

SUMMARY

of Assoc. Prof. Eng. Zhivko Bonev Gochev Ph. D.

Presented for participation in a competition for occupying the academic position „professor“ at the Department of Woodworking machines, Field of higher education 6. Agricultural sciences and veterinary medicine, Professional field 6.5. Forestry, Scientific specialty „Technology, mechanization and automation of Woodworking and Furniture industry“, in the discipline „Cutting of wood and cutting tools“, with a period of 2 months from promulgation in State Gazette, issue 37 / 07.05.2019 and publication on the website of University of Forestry at 12.04.2019, procedure code: WWW – P – 0419 – 06

I. Monographs (1)

2. Gochev Zh. (2017), Preparation and maintenance of band saw blades for cutting of round wood, Publishing „Polygraph Co.“, Haskovo, p. 200, ISBN 978-619-7240-47-4.

- *Reviewer:* Assoc. Prof. Vassil Vlashev Ph.D.

The present monograph uses the long experience of teaching and practical work, theoretical and practical trainings in the country and abroad and the scientific work of the author. The author is also provoked by the fact that in Bulgaria the cutting of wood logs is carried out mainly with the help of band saw machines.

This monograph summarizes the theoretical and practical experience of the preparation, maintenance and operation of saw blades (wide and narrow) for cutting of logs and this experience has been complemented and broken by the present state of sawmill industry in our country.

The present monograph is intended for all producers of lumbering material produced with band saw machines. It will also be useful for the students of the specialties at the Faculty of Forest Industry at the University of Forestry in Sofia.

One of the objectives of the monograph is to be useful to a wider readers: workers, PhD students, lecturers, engineers from the woodworking and furniture industry.

The monograph is structured by an introduction and six chapters. The main advantages of saw blades for the cutting of round wood are explored.

The most common reason for the low cutting productivity of the saw blades is the mistakes that are allowed in their preparation and operation.

The technical requirements of band saw blades, as well as the technological and economic advantages of their using, have been studied.

The methods for selection of the basic linear, angular parameters and the profile of the teeth and the type of steel in the selection of wide and narrow band saws for the logs cutting are presented in detail.

Investing in quality tools and their professional maintenance influences better raw material utilization, greater accuracy and quality of the lumber materials, higher yield, higher cutting and feed rates, longer cutter tool life, shorter downtime and less maintenance time.

In this regard, the experience shows that, in the case of good staff qualifications and good machine condition, the cutting process of producing quality materials lumber materials, to a great extent, approximately 90% depends on the professional, quality preparation of the band saw blade.

The technological and control operations in the preparation of the band saw blades have been systematized. Particular attention is paid to the welding methods of the band saw blades and their physical nature.

The results of experimental studies on the arc welding of band saw blades with melting electrode are presented. The main factors that influence the process are: factors related to welding mode parameters; factors associated with the welded material; factors associated with again heat treatment in the welding zone until normal hardness.

The the arc welding of band saw blades with melting electrode is evaluated by the set of quantities describing the quantitative (welding speed, welding wire feed rate and shielding gas flow rate) and the qualitative (geometric parameters of the welding seam, appearance, smoothness, uniformity and presence of splashes) side of the process.

The basic parameters of the temperature field in electrode welding with melting electrode are determined by the method MIG and MAG. The influence of the quality of the arc welding by the preheating of the edges of the band saw blade was also investigated.

The technique and technology in arc welding in a protective gas environment are presented in detail, and there are proposed rational welding modes, including ones for re-heating in the area of the welding seam.

In the monograph, special attention is paid to the rolling and repairing of the saw blades, giving practical examples and regimes that can be used in practice.

Attention is also paid to the spring-set, swage-set, hardening and stellite-tipped of the band saw teeth, the methods and technologies for their proper implementation.

A special place is also given for the abrasive tools, technologies and sharpening regimes of wide and narrow band saws used for logs cutting.

In conclusion, the problems that may arise during the operation of the band saw blades and methods for their removal are examined.

Well-maintained and sharpened saws cut the logs with minimal cutting forces, work at higher feed rates, the quality of the cut surfaces is greater, and the resulting materials are straight and in uniform thickness.

II. Textbooks and teaching aids (3)

2. Ivanova D., R. Raycheva, P. Panayotov, N. Grigorov, G. Hristova, M. Mladenova, S. Kovacheva, I. Ivanov, V. Brezin, G. Tasev, **Zh. Gochev**, V. Piralkov (2008), Handbook of the entrepreneur in the woodworking and furniture industry, PH Avangard Prima, ISBN 978-954-323-461-5, Sofia, p. 300.

- *Reviewer:* Prof. Bozhidar Dinkov Ph.D.

This handbook of the entrepreneur in the WFI (Wood and Furniture Industry) reflects the current state of WFI, the existing problems and prospects for its development. It is structured in 10 chapters and has been written by 12 authors.

The eighth chapter entitled "Vocational Education and Training" is written by Zhivko Gochev.

The active role of training in the FFI (Forestry and Forest Industry) sector is justified. Increasingly important for companies is the development of key technical, methodological and social competencies.

Education and training in the FFI sector in Bulgaria is organized on three levels: secondary education in specialized vocational schools, university education and after university education.

The strategic objective is to: Increase the contribution of science in the sustainable management and development of the FFI sector and improve the education system and the social status of the staff.

Some results from the author's participation in a joint European project are also presented: „Expanding good practice in Education in the Forestry-Wood Chain sector through the InnovaWood network“.

The InnovaWood network covers 70 organizations from 23 European countries and beyond, presenting the full spectrum of research, technology transfer and training across the FFI chain. The aim is to build a transnational network to improve vocational education and training in the FFI sector.

A methodology has been developed to explore the attitudes and problems of the two main groups - educators and trainees. Here are some of the most common answers from a survey conducted for Bulgaria.

An analysis of the qualification process is carried out, which is based on the results of quantitative and qualitative research among the companies in the sector and their staff in different European countries.

The aim of quantitative research is to confirm the results of qualitative interviews and to develop and test a complete list that allows entrepreneurs at European level to assess their training needs.

The results of qualitative and quantitative research show that the need for training is based primarily on the individual and corporate judgment of the owners, their personal and business experience.

When assessing the need for training, we also need to take into account the customer's requirements for the services, products and services required in the companies in the sector. Otherwise, the analysis of the need for training remains outside the aspects that may be relevant to current and future training needs.

3. Gochev Zh. (2014), CNC machines, tools and technologies. Full lecture course published in the Blackboard system of the University of Forestry.

The lecture course in the subject "CNC machines, tools and technologies" has been developed according to the curriculum of the subject "CNC machines, tools and technologies" for the students of the specialty "Technology of wood and furniture", master degree, specialized modules: "Woodworking machines and Equipment, "Technology of Timber Materials and Composites" and "Furniture Production" at the University of Forestry.

The material includes 13 lectures, including: the place and application of CNC machines and technologies in WWFI; the basics of digital-program management; management programs; types of displacements in CNC machines; basic principles in 3D design; programming with CAD / CAM systems; CNC tools and aggregates; general principles of operation of CNC Center "Rover A 3.30"; installation, setup and operation of tools and aggregates; software assurance for the processing of wood plate materials; "BiesseWorks - BiesseCabinet" control program, WOODWOP; additional programming capabilities.

In addition, three practical exercises for CAD / CAM programming for CNC Center "Rover A 3.30" are included: for drilling; for milling; for drilling of non-standard details.

The aim of the lecture course is to give students basic theoretical and practical knowledge and basic personal skills necessary for career development in the field of CNC machines.

4. Gochev Zh. (2018), Wood Cutting and Cutting Tools, PH Avangard Prima, Sofia, p. 523, ISBN 978-619-239-047-1.

Reviewers: Prof. Panayot Panayotov Ph.D., Assoc. Prof. Vasil Vlasev Ph.D.

The textbook Wood Cutting and Cutting Tools is intended for students from the Faculty of Forest Industry and the Faculty of Business Administration of the University of Forestry in Sofia. One of the aims of the textbook is to be useful to a wider audience: workers, students, PhD students, lecturers, engineers from the woodworking and furniture industry.

The textbook is structured in two sections: the first titled "Cutting of wood and wood-based materials" and the second - "Cutting tools". The experience of the long teaching of the discipline at the University of Forestry, from the practice in our country and from the theoretical and practical trainings abroad, from the author's research work has been used. The first section includes 30 themes and the second one - 27 themes. It is richly illustrated with 506 figures and photos and 133 tables.

Theme 1 is devoted to general terms, terminology and definitions. The purpose, content of the course and its relationship with other disciplines is formulated. A brief historical review, including problems and prospects, is made. The role of Russian school in the theory of wood cutting is analysed. Key concepts and definitions are given.

Theme 2 examines the basic elements and geometry of the teeth of the instrument as well as the types of teeth. The kinematic and dynamic angles of cutting are defined.

Theme 3 includes the processed material and its specific features occurring in the cutting process. A characteristic of the wood and wood-based materials is made.

In **Theme 4** is made a classification of the types of cutting.

Theme 5 discusses kinematics of the process, the work movements, the main kinematic attitude and the kinematic angle of encounter.

Theme 6 covers issues related to the quality of cutting surfaces, accuracy and purity of machining, normative documents and definitions, parameters defining the roughness of the surfaces and methods for their determination.

Theme 7 discusses the processes of chip formation in open cutting, the different process phases, chip parameters, and chip types. There are presented the processes of chip formation in longitudinal, cross and frontal cutting from the position of the real practice.

