92

In the work a limited scope experimental investigation of a long low temperature two phase inclined thermosyphon has been made into the importance of the type of heat carrier, the degree of filling of the thermosyphon working space with a heat transfer medium and the angle of inclination relative to the horizontal on the internal thermal resistance of the thermosyphon and the average temperature of the shell wall in the cooling zone. The heating was carried out with el. heater and cooling with free air. Acetone and distilled water were used for heat carriers. For the importance of the type of heat carrier, the so-called "heat transfer quality criterion" calculated for a temperature of 60°C was used. Filling rates with a heat carrier of 10, 20 and 30% were carried out. The inclination angle of the thermosyphon housing relative to the horizontal was changed from 0°5'÷26°34'. It was found that when maintaining stationary heat transfer conditions with a power of 40W all three factors significantly affect the value of the internal thermal resistance and the average temperature of the thermosyphon housing wall in the cooling zone.

The value of the internal thermal resistance of the thermosyphon "R_t" essentially depends on the degree of filling of the heat carrier ε and on the angle of inclination of the thermosyphon housing relative to the horizontal α (i.e. tgα). Its smallest value is at ε=20%. In the interval tg α =0.01÷0.10 (i.e. α = 0°5' ÷ 5°34') R_t has a pronounced minimum. The dependence of Rt on tgα is approximated by algebraic equations – for ε=10% - of the second power, for ε=20% - of the fourth power, for ε=30% - of the third degree.

In the range α = 0°5'÷26°34' acetone is the more suitable heat carrier, and in the range α = 8.0°0.5'÷26°34' distilled water is a more suitable heat carrier.

Г.8.17. Atanasov G., Munis T., Yordanov K., Zlateva P., The heat transfer of a long heat pipe made of aluminium with a capillary system - 36 longitudinal grooves with a cross-section of 0,5x0,5 mm and acetone as heat carrier, Thermal engineering-13, Year 9, No.1, 2018, TU-Varna, ISSN: 1314-2550, pp. 93-97

An investigation was made for the values of internal thermal resistance and the average shell temperature in the cooling zone of a long (3.0 m) straight low temperature twophase heat pipe of aluminium (Ø17x1.5) with a capillary system – longitudinal channels with a cross section of 0.5x0.5 mm on the inner surface of the tube shell. Acetone was used as a heat carrier. Degree of filling of the working space of the heat pipe with a heat carrier – 10%.

The study was made at a horizontal and inclined position relative to the horizontal of the heat pipe shell, the cooling zone being located above the heating zone. The measurements were made under steadystate heat transfer conditions. The heating was carried out with el. heater. Powers of 10÷40 W are set. The cooling is free air with a temperature of 25.4 ° C. The angle of inclination is changed from 0°5'÷26 °34'. For comparison under identical physical conditions and heat transfer power 40W a straight long (3,198m) inclined smooth-walled twophase thermosyphon of Ø16x1 copper tube was also investigated. It was found that at the inclined position both the internal thermal resistance and the temperature of the casing in the cooling zone were significantly lower at the heat pipe.

At the horizontal position of the heat pipe the temperature of the wall of the heat pipe of aluminium — and in the heating zone $\overline{t_W^{3H}}$ and in the condensation zone $\overline{t_W^{3K}}$ increase with increasing heat input. $\overline{t_W^{3H}}$ increases straight, a $\overline{t_W^{3K}}$ - after Q=30W – decreases the rate of increase.

The thermal resistance Rt is a decreasing linear function – up to Q=30W, and then the rate of decrease increases.

At a thermal power above 40W, areas of drying of the capillary system in the heating zone are expected, which will cause overheating of the wall.

Г.8.18. Spasova D., Yordanov K., Mathematical model of the heat interaction between the metal matrix and the reinforcement phase during the production of Metal Matrix Composites, Annual Journal of Technical University of Varna, Vol. 2 Issue 1 (2018), ISSN: 2603-316X (Online), pp. 1-8, DOI: 10.29114/ajtuv.vol2.iss1.61

The present paper is relevant for establishing the mathematical model of the thermal interaction between the metal matrix (liquid phase-Cu) and the reinforcement (solid phase-Fe), during the fabrication of metal matrix composites (MMC) by the capillary forming method.

In this case, a heat object is replaced by a mathematical model composed and substantiated to investigate the initial behaviour and properties, clarifies the temperature fields in the bodies.

The established simulation elucidates the temperature fields and the causal relationship between the metal matrix and the reinforcement phase in the formation of macro and microstructure during MMC production. The simulation of the casting process is an approved method to optimize the casting technology methods. The main capabilities, ideology and structure of the software "MATLAB FEA" are presented to simulate the casting technology. The capabilities of the product are illustrated by the results obtained from computer simulation from the technical process of MMC production.