Theme 8 discuss the processes of chip formation in inside cutting, the types of sawing, the need and methods for expanding the slit, the shape and size of the chips in spring-set and swage-set

teeth. The advantages and disadvantages of cutting with spring-set and swage-set teeth, as well as the chip formation process in longitudinal and cross sawing, are examined.

Theme 9 is devoted to the role of the blade in the cutting process, the stresses that occur at its peak and the relationship between it and the radius of the blade, as well as its influence on the roughness of the resulting surfaces.

In Theme 10, the processes of deformation of the wood in the enclosed space are examined, and by formulating the hypothesis for the chip formation the general law of cutting is defined.

Theme 11 discusses the issues related to the specific resistance, the specific force and the specific cutting work, and the cutting power.

Theme 12 focuses on the forces with which the wood counteracts the entry of perfectly sharp and real teeth.

Theme 13 discusses the forces with which absolutely sharp and real teeth act on the wood. Formulas for tangential and radial force, as well as for the specific resistance of cutting are given: in open cutting with sharp teeth; in open cutting, taking into account the dulling of the teeth and in the inside cutting.

Theme 14 examines the power of the feed and the required power of the feeder to overcome the cutting forces. It is used to select the power of the feeder's motor.

Theme 15 focuses on the influence of various factors on the cutting process and the quality of processing: factors associated with the material being processed; factors relating to the cutting tool; factors that characterize the cutting process; factors related to the dynamics of the cutting process and organizational factors.

Theme 16 relates to the basic requirements for compiling optimal cutting modes such as cutting tool selection, cutting height, cutting and feed rate determination, providing cross-resistance to the cutting tool.

Themes 17, 18 and 19 discuss the kinematics and the dynamics of cutting with saws: band saw blades, frame saws and circular saws. General information about the processes from the position of the current state of the sawmill industry in Bulgaria is given, the main kinematic and dynamic quantities that influence the processes of cutting are defined.

Themes 20, 21 and 22 discuss the kinematics and dynamics of milling processes. General information and kinematics and dynamics of cylindrical milling with cutter heads as well as milling with router bits and chainsaw mortise are given. The influence of the run-out of the cutting edges on the roughness of the surfaces in the cylindrical milling is investigated.

Theme 23 is dedicated to the kinematics and dynamics of the drilling processes in length and across the wood fibres.

Theme 24 examines the kinematics and dynamics of manufacturing process of wood veneer by flat slicing and rotary cutting.

Theme 25 is dedicated to the wood turning process. General information is given on centre and centreless turning, types of turning chisels. The kinematics and the dynamics of the process of axial turning were studied.

Theme 26 is dedicated to the grinding process and includes general information, kinematics and power grinding power.

Theme 27 discusses the issues related to the shredding of wood chips and particles used as raw material in the pulp and paper industry, in the production of wood fiber boards and particleboard, and other composite materials, and also as a raw material for the production of pellets and briquettes. It presents the kinematics and dynamics of the processes with disk and drum chipper machines.

Theme 28 addresses issues related to the debarking processes of logs, the specific features of the process, and the methods and machines being used. Key kinematic and dynamic values were obtained in centrifugal-rotor and milling debarker machines.

Theme 29 discusses the specifics of cutting, milling and drilling of wood-based materials. A methodology for practical determination of the basic kinematic and dynamic quantities by using TCT tools is presented.

Theme 30 is dedicated to laser cutting of wood and wood-based materials. The specific features of CO₂ lasers and their radiation are explored. The energy conditions of interaction of laser radiation and wood, the factors influencing the process and the optical elements - mirrors and lenses

were studied. The specific energy of laser cutting is defined. Technological laser systems for cutting wood and wood-based materials are presented.

Theme 31 treats the basic requirements and qualifications of woodcutting tools. The exploitation, technological and economic requirements are considered. Theme 31 treats the basic requirements and qualifications of woodcutting tools. The exploitation, technological and economic requirements are considered.

Theme 32 is dedicated to the materials from which woodcutting tools are made: tool steels; solid alloys; polycrystalline ultra-hard materials; their indications under BDS and EN as well as their thermal treatment.

Theme 33 addresses the wear and dulling of cutting tools. A concept of wear and dulling is given, the physical nature of the wear and the types of wear of the cutting tools are presented. Theme 33 addresses the wear and dulling of cutting tools. A concept of wear and dulling is given, the physical nature of the wear and the types of wear of the cutting tools are presented.

Theme 34 discusses methods for enhancing the durability of woodcutting tools. The main directions are classified. The features and practical use of the tools are given: with TC teeth; with stellite topped teeth; with PCD and CBN teeth; with hardened teeth in a high frequency current field; with electrostatic plating of the teeth; with an arc welding of the teeth; with chemical-thermal technology of teeth treating and tools tefloning.

Theme 35 is dedicated to abrasive materials and abrasive sharpening tools. A classification of the ordinary and ultra-hard abrasive materials and tools, their designations and applications has been made. Detailed methods for proper selection of the abrasive tools as well as its static balancing are described.

Theme 36 treats abrasive sanding belts. The types of abrasive sanding belts, their peculiarities, their features use and their purpose and indications are presented.

Theme 37 is related to the narrow and wide band saw blades, their practical use, and the features of the linear and angular parameters of the teeth, teeth profile and the types of steel from which the saw blades are made. The influence of the physical-mechanical indicators of wood on the parameters of the teeth of the band saw blades was also examined.

Theme 38 discusses the technical operations for belt saw preparation. Requirements and stages in the preparation and control: unrolling, sizing and welding of the band saw blades.

Theme 39 is dedicated to the rolling and repair of band saw blades. Rolling methods including practical examples are discussed. Attention is also paid to straightening saw blades and removing defects from the saw blade.

Theme 40 is dedicated to frame saw blades: features of the linear and angular parameters of the teeth of the frame saw blade; choosing the saw type, the tooth profile and their preparation, the steel brand and their hardness.

Theme 41 examines the preparation, repair and rolling of frame saw blades. The main stages in the preparation of the frame saw blades are considered; cutting the sail of the saw along its length and width, cutting out new teeth and straightening the back of the saw; rolling and removing defects of the frame saw blade; studding plates and tensioners to the plate of frame saw blades; tensioning the saws in the frame.

Theme 42 is dedicated to circular saws and especially to monolith steel saws. Types of circular saws are considered according to their shape, construction and the material of the cutting part of the teeth: flat; conical; opposite conical.

Theme 43 discusses issues related to giving the circular saws the right shape and the stressed condition. Preparation of circular saws. Tensioning of circular saws, rolling and defect removal.

Theme 44 is dedicated to circular saws with stellite tipped teeth, TCT teeth, PCD teeth and CBN teeth. The structural features, basic dimensions, are considered and the linear and angular parameters of the circular saws with. The specific shape of the teeth and the practical methodology for the selection of circular saws are presented.

Theme 45 discusses the methods, tools, devices and technologies for setting and swaging of the saws teeth.

Theme 46 is dedicated to technology and sharpening machines for frame saw; band saw blades and circular saws. The various sharpening methods, sharpening machines and their working

principle are examined. A special place is dedicated to the abrasive tools and sharpening regimes of wide and narrow saw blades for portable band sawmills.

Theme 47 is dedicated to sharpening of circular saws with TCT teeth. Problems related to TCT teeth wear, machines, technology, abrasive tools and sharpening regimes are discussed.

Theme 48 examines the chainsaws, their preparation and sharpening. General information and constructive features of chainsaws are given: chain, guide bar, shape of cutting tooth, step, etc. Special attention is paid to the maintenance and sharpening of chainsaws, the control, the defects that arise and the methods for their removal.

Theme 49 is devoted to cutter tools, their classification and peculiarities. The basic technical parameters of the cutter tools with hole are presented in detail: with steel teeth, with TCT teeth, Adjustable cutter head, grooving gutter, for manual feed, etc.

Theme 50 is dedicated to router bits, their design and technical features, classification, material of fabrication, application areas.

Theme 51 discusses the technology and machines for sharpening cutter and router bit tools. The basic principles of sharpening of milling tools and machines are presented. The steps of preparing the milling tools, sharpening technologies, abrasive tools and modes, sharpening quality, control and balancing of milling tools are explored.

Theme 52 is dedicated to the flat knives, their classification, specific features and purpose, the material they are made of, their linear and angular parameters.

Theme 53 discusses the technology and machines for flat knives sharpening. The feature of the sharpening process, the preparation, the equipment and the technology for sharpening flat knives are presented. Attention is paid to sharpening machines, their working bodies, mounting methods, abrasive tools and sharpening, control and balancing of flat knives.

Themes 54 and 55 are dedicated to the drill bits and countersink, their classification and purpose, their constructional and technical parameters, the material of which they are made. The methods of sharpening, machines, abrasive tools, sharpening technologies and modes are discussed.

Theme 56 discusses the methods, technologies and sharpening machines of PCD tools. Special attention is paid to electro-erosion sharpening with wire and disk electrode.

Theme 57 is devoted to the organization of the instrumental property: organization systems; structure; number of staff and machines; area of the tool section; necessary quantity, need and stock of cutting tools.

III. Books (1)

5. Gochev Zh., P. Zhelev (2006), Forest and Forestry Industry of Japan, PH Geosoft LTD, Sofia, p. 136.

The authors of the book are former participants of the Japan International Cooperation Agency (JICA): Zhivko Gochev in the field of "Wood Based Materials Application Technology"; Petar Zhelev - "Devastated Forest Restoration Technique".

The second part of the book, named "Japan's Forestry Industry" is devoted to the efficient use of the wood and wood-based materials in all areas of Japan's woodworking and furniture industries. Information on visited companies, services and educational institutions is provided.

Particular attention is paid to the position and role of the forest industry for Japan: the demand and supply of wood; innovations and trends in the woodworking industry, the production of wood-based materials - engineering wood; the construction of family houses using engineering wood. The Japanese methods of technological woodworking, the cutting tools used; methods for drying wood; the construction of protective-decorative coatings.

The methods for recycling and recovery of wood waste are presented. There is also a place for quality control as an essential part of Japanese companies' operations.

IV. Publications in foreign referenced and indexed scientific journals, issues and conference proceedings – Web of Science и SCOPUS (13)

6. Gochev Zh. (2007), Comparatively investigation on working capacity of wide band saw blades with setting, swaging and stellite teeth, 2nd International Science Conference on WOODWORKING TECHNIQUES: proceedings of papers, University of Zagreb, September 11–15, Zalesina, CROATIA, pp. 47-52, ISBN 978-953-292-009-3.

The paper presents some experimental results have respect to working capacity of wide band saw blades with part-set, swage-set and stellite-set teeth. Their advantages and disadvantages were analyzed. Recommendations about their more effective using in wood-processing industry of Bulgaria are made.

7. Gochev Zh. (2009), Investigation on cutting process of poplar and pine logs through wide band saw blades with part-set and swage-set teeth, 3rd International Science Conference on WOODWORKING TECHNIQUES: proceedings of papers, University of Zagreb, September 2-5, Zalesina, CROATIA, pp 233-240, ISBN 978-953-292-009-3.

The paper deals some experimental results concerning cutting process of poplar and pine logs through wide band saw blades with part-set and swage-set teeth. Their advantages and disadvantages were analyzed. Recommendations about their more effective using in wood-processing industry of Bulgaria are made.

8. Gochev Zh. (2009), Proper utilization of tools and units for CNC machining centers, 3rd International Science Conference on WOODWORKING TECHNIQUES: proceedings of papers, University of Zagreb, September 2-5, Zalesina, CROATIA, pp 241-248, ISBN 978-953-292-009-3.

The paper scrutinizes some aspects of CNC machining centers and particularly most usable tools. Some of theirs large arsenal of tools and units are examined, their works characteristics the adjustment methods as well (mechanical and software).

9. Atanasov V., R. Milchev, Zh. Gochev (2012), Approach to creating models of blade for portable sawmills, 8th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 06-08.IX. Zvolen, Slovakia, ISBN 978-80-228-2385-2, ISBN 978-80-228-2385-2, pp. 13-18, ISBN 978-80-228-2385-2.

The present paper considers the opportunities for creation of digital models of band saw blade through which to study the behaviour of mobile sawmills. Development of two- and three-dimensional models is essential part of design and analysis process based on use of numerical methods. Application of numerical methods depends on generated mesh of studied areas and objects. In the particular case the finite element method mesh generation has been applied in order to give an account to behaviour of cutting instruments in different mechanical conditions. The analysis of possible use of different computer application and development of proper procedures of their interaction for creation of quality two-and three- dimensional models has been done.

10. Gochev Zh., S. Stoilov, K. Marinov, M. Ferenčík, M. Lieskovský (2012), Woody biomass utilization in Bulgaria and Slovakia, 8th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 06-08.IX. Zvolen, Slovakia, pp. 117-124, ISBN 978-80-228-2385-2.

This report examines the current state of the use of woody biomass for energy production in Bulgaria and the Republic of Slovakia, development possibility, advantages and disadvantages of woody biomass utilization in both countries.

11. Kovachev G., Zh. Gochev (2012), Investigation of oscillation in the classical wedge belts in woodworking machines, 8th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 06-08.IX. Zvolen, Slovakia, pp. 217-225, ISBN 978-80-228-2385-2.

The proposed work is an overview study of the use of classical wedge belts to drive the modern woodworking machinery. Simple construction, quiet operation, no special maintenance and low cost of the product makes it a leading choice of drive gear. The article examines the behaviour of the belt during operation. It helps us to get accurate information for the impact on individual elements and nodes of the machine. The data is directly link to the quality of treated products, the load of machine parts, with their wear and others.

12. Marinov K., Zh. Gochev, S. Stoilov (2012), Screw presses study for briquettes' for densified wood, 8th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 06-08.IX. Zvolen, Slovakia, pp. 175-178, ISBN 978-80-228-2385-2.

Energy production from biomass is among the priorities of the energy strategy of Bulgaria and Europe for using renewable energy sources. One of the methods for converting woody biomass

into fuel for powering industrial and municipal energy plants is the production of briquettes and pellets. This work was conducted to determine some basic parameters of the screw presses for production of briquettes from densified woody biomass. There are basic relations for determining the needed pressure in the screw presses for densifying comminuted wood biomass. Analytical relationships are derived for the determination of certain structural and technological parameters of the machines.

13. Vukov G., Zh. Gochev, V. Slavov (2012), Torsional vibrations in the saw unit of a kind of circular saw. Numerical investigations of the natural frequencies and mode shape, 8th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 06-08.IX. Zvolen, Slovakia, pp. 371-378, ISBN 978-80-228-2385-2.

A numerical investigation of the natural frequencies and mode shapes of the circular's saw unit is presented in this study. The research is done on the base of an adequate mechanic-mathematical model for investigation of free torsional vibrations of a circular saw developed by the authors. The model presents features in the construction of a kind of circular saws. As a result this study allows the determination of the resonant work regimes. The determination of these regimes is important for introduction of adequate measures which can guarantee their using. The results of the investigation can be used as a base for making some recommendations concerning the increase of reliability of the machine as well as the accuracy and quality of the production.

14. Deliiski N, L. Dzurenda, N. Trichkov, Zh. Gochev, D. Angelski (2016), Modelling of the unilateral convective heating process of furniture elements before their lacquer coating, Scientific journal Acta Facultatis Xylogiae, Zvolen, 58(2), DOI: 10.17423/afx.2016.58.2.06, pp. 51-64, ISSN 1336-3824.

Two mutually connected 1D mathematical models have been created and solved. The first of them allows the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating furniture elements before their subsequent lacquer coating. The second one allows the computation of the non-stationary distribution of temperature, t , along the thickness of the carrying rubber band, on which the non-heated surface of the furniture elements lies. A software program has been prepared for the simultaneous numerical solution of both models with the help of an explicit scheme of the finite difference method, which has been input in the calculation environment of Visual Fortran Professional. With the help of the program, computations have been made for the determination of the 1D change of t in flat oak elements and in the rubber band, on which the non-heated surfaces of the elements lie. In the simulation experiments the oak elements were with thickness of 16 mm, length of 1,2 m, initial temperature of 20 °C, and moisture content of 8%. The duration of the elements' unilateral convective heating by air with temperature of 100 °C and speed of 2 m/s, 5 m/s, and 8 m/s was equal to 10 min. The rubber band was with thickness of 4 mm, width of 0,8 m, initial temperature of 20 °C, and the temperature of the surrounding air was 20 °C. The computer solutions of both mathematical models could be used for visualization and technological analysis of the temperature change along the thickness of furniture elements made of different wood species, different thickness, length and moisture content, during their unilateral convective heating with different temperature and speed of the circulated air prior to their lacquering.

15. Gochev Zh., G. Vukov (2017), Influence of the wearing of the saw unit elements of the wood shaper on the system vibration, Journal Acta Facultatis Xylogiae Zvolen, 59(2), DOI: 10.17423/afx.2017.59.2.14, pp. 147-153, ISSN 1336-3824.

The article deals with the issue of vibration of lower one-spindle milling cutter. There are analyzed the causes of vibrations origin and their influence on the process of wood working. A particular attention is paid to the dependence of vibrations on the machine wear. A complete numerical model of vibration detection including a description of input variables is applied on a universal wood formatting machine with a spindle in a lower position on the FD-3. The model is applied under the alternative without damping as well as under forced torsional vibrations which were caused by wear of the wood forming machine after long-term use, especially for the rotor of the

electric motor, the pulley mounted on the motor shaft, the pulley mounted on the spindle and the cutting tool.

At the end, there are summarized the influences of forced torsional vibrations caused by the wear of the wood working machine FD-3 and their practical effects on the quality of the worked surface.

16. Vukov G., Zh. Gochev (2018), Modeling of the influence of wearing of a saw unit elements of a wood shaper on its vibrations, *Journal Acta Facultatis Xylogologiae Zvolen*, 60(1), DOI: 10.17423/afx.2018.60.1.14, pp. 129-135, ISSN 1336-3824.

Mechanic - mathematical model of the saw unit of the wood shapers developed by the authors is presented in the paper. This model is designed for studying the influence of wearing and change of parameters of saw unit elements on the accuracy and quality of the production. Wearing and changes of elastic and damping parameters of a belt drive are the first factors analysed and accounted in the model. A variable torsional moment of an electric motor formed by inevitable deviation from correct stator shape and rotor imbalance is the second considered factor. The third factor taken into account is a variable torsional moment of a cutting tool of a wood shaper. These three factors affect machine torsional vibrations and its precise work directly. The mechanic - mathematical model developed by the authors allows numerical investigation of free and forced torsional vibrations of a saw mechanism in this type of machines. The conclusions based on the numerical investigations are confirmed by the examinations of a machine in real conditions. The results of the investigation can be applied in specific well-founded recommendations concerning the operation of the machines. The recommendations are important to increase the accuracy and quality of wood shaper production.