After the investigation carried out, on the basis of the results obtained, the following conclusions are drawn:

- On the basis of the measured temperatures during the fabrication of a complex relief MMC, a mathematical model of the behaviour of the liquid phase melt Cu relative to the reinforcement phase Fe has been made.
- A simulation has been created which clarifies the temperature fields and the causal relationship between the matrix and the reinforcement phase during the preparation of the complex MMC relief from the capillary method of forming.
- The generated mathematical model provides an opportunity to clarify the interaction between the liquid and solid phase, based on the temperature field, thus contributing to the technology the expected wetting of the reinforcement phase.

Г.8.19. Krastin K. Yordanov, Aneliya M. Stoyanova, Study of the impact of technological parameters on the process of MIG/MAG welding, Power Transmissions'19 Proceedings, Vol. 3, ISBN: 978-619-7383-12-6, pp. 415-418

This paper investigates the impact of technological parameters on the semi-automatic MIG/MAG welding process of shipbuilding steel by determining the number of defects in the metal in the joint.

The aim of the study is to establish the technological capabilities of the semi-automatic MIG/MAG welding method by using experiment planning methods and mathematical statistics to optimize the mode parameters in an experimental way and to create new methods and means to improve surface quality.

Based on the methodology developed and the experiments on S355N steel samples, the regression equation and isolines were obtained which take into account the impact of the technological parameters of the semi-automatic welding process on the number of defects determined in the metal at joining.

It can be seen that at the lower level of the welding current, a minimum number of defects (~ 5 ÷ 10%) are obtained. Both variable factors (x_2, x_3) are approximately the same in importance. It is necessary to reduce the welding current and increase the feed rate of the electrode wire to reduce the number of defects in the metal in the joint.

The base metal has a ferrite-pearlite structure with a pearlite content of about 10 - 12%. The welded welded metal has a coarse dendritic structure which, as the alloying limit is approached, becomes finer and the amount of ferrite increases.

Based on the analysis of the study, the following conclusions can be drawn:

- A mathematical description of the MIG/MAG welding process in a protective gas environment was performed and the regression equation was obtained.
- The MIG/MAG welding mode was defined for shipbuilding steel in a protective gas environment with a minimum of defects in the joint metal (~5%).

Г.8.20. Tatyana M. Mechkarova, Krastin K. Yordanov, Semi-automatic MAG welding of alloyed machine-building steels, Power Transmissions'19 Proceedings, Vol. 3, ISBN: 978-619-7383-12-6, pp. 419-422

The present study investigates the possibility of semi-automatic MAG welding of three steels with carbon equivalents 0.40%, 0.50% and 0.60%. The impact of welding speed on crack formation is determined by structural analysis (thermal impact zone). A three-factor experiment was carried out to determine the impact of the factors on the hardness obtained. The regression equation was obtained and isolines showing the impact of these factors were drawn.

The task of the present study is to determine, by a full factorial experiment, by metallographic analysis of structural changes in the weld mixture in semi-automatic MAG welding of different types of steels with carbon equivalents in the range of (0.40 ÷ 0.60)%. The research is necessary as a result of the introduction into the industry of a low carbon low alloy steel with increased strength (Re up to 1300 MPa). These steels have a carbon equivalent of up to 0.60% and a large share of them are used in the construction of pipelines and metal structures operating under harsh conditions.

Based on the analysis of the research, the following conclusions can be drawn:

- In semi-automatic welding in carbon dioxide environments with increasing carbon equivalent (0.40% $\leq C_{eq.} \leq$ 0.60%) at welding speeds ~ 10 m/h, crack initiation was observed in the thermal impact zone.
- In semi-automatic MAG welding of steel: X60, S460N and S960QL, at welding speeds less than or equal to 5 m/h, no cracks are formed in the thermal impact zone.
- In semi-automatic MAG welding of steels with $C_{eq.} \geq$ 0.40% for the determination of welding modes it is necessary to use the thermokinetic diagrams of the respective steels.