17. Deliiski N., D. Angelski, N. Trichkov, L. Dzurenda, Zh. Gochev, N. Tumbarkova (2018), Modelling of the energy consumption of the unilateral convective heating process of furniture elements before their lacquer coating, *Journal Acta Facultatis Xylogologiae Zvolen*, 60(2), DOI: 10.17423/afx.2018.60.2.07, pp. 71-83, ISSN 1336-3824.

Two mutually connected 1D linear mathematical models created and solved by the authors earlier, are updated and presented as a nonlinear model. The first of them allows the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating flat wooden furniture elements before their subsequent lacquer coating. The second one allows the computation of the non-stationary distribution of the temperature along the thickness of the carrying rubber band, on which the non-heated surface of the furniture elements lies. A methodology for the computation of the specific (for 1 m²) energy consumptions needed for warming up both the furniture elements and the carrying rubber band, and also for covering of the heat emission from the band to the surrounding air are suggested. The methodology is based on the integration of solutions of two mutually connected nonlinear models mentioned above. For the numerical solution of the models with the aim at applying the methodology, a software program as an input in the calculation environment of Visual Fortran Professional was prepared. The computations were carried out to determine the specific energy consumption during the unilateral heating process of flat oak furniture elements with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, width of 0,6 m, and length of 0,6 m, 1,2 m, and 1,8 m, during their 10 min convective heating by hot air with the temperature of 100 °C and velocity of 5 m/s. At the temperature of the surrounding air of 20 °C, and the initial temperature of 20 °C, the thickness of the rubber band was 4 mm, the width was 0,8 m, The obtained results can be used for technological and energy calculations of unilateral heating processes of furniture elements at different boundary conditions, as well as in the software of systems for model based automatic control of these processes aimed at improvement of thermal conditions for the subsequent lacquering of the elements.

18. Vitchev P., Zh. Gochev (2018), Study of milling surfaces depending on the parameters of technological process, 29th International Conference on Wood Science and Technology – ICWST: proceedings of papers, Faculty of Forestry, University of Zagreb, Croatia, pp. 193-199, ISBN: 978-953-292-059-8.

The aim of the current study was to investigate the surface quality of articles from oak wood (*Quercus petraea* L.) during milling. The influence of the following technological factors: rotation speed of the cutting tool (n), feed rate (U) and thicknesses of the cut-out layer (h) on the changes in the roughness parameter R_z has been evaluated. The surface roughness was measured with a

roughness tester, type „Surftest SJ-210“ (Mitutoyo, Japan). Based on the results from the current study, the rate of influence of the investigated factors on the quality of the processed surfaces has been assessed and graphical dependencies, representing the relationship between the different factors have been derived.

V. Publications in foreign scientific journals, issues and conference proceedings, referenced and indexed outside Web of Science and SCOPUS (8)

19. Wieloch G., **Zh. Gochev**, B. Porankiewicz (2012), Image of wear of tools from cemented carbide during milling of glued wood elements, Annals of Warsaw University of Life Sciences – SGGW Forestry and Wood Technology № 80, 2012: 173-177, (Ann. WULS-SGGW, Forestry and Wood Technology 80, 2012), Poland, pp. 173÷177, ISSN 1898-5912.

In the work was performed an analysis of worn out area of cemented carbide KCr08 cutting edge after cutting of laminated wood of scotch pine with use of POW glue „Folkolit“ by moisture content of 9%. Machining was performed with use of Superset NT machine manufactured in Italy. The work was aimed at evaluation of wearing parameters of the cutting edge and an attempt to explain mechanism of creation of unusual wearing area of cemented carbide cutting edge in a form of groove by machining of secondary wood based products. Dimensions of a nose between groove and the cutting edge, namely width in the bottom. In the worn out area it was found extensive corrosion mosaic, with characteristic dimensions much larger then dimension of a single tungsten carbide grain being main building element of the cutting edge material.

20. Vukov G., **Zh. Gochev**, V. Slavov, G. Wieloch (2013), Investigation of the Forced Torsional Vibrations in the Saw Unit of a Kind of Circular Saws. Part I: Mechanic Mathematical Model, Annals of Warsaw University of Life Sciences – SGGW, Forestry and Wood Technology № 81, 2013, pp. 279÷285, ISSN 1898-5912.

A model for investigation of the forced torsional vibrations of the circular’s saw unit is presented in this study. The mechanic-mathematical model for investigation of the torsional vibrations of this kind of a circular saw, developed by the authors, allows lots of simulative studies. The model presents features in the construction and operation of the circular machines. This model takes into account the characteristics of the interaction between the cutting tool and work piece. The model also gives possibilities for modelling and analysis of the effects of a number of defects. The results of the investigation can be used as a base for making some recommendations concerning the increase of reliability of the circular machines as well as the accuracy and quality of their production. Numerical investigations and analysis of the survey results is the subject of the next part of this work.

21. Vukov G., **Zh. Gochev**, V. Slavov, G. Wieloch (2013), Investigation of the Forced Torsional Vibrations in the Saw Unit of a Kind of Circular Saws. Part II: Numerical Investigations, Annals of Warsaw University of Life Sciences – SGGW, Forestry and Wood Technology № 81, 2013, pp. 286÷292, ISSN 1898-5912, ISSN 1898-5912.

The proposed study presents a numerical investigation of the forced torsional vibrations in the saw unit of a class of circular machines. The investigation is done on the base of the authors developed adequate mechanic – mathematical model for the examination of torsional vibrations of this class of a circular machine. The model is given in the first part of the proposed study. The natural frequencies and mode shapes of the studied saw unit are determined. The free damped vibrations of the mechanism are investigated and analyzed. Some investigations of the forced vibrations of the cutting mechanism, due to the presence of defects in the drive electric motor, are conducted. The amplitude-frequency characteristics of the system are obtained.

The results of the study can be considered as a basis for the formation of specific recommendations. These recommendations aim improving the reliability of the machine and the accuracy and quality of the production process. The results are important for the vibrocontrol of circular machines and they are of unquestionable benefit in conducting vibration analysis of the system.

22. Grzegorz W., J. Wilkowski, **Zh. Gochev** (2015), Basic board problem in „nesting”, Annals of Warsaw University of Life Sciences - SGGW Forestry and Wood Technology № 92, 2015: 468-472 (Ann. WULS - SGGW, For. and Wood Technol. 92, 2015), pp. 468÷472, ISSN 1898-5912.

Work in nesting technology is possible because of usage of cutter as cutting tool. Thereby one can obtain cutting precision with minimal fillet radius of edge depending on cutter diameter. The machining technology is realized via cutting off by so called shank cutter; parts from the whole large dimensions board. During this process shank cutter penetrates the basic board only for under one millimeter. Before nesting the machined board is placed on basic board on screen table which enables damage of screen table. Unfortunately after each operation the basic board has cutting traces which are differential and depend on stability of thickness dimension on the whole board surface. The above dependence enforces so called facing of the whole surface to level the board so that it has equal thickness on the whole surface (regeneration of basic board). In nesting technology very important problem is depth value of tool in basic board. Milling of chip laminated board and measurement of depth value of shank cutter in the basic board was performed in CNC PRATIX Z2 produced by SCM.

23. Gochev Zh., G. Vukov, P. Vitchev, V. Atanasov, G. Kovachev (2017), Influence of the cutting mode on the overall vibrations generated by the woodworking milling machine, Annals of Warsaw University of Life Science – SGGW, Forestry and Wood Technology № 98, pp. 33÷42, ISSN 1898-5912, ISSN 1898-5912.

The current study investigates the changes in the overall vibrations, generated by the universal woodworking spindle milling machine in relation to some fundamental parameters characterizing the cutting mode: the cutting speed (V), the feed speed (U) and the thickness of the out-cut layer (h). On the basis of these experiments and the obtained results we determined the degree of influence of the investigated parameters on the intensity of the vibrations generated by this type of machines

24. Vukov G., Gochev Zh., Slavov V., Vitchev P., Atanasov V. (2017), Mechanic-mathematical model for investigations of the forced spatial vibrations of wood shaper and its spindle, caused by unbalance of the cutting tool, Scientific journal „PRO LIGNO“, Volume 13, Issue 4, pp. 148÷153, ISSN 2069-7430.

A mechanic - mathematical model of wood shaper and its spindle, developed by the authors, is presented in this work. The model provides the opportunity to explore the forced space vibrations of this type of machinery, caused by unbalance of the cutting tool. It takes into account the characteristics in the construction of wood shapers. In this model the wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic and damping elements with each other and with the motionless floor. The model takes into account the necessary mass, inertia, elastic and damping properties of the elements of the considered system. It includes all needed geometric parameters of this system. A necessary system of matrix differential equations is compiled and analytical solutions are presented. Numerical solutions can be obtained with their help by using the parameters of a specific machine.

25. Vukov G., Zh.Gochev, V. Slavov, P. Vitchev, V. Atanasov (2017). Numerical investigations of the forced spatial vibrations of a wood shaper and its spindle, caused by unbalance of the cutting tool, Scientific journal „PRO LIGNO“, Volume 13, Issue 4, pp. 154÷161, ISSN 2069-7430.

This study presents the results of the numerical investigations of the forced spatial vibrations of a wood shaper and its spindle, caused by unbalance of the cutting tool. The paper is based on a specific mechanical - mathematical model, developed by the authors, which allows studying of vibrations of this type of machinery. In this model a wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic and damping elements with each other and with the motionless floor. This study renders an account the mass, inertia, elastic and damping properties and geometric parameters of the machine. The results of the numerical investigations are presented. They are obtained through modern software and by using parameters of a particular machine.

26. Gochev Zh., Vukov, V. Atanasov. P. Vichev (2018), Factors influencing the cutting power in longitudinal milling of solid wood, Annals of Warsaw University of Life Sciences – SGGW Forestry and Wood Technology № 102, 2018, pp. 103÷111, ISSN 1898-5912.

Some factors which affect the cutting power during longitudinal milling process of solid wood are studied in this paper. These factors are: the cutting speed, the feed speed and milling area. The input power of the cutting mechanism in idle and power motion is measured for the purposes of the study. Modern equipment with corresponding for this study software is used. The present studies have been conducted in the processing wood details from beech (*Fagus sylvatica L.*). A comparative

analysis of these results and the results obtained in the treatment of details from pine (*Pinus sylvestris* L.) is made. The obtained results are analyzed and some recommendations that support the practice of longitudinal milling of wood are proposed.

VI. Publications in Bulgarian scientific journals, issues and conference proceedings, referenced and indexed outside Web of Science and SCOPUS (10)

27. Gochev Zh., (2008), INNOVAWOOD InnovaWood and University of Forestry for one United Europe in Field of Innovations , Researches and Qualifications in the Forest-Wood Based Sector, Journal Management and Sustainable Development, № 1, Sofia, pp. 233÷238, ISSN 1311-4506.

In the report the European network is showed for education and transfer of technologies in the area to the forest enterprises and the forest industry, its activity and part. The point of University of Forestry of this European structure, the results, being as well projects by the collaborative activity.

Some consequences of engagement of University of Forestry are presented in collaborative project: „Expanding good practices in vocational education and training in the Forest-Wood Chain sector through the InnovaWood network“.

28. Marinov K., Zh. Gochev, M. Lieskovski, M. Ferenchik (2014), Енергийни характеристики на дървесната биомаса на евроамерикански хибридни тополи, Journal Management and Sustainable Development, № 6, Sofia, pp. 103÷112, ISSN 1311-4506.

This article presents the results of the study of the energy characteristics of wood biomass from some Euro-American hybrid poplars introduced in Bulgaria. Energy properties from several clones of *Populus x euroamericana*, cl. I-214, I-45/51, *Pannonia*, *Weltcheimei-Pappei* and *NNDV* have been studied for this purpose. These hybrid clones are promising for creating fast-growing energy plantations. These poplar clones are characterized by rapid initial growth and accelerated accumulation of biomass; they have high coppice capability and are suitable for our climatic conditions. As a result of the study, the higher and lower heating value, the relative humidity and ash contents of the juvenile wood and juvenile bark of one year old poplar stems were defined. Materials and test samples were taken from the specialized State Poplar Farm in the town of Pazrdzhik, Bulgaria. Testing of the samples was conducted in the laboratory of the Department of Forest Harvesting, Logistics and Agromelioration at the Technical University in Zvolen, Slovakia.

29. Deliiski N., R. Stanev, D. Angelski, N. Trichkov, Zh. Gochev (2016), Heat transfer coefficients during unilateral convective heating process of wood details before their lacquering, Scientific journal Engineering sciences, Year LIII, № 3, Bulgarian Academy of Science, pp. 26÷42, ISSN 1312-5702.

Based on the differential equation of the thermo-conductivity, two mutually connected 1D non-linear mathematical models have been created and solved. The first of them allows for the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating of flat wood details before their lacquering. The second one allows for the computation of the non-stationary distribution of the temperature t along the thickness of the carrying rubber band, on which the non-heated surface of the details lies. A mathematical description of the heat transfer coefficients, which participate in the models' boundary conditions, has been suggested. For the numerical solution of the models a software program has been prepared by means of explicit scheme of the finite difference method, which has been implemented in the calculation environment of Visual Fortran. Using the program, computations have been carried out for the determination of the change in temperatures and the heat transfer coefficients of the surfaces of flat oak details with an initial temperature of 20 °C, moisture content of 0,08 kg/kg, thickness of 16 mm, lengths of 0,6 m, 1,2 m, 1,8 m, and also of the carrying rubber band with thickness of 4 mm, width of 0,8 m, and an initial temperature of 20 °C, during their 10 min unilateral heating by air with temperature of 100 °C and velocity of 5 m/s.

30. Deliiski N., D. Angelski, N. Trichkov, Zh. Gochev (2016), Determination of the time needed for convective heating of flat oak details before their subsequent lacquering, Journal Management and Sustainable Development, № 6, Sofia, pp. 119÷123, ISSN 1311-45-06.

Based on the differential equation of the thermos-conductivity, a linear model of the unilateral heating process by circulated hot air of flat furniture details before their lacquering has been suggested. A software program has been prepared for the solution of the model in the calculation environment of Visual Fortran. Using the program, computations have been carried out for the

determination of the 1D temperature distribution along the thickness of flat oak details with an initial temperature of 20 °C, moisture content of 0,08 kg/kg, and thickness of 16 mm during their 14 mm heating by air with temperatures of 60 °C, 80 °C, 100 °C and velocity of 3 m/s.

31. Deliiski N., N. Trichkov, **Zh. Gochev**, D. Angelski (2016), Modelling of the Energy Consumption for Warming up of Furniture Elements during their Unilateral Convective Heating before Lacquering, Science Institute of Information and Communication Technologies of Bulgarian Academy of Sciences, „Information technologies and control“, DOI: 10.1515/itc-2017-0012, vol. 14, Issue 4, Dec 2016, pp. 11÷18, ISSN: 2367-5357

A mathematical model and a numerical approach for the computation of the specific energy consumption, which is needed for warming up of flat furniture elements before their lacquering, have been suggested. The approach is based on the integration of the solutions of a non-linear model for the calculation of the nonstationary 1D temperature distribution along the thickness of subjected to unilateral convective heating furniture elements. With the help of a self-prepared software program, computations have been carried out for the determination of the change in the specific energy, which is consumed by oak furniture elements with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, and length of 0,6 m, 1,2 m, and 1,8 m, during their 10 min unilateral convective heating by hot air with temperature of 100 °C and velocity of 5 m/s.

32. Deliiski N., N. Trichkov, **Zh. Gochev**, D. Angelski (2017) Modelling of the energy needed for covering of the heat emission of subjected to convective heating furniture elements before lacquering, Journal Management and Sustainable Development, № 6, vol. 67, Sofia, pp. 144÷148, ISSN 1311-45-06.

Based on the differential equation of the thermal conductivity, a 1D linear mathematical model of the unilateral convective heating process of flat wooden furniture elements before their lacquering, and also a methodology for the computation with it of the specific energy needed for covering of the heat emission of the elements from 1 m² of their non-heated surface, has been suggested. For the numerical solution of the model with the aim of applying the methodology a software program has been prepared, which has been input in the calculation environment of Visual Fortran Professional. Using the program, computations have been carried out for the determination of the specific energy and the specific heat flux needed for covering of the heat emission of flat oak furniture elements with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, width of 0,6 m, and length of 0,6 m during their 30 min unilateral convective heating at temperature of the processing air medium of 100 °C, which circulates above the elements with a velocity of 2 m/s, 5 m/s², and 8 m/s aimed at improvement of the conditions for the subsequent lacquering, at temperature of 20 °C of the surrounding air from the non-heated surface of the elements. The obtained results are graphically presented and analyzed.

33. Deliiski N, N. Trichkov, D. Angelski, **Zh. Gochev** (2018), Computation of the temperature distribution in flat oak details during their one side heating before bending, Journal Management and Sustainable Development, Vol. 73, № 6, Sofia, pp. 140-144, ISSN 1311-4506.

A software program has been prepared in the calculation environment of Visual Fortran Professional for solving of a mathematical model of the one sided heating process of flat wood details, which has been suggested by the authors earlier. With the help of the program, the 1D non-stationary temperature distribution along the thickness of flat oak details with initial temperature of 20 °C, moisture content of 0,15 kg/kg, thickness of 12 mm, 16 mm, and 20 mm during their 30 min one sided heating at temperature of 80 °C, 100 °C, and 120 °C of the heating metal body before bending has been calculated. The obtained results are graphically presented and analyzed.

34. Gochev Zh., G. Vukov, V. Atanasov. P. Vichev (2018), Study on the power energetic indicators of universal milling machine, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. VII, № 1, Sofia, pp. 18-24, ISSN 1314-6149.

Experimental studies during milling of solid wood were carried out. The current study was performed at the Laboratory of Woodworking Machinery, University of Forestry, Sofia. The measurements were carried out using universal milling machine FD – 3 (ZDM – Plovdiv). The correlations between fundamental factors influencing the milling process and target functions, such as cutting force and power, specific cutting work, specific power consumption have been

investigated. On the basis of the analysis of the obtained results, practical recommendations have been proposed.

35. Vukov G., Zh. Gochev (2018), Modelling of the free spatial vibrations of wood shaper and its spindle, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 2, Sofia, ISSN 1314-6149, pp. 19÷26.