Г.8.21. Kirov D., Munis T., Yordanov Kr., Experimental study of low-temperature straight and sloped two-phase thermosyphones with smooth walls, "Manufacturing engineering and technology", 2019y., ISSN: 1312-0859, pp. 28-34

Results of experimental investigations under laboratory conditions of straight inclined view thermosyphons with shells of copper, aluminium and steel pipes INOX – AISI304 – L = 2,100 m, Ø20x2 are presented and analysed. Diethyl ether, acetone and ethanol were used for heat carriers at a degree of filling the working space of thermosyphons ε = 30%; 40% and 50%. The thermosyphons are located at an inclination relative to the horizontal α = 0°4'; 0°5' and 0°26' (i.e. — at TGA = 5/1000; 10/1000 and 15/1000). Heat misleading was carried out under the same conditions with heating water with temperature T_{ent}/T_x = 60°/55°C to 85°/80°C, and cooling – with free air with a temperature of 24°C. The heat transfer capabilities of the three thermosiphons were compared. As a criterion for the best heat transfer is used the reached average wall temperature of thermosiphons in their cooling zone (i.e. – condensation) - $\overline{T_W^{3K}}$, °C. It was found that the influence of the tilt angle on the $\overline{T_W^{3K}}$ is immaterial. Significant are the influences of the type of heat carrier, the degree of filling with a heat carrier and the temperature of the heating water. The highest values of $\overline{T_W^{3K}}$ were achieved at the thermosyphon with a housing of copper and heat carrier diethyl ether. There is a need and guidelines for further study of the thermosyphon with a body of copper and heat carriers diethyl ether and acetone.

Based on their research and analysis, the following conclusions were drawn:

- The results obtained and their analysis show that in these ways of conducting experimental studies, the lower threshold of sensitivity and internal thermal resistance of thermosyphons cannot be determined.
- It is appropriate to conduct more in-depth studies on the peculiarities of heat transfer of thermosyphon with copper and coolant housing – diethyl ether and acetone in a wider range of change of the angle of inclination, by measuring the power of heat transmission and the degree of filling with a heat carrier 30%.

Г.8.22. Krastin Yordanov, Analysis of the natural gas transmission and supply chain, 25-th Scientific Conference on Power Engineering and Power Machines (PEPM'2020), Proceedings Energy - Ecology - Comfort - Self-confidence, ISSN: 1314-5371, pp. 21-27, http://copepm.eu/documents/2020.pdf

Natural gas is a fuel with an extremely complex supply chain that affects both the extraction, transportation, storage and distribution, as well as the price of natural gas. The aim of this study is to examine in more detail the stages for the efficient use of the natural gas supply chain. In order to optimize the natural gas supply chain, it is necessary to present the path of natural gas from its extraction in natural gas fields to its distribution to the end user. The stages of gas transfer are described in detail as well as their advantages and disadvantages. An overview of the types of gas storage is made, terms used in the storage of natural gas are described.

The combustion of natural gas is characterized by lower levels of greenhouse gases in the atmosphere compared to solid fuels. Natural gas reserves can support global consumption for at least 120 years, unlike oil reserves, and between 2019 and 2020, natural gas consumption increased by 12%.

Based on the analyses made, based on the concepts of the gas industry and the connections between the components of the transmission and distribution network, four stages of the natural gas transmission and supply chain were introduced. The supply chain presented is presented as a single product model (natural gas). The aim of this model is to examine in more detail the stages for the efficient use of the natural gas supply chain. The path of natural gas from its extraction in natural gas fields to its distribution to the end user is presented. The stages of gas transfer are described in detail as well as their advantages and disadvantages. An overview of the types of gas storage is made, and terms used in the storage of natural gas are described.

Г.8.23. Krastin Yordanov, A solar potential map algorithm, 25-th Scientific Conference on Power Engineering and Power Machines (PEPM'2020), Proceedings Energy - Ecology - Comfort - Self-confidence, ISSN: 1314-5371, pp. 55-60, http://copepm.eu/documents/2020.pdf

The proposed algorithm combines the estimation of the solar potential of the two energy systems, solar resources and different integration models. These solutions produce results for a realistic assessment of the use of solar energy in the country. Solar potential models are designed for primary evaluation and input data are limited. The current maps of Bulgaria's solar potential are too general and inaccurate to meet the requirements for assessing the energy potential for a specific geographical region. The assessment must be carried out in order to analyse the available solar energy falling over an area dedicated to the construction of solar thermal or photovoltaic plants. To reduce to a one-year period for site assessment, there is a need for detailed maps of solar potential for a user region or for the whole country. Due to the stochastic behaviour of solar radiation the sun map has to be performed on the basis of a detailed numerical analysis on a data acquisition basis. In the present work, an attempt has been carried out to set up an algorithm related to numerical analysis of measured solar potential data.

Based on the analysis of the study, it follows that the limit values of the potential should be known. This is one of the disadvantages of this method. It is often very difficult to detect the correct potential of the point with specific latitude and longitude. In this case, other maps or statistics may be useful as well-known sources. NASA offers data until 12.2019, and the last PVGIS map is from 08.2019. If the inner point with unknown potential is close to some of the peaks, so the value sought is closer to the known potential.