The proposed study deals with the modelling of the free spatial vibrations of a woodworking shaper and its spindle. An original mechanical - mathematical model of woodworking shaper and its spindle, developed by the authors, is presented in this work. The model provides the opportunity to explore the free undamped space vibrations of this type of machinery. In this model the woodworking shaper and its spindle are regarded as rigid bodies, which are connected by elastic elements with each other and with the motionless floor. A system of matrix differential equations is compiled and analytical solutions are presented. The natural frequencies and mode shapes for a specific machine can be obtained with their help. The model is supplemented in order to investigate the free damped space vibrations of the considerate system. The new model takes into account the damping properties of machine's elements. A new system of matrix differential equations is developed and the relevant analytical solutions are presented. They allow various numerical solutions for specific machines. The models take into account the characteristics in the construction of woodworking shapers. They include all necessary geometric parameters of this system. Numerical solutions and graphs can be obtained with the help of the developed models. These solutions and graphs are necessary for analyzing the free undamped and the free damped space vibrations of a particular considerate machine.

36. Deliiski N., N. Trichkov, D. Angelski, L. Dzurenda, Zh. Gochev, N. Tumbarkova (2018), Computation of the energy consumption for warming up of flat oak details before their bending, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 2, Sofia, pp. 5÷11, ISSN 1314-6149.

A software program has been prepared in the calculation environment of Visual Fortran for solving of own 1D non-linear model of the one sided heating process of flat wood details. With the help of the program, the 1D non-stationary temperature field in flat oak details with initial temperature of 20 °C, moisture content of 0.15 kg/kg, thickness of 12 mm, 16 mm, and 20 mm during their 30 min one sided heating at temperature of 80 °C of the heating metal body has been calculated. After integration of the temperature field, the energy consumption for warming up of the details before their bending in the production of curved back parts of chairs has been calculated. The obtained results are graphically presented and analyzed.

VII. Publications in unrefined scientific journals and series (27)

37. Gochev Zh. (2006), Electric arc welding of band saw with smelt electrode (Part I), Journal Woodworking and Furniture Manufacturing, № 1, Sofia, pp. 24-30, ISSN: 1311-4972.

Electric arc welding of band saw with smelt electrode increasingly used in Bulgaria. This I-th part of the study performed peculiarity of the processes and technical aspects of the electric arc welding of band saw with smelt electrode in gas protected surround.

38. Gochev Zh. (2006), Electric arc welding of band saw wit smelt electrode (Part II), Journal Woodworking and Furniture Manufacturing, № 2, Sofia, pp. 19-24, ISSN: 1311-4972.

Electric arc welding of band saw blades with smelt electrode increasingly used in Bulgaria. This II-th part of the study continues to performing characteristics of the processes and technical aspects of the electric arc welding of band saw blades with smelt electrode in gas-protected surround. The influence of regime on the geometrical performances and quality-welding joint has investigated. For that, purpose has been used two methods of welding. The first one was MIG welding (Metal-Inert-Gas) with heating in advance and second one – MAG welding (Metal-Active-Gas) without heating in advance.

39. Panayotov P., Zh. Gochev, G. Vasileva (2009), Investigated the influence of some factors affecting on the adhesion on protective decorative coatings on solid wood, Journal Woodworking and Furniture Manufacturing, № 1, Sofia, pp. 13÷20, ISSN: 1311-4972.

It was researching the kind and roughness on the substrate, chemical nature and water-thermally treatment on the adhesion of protective-decorative coatings on solid wood of spruce,

basswood, beech and oak. It was used acrylic, polyurethane and urethane-acrylic varnishes. The adhesion was determined by pull up methods, recommended of BDS 13088-86. The obtained results show influence of water-thermally treatment on the coast adhesion on solid wood.

40. Panayotov P., Zh. Gochev, D. Borisov (2010), Influence of surface roughness on the adhesion of films protective-decorative coatings, Journal Woodworking and Furniture Manufacturing, Vol. 1, Sofia, pp. 8-19, ISSN: 1311-4972.

It was researching influence of surface roughness on the adhesion of films protective-decorative coatings on solid wood of spruce, pine, beech, oak, and MDF. It was used acrylic varnish (AF 5350: Sayerlack- Italy), 2-component polyurethane (Finipur 683/50 BS+ Hardener B-640: Astravernichi- Italy) varnish and 2-component polyurethane primer (Finipur30-E+ Hardener B-640- Astravernichi- Italy). The adhesion was determined by pull up methods, recommended of BDS 13088-86. The obtained results show influence of surface roughness on the adhesion of film coatings on solid wood.

41. Gochev Zh. (2012), Study on sharpening of circular saw with steel teeth, Journal Innovation in Woodworking Industry and Engineering Design, № 1, Sofia, pp. 156-166, ISSN 1314-6149, ISSN 1314-6149.

The process of woodworking tools sharpening is a direct connection from the right choice of the abrasive tools form and its characteristics. Commonplace in companies of the woodworking and furniture industry are significant difficulties on the correct selection and use of abrasive tools. This is negatively effects on productivity and sharpening of cutting tools, respectively, on the cost of tools and materials.

The article presents some experimental results concerning indicators of performance and quality of abrasive instruments with ceramic and organic bond by sharpening of circular saws with steel teeth and made appropriate recommendations for their use.

42. Gochev Zh. (2012), Study on sharpening of narrow band saw blades, Journal Innovation in Woodworking Industry and Engineering Design, № 2, Sofia, pp. 88÷97, ISSN 1314-6149.

Sharpening and smoothing of cutting tools are basic and final stages in their preparation as well. Moreover, in these processes cannot always get an edge with the necessary quality. This requires engineering and technical staff directly involved in the maintenance of the instruments to have good depth knowledge and practical skills.

The article presents results of experimental studies of narrow band saw blades sharpening with abrasive tools with ceramic and organic bond. The indicators of performance and quality of abrasive tools are defined. The durability of sharpened band saw blades was determined.

43. Marinov K., Zh. Gochev, S. Stoilov (2013), Technological opportunities survey of forest short rotation plantations in Bulgaria for energy biomass production. Part 1: Analysis of the production of energy from biomass in Bulgaria and perspectives for creating energy plantations from short rotations wood crops, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 1, Sofia, pp. 148÷160, ISSN 1314-6149.

This report presents some problems on the state and future use of biomass as a renewable source for production of heat and electricity in Bulgaria and Europe. The report covers the potential opportunities of the agricultural lands in Bulgaria for production of energy plantations (SRP) and in particular from forest tree species such as poplar, willow and black locust. A review of their main advantages and disadvantages is made and recommendations for their future development in Bulgaria are presented.

44. Marinov K., Zh. Gochev, S. Stoilov (2013), Technological opportunities survey of forest short rotation plantations in Bulgaria for energy biomass production. Part 2: Technology stages of creation and cultivation of wood biomass plantations, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 1, Sofia, pp. 161÷172, ISSN 1314-6149.

A study on the technologies for creating and growing SRC plantations for the production of biomass for energy purposes has been conducted in the present report. An analysis of the main steps in the technological process has been made. Recommendations are made to the Bulgarian farmers on the necessary techniques for incorporating the crops and the use of appropriate machinery for site preparation, planting and growing of crops.

45. Marinov K., Zh. Gochev, S. Stoilov (2013), Technological opportunities survey of forest short rotation plantations in Bulgaria for energy biomass production. Part 3: Analysis of the technologies and machines for wood biomass plantation harvesting, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 1, Sofia, ISSN 1314-6149, pp. 173÷182, ISSN 1314-6149.

The present survey analyses the key technologies for harvesting SRC plantation for production of biomass and the typical harvesters, suitable for willow, poplar and black locust harvesting in Bulgaria. The advantages and disadvantages of the various technological schemes are highlighted and some recommendations to the Bulgarian producers on their application are made.

46. Gochev Zh. (2013), Investigation of the operating conditions by cutting of poplar and pine logs through wide band saw blades with part-set and swage-set teeth, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 2, Sofia, pp. 99÷105, ISSN 1314-6149.

The paper presents some experimental results concerning cutting process of poplar and pine logs through wide band saw blades with part-set and swage-set teeth. The researches were carried out in a production process of company „Fagus Ltd“, town Pernik. The influence of the feed speed and height of cutting on the productivity of the process and energy consumption were analysed. The results are suitable to have a better knowledge and work out of the production and operating indexes and its optimization by using of wide band saw blades.

47. Gochev Zh., V. Atanasov (2013), Research on the cutting of spruce logs in winter conditions with narrow band saw blades, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. II, № 2, Sofia, pp. 47÷52, ISSN 1314-6149.

Experimental researches were performed in winter conditions with a horizontal band saw „Wood-Mizer“ WM 3000. The tests were conducted in manufacturing conditions of the „Chil Tepe – 97“ Ltd. facility in town of Laki by processing spruce logs. Two types of cutting tools were used: with normal and hardened teeth. The results are analysed and some recommendations are proposed for more efficient use of this machine types.

48. Gochev Zh. (2014), Examination the process of longitudinal solid wood profile milling. Part I: Performance of cutter profile, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. III, № 3, Sofia, pp. 40÷47, ISSN 1314-6149.

In this article the, process of longitudinal solid wood profile milling has been studied. In the first part of the article, an analysis is done with regard to: the profile of universal cutter head used for experimental studies; the characteristics of the chips formation process by longitudinal milling; the influence of the feed per tooth and the accuracy of the cutter teeth placement on the quality of the processed surfaces. The conclusions will be used in the experimental investigation of the milling processes.

49. Gochev Zh. (2014), Examination the process of longitudinal solid wood profile milling. Part II: Influence of the revolution frequency and feed rate on the roughness of the treated surfaces, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. III, № 3, Sofia, pp. 48÷54, ISSN 1314-6149.

This article presents the results of experimental studies of longitudinal solid wood profile milling. In the present part II, the influence of the cutter rotational frequency and the feed rate on the roughness of the processed surfaces are tested. The studies were carried out in the laboratory of „Cutting of wood and cutting tools“ to University of Forestry. For this purpose universal wood shaper machine, model FD-3 (Bulgaria), with bottom-mounted shaft and mechanical feed of material was used. The results obtained can be used as a basis for the formation of specific recommendations aimed at increasing the reliability of the machine and the accuracy and quality of the production.

50. Lieskovsky M., M. Ferencik, Zh. Gochev, K. Marinov (2014), Evolution of energy potential of wood pellets, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. III, № 3, Sofia, pp. 118÷126, ISSN 1314-6149.

The paper presents basic energy characteristics of wood pellets from different producers. We took the samples from producers in Bulgaria and in Slovakia. Energy characteristics of the pellets, such as their dimensions, moisture content, and content of ash, gross and net calorific value were

estimated in accordance with European technical standards. We used the standard STN EN 14961-1:2010, Solid biofuels as a basic platform for estimation. Values of net calorific value belonged to interval between 16,103 MJ/kg and 17,120 MJ/kg, moisture content values were in interval 7,2÷12 %. We observed ash content of the samples from 0,43 to 1,47 %. All of tested samples met the requirements of the standards for ecological biofuel.

51. Marinov K., Zh. Gochev, M. Ferencik, M. Lieskovsky (2014), Exploring the energy performance of wood chips from forest short rotation plantations, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. III, № 2, Sofia, pp. 50÷56, ISSN 1314-6149.

The article presents the methodology and results of an experimental testing of the calorific value and ash content of wood chips, used as a fuel for heating and electricity plants. The wood chips was extracted from willows' short rotation plantation of *Salix Viminalis* – klon Tordis. Studies were conducted in the “Department of Forest Harvesting, Logistic and Amelioration” of the Technical University in Zvolen, R of Slovakia. Wood chips produced from *Salix Viminalis*, klon Tordis indicates a high gross (20,597 MJ/kg) and net calorific value of dry mass (19,255 MJ/kg) under the specific production conditions. Naturally dried wood has a relative humidity $W_r = 11,3\%$ and according to ISO 1928:2011 it has a clean net calorific value 16,907 MJ/kg. This gives grounds to assume that the wood produced from such an energy plantation will have high energy characteristics and will satisfy the market for energy chips.

52. Vukov G., Zh. Gochev (2015), Investigation of the influence of the wearing and the belt drive parameters' changes over the forced torsional vibrations in the saw unit of a wood shaper, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. IV, № 1, Sofia, pp. 50÷58, ISSN 1314-6149, ISSN 1314-6149.

The proposed study presents an investigation of the influence of the wearing and the belt drive parameters' changes over the forced torsional vibrations in the saw unit of a wood shaper. These changes affect the elastic and damping coefficients of the machines' elements. The research is done on the base of a concrete mechanic-mathematical model for numerical investigations of the torsional vibrations of a wood shaper's saw developed by the authors. The main features in the construction of the wood shapers are rendered an account in this model. Work's conditions in the practice are modelled with the variable moments on the drive electric motor and the wood shaper's saw. The conclusions based on the numerical investigations are confirmed by the real conditions.

The results of the whole investigation are applicable to the direct well-founded recommendations concerning the operation of these machines. These recommendations are important for the increase of the accuracy and quality wood shapers' production. At the same time the results of this research are useful for technical diagnostics of the wood shapers.

53. Gochev Zh., V. Atanasov (2016), Sawing of Douglas fir logs wit narrow band saw blades in winter conditions, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. V, № 1, Sofia, pp. 5÷12, ISSN 1314-6149.

The report presents some experimental studies carried out by sawing of logs with narrow band saw blades in winter conditions. The experiments were carried out in manufacturing conditions in February. For the purpose a horizontal band saw „Wirex CZ-1/ZM“, was used.

Operating conditions were established and the quality of sawn lumber from semi frozen logs of Douglas fir (*Pseudotsuga menziesii (Mirb.) Franco*) was tested. The quality preparation of the band saw blade with the used horizontal band saw provides good parameters of the sawn lumber: surface roughness $\bar{R}_m = 190 \mu\text{m}$; variation in the accuracy of the size and shape of 1,5 mm and 1,8 mm at a feed speed of $U = 11,5 \text{ m/min}$.

54. Deliiski N., N. Trichkov, D. Angelski, Zh. Gochev (2016), Computation of the heat flux needed for unilateral warming up of flat spruce details before their bending, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. V, № 2, Sofia, pp. 50÷58, ISSN 1314-6149.

An approach for the computation of the heat flux, which is needed for warming up of flat wood details during unilateral heating aimed at their plasticizing in the production of curved outside parts for corpses of stringed music instruments, has been suggested. The approach is based on the numerical integration and differentiation of the solutions of a linear model for the calculation of the non-stationary 1D temperature distribution along the thickness of subjected to unilateral heating flat wood details. The paper presents solutions of the model concerning the non-stationary change in the

specific heat flux needed for warming up of flat spruce details with thicknesses of 6, 8 and 10 mm during their unilateral heating at temperatures of the electrically heated metal band equal to 100, 120, and 140 °C.

55. Deliiski N., N. Trichkov, **Zh. Gochev**, D. Angelski (2017), Transformation of two mutually connected models for convective heating of wood details before their lacquering in a form, suitable for programming, Science journal „Innovations in Woodworking Industry and Engineering Design“, vol. VI, № 1, Sofia, pp. 27÷34, ISSN 1314-6149.

Using the explicit form of the finite-difference method, two suggested by the authors mutually connected mathematical models have been transformed in a form, suitable for programming. For the numerical solution of the transformed models, a software program has been prepared in the calculation environment of Visual Fortran Professional. With the help of the program, the 1D distribution of the temperature along the thicknesses of flat oak details and of their carrying transport rubber band with $h_w = 16$ mm, $l_w = 0,6$ m, $u = 0,08$ kg/kg, $h_B = 4$ mm, $b_B = 0,8$ m, and $t_0 = 20$ °C, during unilateral convective heating for a period of 10 min at $t_{ha} = 100$ °C, $v_{ha} = 2$ m/s, 5 m/s, 8 m/s, and $t_{nha} = 20$ °C in order to ensure suitable thermal conditions for the subsequent details' lacquering has been calculated, visualized and analyzed.

56. Gochev Zh., Z. Janjic (2010), CNC control and CAD&CAD systems, Časopis „Menadžment znanja“, Godina V, broj 1÷2, Srbija, pp. 167÷175, ISSN 1452-9661.

In the present paper some principle aspects of the control and programming insurance on production CNC centre are considered, respectively CAD / CAM systems for graphic programming.

57. Mijatović, M., Janjić, Z., Jevremović, V., **Gočev Ž.** (2010), CAD programming system for CNC, Časopis „Menadžment znanja“, Godina V, broj 1÷2, , Srbija, pp. 143÷149, ISSN 1452-9661.

In order to increase the automation process in CNC machine programs, computer capabilities are increasingly being used. Computers are used in several phases of the programming process, which increases accuracy and shortens programming time. Manual and machine programming are performed according to the system programming language in fully geometric and technologically defined worksheet drawings. This programming approach has no connection with designing parts, that is, no database of geometric and technological information developed for design is used. Modern software tools use CAD product definition systems that are integrated with dedicated CAM systems to produce CNC machines.

58. Mijatović, M., Janjić, Z., Jevremović, V., **Gočev Ž.** (2010), Generisanje putanje alata i automatska izrada programa za CNC mašinu v programskom paketu Pro/ENGINEER, Časopis „Menadžment znanja“, Godina V, broj 3÷4, Srbija, pp. 156÷168, ISSN 1452-9661.

The introduction of software packages for modelling machine parts in modern industrial processes creates conditions for more efficient and better programming of the production process of CNC machines. The classic way of programming was limited to the very large and complex work of the developer, and everything else related to the machine's characteristics. Linking computers and control devices to CNC machines reduces the developer's performance and facilitates the development of a program to produce different products. Namely, based on the model, the tool trajectory can be traced and automatically generated a CNC machine program.

59. Vukov G., **Zh. Gochev**, V. Slavov (2013), Investigation of the natural frequencies and the mode shapes of circular saw with compensating slots by the finite elements method, Journal of Wood Science, Design and Technology „Wood, Design & Technology“, vol. 2 № 1, Skopje, pp. 53÷61, ISBN 1857-838.

This paper shows the methodical and results of the simulative investigations of the circular saw with compensating slots. The investigations are an extension of the previous ones of the authors. The natural frequencies and mode shapes of this kind of circular saws are obtained as results of the investigations. The estimation is done by the application programme Cosmos Works. Physical and mechanical properties of the materials are taken into account. The adequate mechanic-mathematical model is used for the aims of the study. The typical characteristics of the construction of this kind of circular saws are taken into account in the model. The circular saw is drawn in 3D by the application programme Solid Works and it is modelled with four nodes 3D finite elements. The results of this investigation prove the practical significance of the model. They point the possibilities for determinations of resonant regimes and they are a base for their detail studying.

60. Vukov G., **Zh. Gochev**, V. Slavov (2014), Investigation of the natural frequencies and the mode shapes of circular saw with compensating slots and low noise slots by the finite elements method, Journal of Wood Science, Design and Technology „Wood, Design & Technology“, vol. 3 № 1, Skopje, pp. 57-65, ISBN 1857-8381.

This paper shows the methodical and results of the simulative investigations of the circular saw with compensating and low noise slots. The investigations are an extension of the previous ones of the authors. The natural frequencies and mode shapes of this kind of circular saws are obtained as results of the investigations. The estimation is done by the application programme Cosmos Works. Physical and mechanical properties of the materials are taken into account. The adequate mechanic-mathematical model is used for the aims of the study. The typical characteristics of the construction of this kind of circular saws are taken into account in the model. The circular saw is drawn in 3D by the application programme Solid Works and it is modelled with four nodes 3D finite elements. The results of this investigation prove the practical significance of the model. They point the possibilities for determinations of resonant regimes and they are a base for their detail studying.

61. Atanasov V., **Zh. Gochev**, G. Vukov, P. Vichev, G. Kovachev (2018), Influence of some factors on the cutting force in milling of solid wood, Scientific journal, „Chip and Chipless Woodworking Processes“, Technical University- Zvolen, Slovakia, pp. 9-15, ISSN 2453-904X (print), ISSN 1339-8350 (online).

The paper examines the impact of factors cutting speed V , feed speed U and milling area A over the cutting force P when operating with a universal woodworking milling machine with a lower spindle position. For this purpose, a planned three-factor regression analysis was carried out. Modern testing equipment and relevant software products were used to process the obtained values. The selected wood is beech (*Fagus sylvatica L.*). A regression equation was obtained. It can be used to calculate the cutting force P at different levels of considered factors. The results are analysed and practical recommendations are proposed.

62. Vichev P., **Zh. Gochev**, V. Atanasov (2018), Influence of the cutting mode on the surface quality during longitudinal plane milling of articles from beech wood, Scientific journal, „Chip and Chipless Woodworking Processes“, Technical University - Zvolen, Slovakia, pp. 183-190, ISSN 2453-904X (print), ISSN 1339-8350 (online).

The objectives of the current study are to investigate the influence of the cutting mode on the surface quality during longitudinal plane milling of details from beech (*Fagus sylvatica L.*) wood. The influence of the rotation frequency (n) and the feed rate (U) at different thickness of the cut-out layer (h) has been assessed. On the basis of the obtained results, graphical dependencies, representing the relationship between the different studied factors have been derived. In order to achieve a higher quality of the processed surfaces, practical recommendations for the optimal values of the evaluated factors have been suggested. The surface roughness of the material (surface) was measured with a roughness tester, type „Surftest SJ-210“ (Mitutoyo, Japan).

63. Deliiski N., D. Angelski, N. Trichkov, L. Dzurenda, **Zh. Gochev**, N. Tumbarkova (2018), Computation of the heat energy and flux needed for covering of the emission from flat oak details during their one sided heating before bending, Scientific journal, „Chip and Chipless Woodworking Processes“, Technical University- Zvolen, Slovakia, pp. 241-248, ISSN 2453-904X (print), ISSN 1339-8350 (online).

A software program has been prepared in the calculation environment of Visual Fortran for solving of own 1D non-linear mathematical model of the one sided heating process of flat wood details. The model includes a mathematical description of the specific (for 1 m^2) energy consumption, q_e , and the specific heat flux, $dq_e/d\tau$, needed for covering of the emission in the surrounding environment of the subjected to one sided heating wood details aimed at their plasticizing before bending.

Using the program, computations have been carried out for the determination of the change in the energy q_e and in the flux $dq_e/d\tau$, which are consumed by flat oak details with an initial temperature of $20 \text{ }^\circ\text{C}$, moisture content of $0,15 \text{ kg/kg}$, and thicknesses of 12 mm , 16 mm , and 20 mm during their 30 min unilateral heating at temperatures of the heating metal body of $80 \text{ }^\circ\text{C}$ and of the surrounding air of $20 \text{ }^\circ\text{C}$. The obtained results are graphically presented and analysed.

VIII. Publications in proceedings of scientific forums (37)

64. Gochev Zh., P. Nikolov (2008), Investigation on the working capacity and the quality of band saw blades with setting teeth for band saw machines with carriage and for horizontal mobile band saw machine, Proceedings of International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November 14-16, Yundola, pp. 201-205, ISSN 1314-0663.

The paper presents some experimental results have respect to working capacity, quality and wearing out of wide band saw blades with part-set teeth for band saw machines with carriage and narrow band saw blades with part-set teeth for horizontal mobile band saw machines. Some dependences and recommendations about their more effective using in wood-processing industry of Bulgaria are made.

65. Gochev Zh., M. Tevosyan (2009), Software ensures at working of wood composite materials with CNC machining centers „WEEKE Ventures 3M“, Scientific proceedings, 2-nd, International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November , 6÷8, Yundola, pp. 115-120, ISSN 1314-0663.

In the present paper the programming insurance on production CNC centre is considered, respectively CAM systems for graphic programming. Through them the detail programmes are made. The work pro-gramme „WoodWOP“ for CNC centre model „WEEKE Ventures 3M“ is examined.

66. Гочев Ж., (2009), For some defects in stellite deposition of band saw teeth, Scientific proceedings, 2-nd, International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November 6-8, Yundola, pp. 168-175, ISSN 1314-0663.

In the article are examined the method of satellite depositing on band saw teeth and there application in Bulgaria. The defects that are developed in inappropriate stelliting are explored. Experimental investigations on the working capacity of wide band saw blades are carried out and the defects in satellite deposition of their teeth were considered as well. Technology recommendation about the preparation of the band saw blades teeth by their stelliting without allowing defects are made.

67. Panayotov P, G. Saykova, Zh. Gochev (2010), Investigation the influence of roughness of the wood on the gloss of protective-decorative films, Scientific proceedings, 3-th, International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November 5-7, Yundola, pp. 211-218, ISSN 1314-0663.

This report experimentally investigated the influence of roughness of the wood based on the gloss of the protective - decorative films. Established and the factors affecting the decorative feature (glow) of the solid coating. For this purpose used test fixtures wood beech and spruce, one-component water-soluble acrylic lacquer and two-component polyurethane varnish. High-gloss surface film is determined in accordance with regulations of BS EN ISO 2813:2001 with a gloss meter an angle of incidence of the luminous flux of 20°, 60° and 85°. Test results obtained showed significant roughness of the wood based on the gloss of the coating film formed on it.

68. Stefanov St., Zh. Gochev, N. Trichkov, P. Vitchev, D. Koynov (2010), Initial study of stress variations of a saw shaft with regard to fatigue calculation, Scientific proceedings, 3-th, International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November 5-7, Yundola, pp. 163-168, ISSN 1314-0663.

The paper is the first step of directing research resources to covering the deficiency of specific studies of loading variation in machines and technological equipment in forest industry with regard to fatigue calculation. A beginning was set with a study of the stress variations in a saw shaft as one of the popular components of woodworking machines. That shaft had been studied in terms of strength in a series of papers, however not in terms of fatigue strength under time varying stresses of bending and torsion. As the bending appears during rotation i.e. it is so called rotating bending, the stress of bending is not static: it is cyclic and follows a simple sinusoid in case the bending moment is constant. However, under actual operational conditions, the bending moment varies: the possible variations of the cutting forces are studied in the paper. Then, the mentioned sinusoid is not kept the same but changes upon every revolution. Together with the bending moment, the torsional moment also varies (with peaks when the saw meets knars) and thus the stress of torsion also changes. Hence,

the two stress-time functions are difficult to study: they are too complicated, too specific (not met in other machine shafts), non-cyclic, random and no proportional. In this situation, the so called IDD (Integration of Damage Differentials) method can be applied for fatigue life evaluation as developed at the University of Forestry. In the paper, possible oscillograms of the stresses of bending, torsion etc. are shown and in next study they are envisaged to be compared with experimental ones obtained by strain gauges.

69. Vukov G., **Zh. Gochev**, V. Slavov (2010), Torsional vibrations in the saw unit of a kind of circular saws. Mechanical-mathematical model, Scientific proceedings, 3-th, International Science and Technology Conference, „Innovation in Woodworking Industry and Engineering Design“, November 5-7, Yundola, pp. 185-188, ISSN 1314-0663.

This study focuses on an original mechanical-mathematical model for investigation of torsional vibrations in the saw unit of a kind of circular saws. This model allows investigating of dynamical processes in circular saws in specific work regimes. The model also gives an opportunity to find out and analyse reasons for appearance of vibrations and noise. As a result, it becomes possible to make some recommendations about decrease of vibrations and noise during the work of these machines and it leads to achievement of necessary accuracy and quality of treated pieces.

70. Deliiski N., N. Trichkov, **Zh. Gochev**, D. Angelski (2016), Modelling of the energy needed for warming up of flat wood details during their convective heating before lacquering, International scientific conference „Automatics and Informatics’ 16“: proceedings of papers, 4-5 October, Sofia, pp. 37-40, ISSN 1313-1850.

A mathematical model and a numerical approach for the computation of the specific energy consumption, which is needed for warming up of flat furniture elements before their lacquering, have been suggested. The approach is based on the integration of the solutions of a non-linear model for the calculation of the nonstationary 1D temperature distribution along the thickness of subjected to unilateral convective heating furniture elements. With the help of a self-prepared software program, computations have been carried out for the determination of the change in the specific energy, which is consumed by oak furniture elements with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, and length of 0,6 m, 1,2 m, and 1,8 m, during their 10 min unilateral convective heating by hot air with temperature of 100 °C and velocity of 5 m/s.

71. Deliiski N., N. Trichkov, **Zh. Gochev**, D. Angelski (2017), Computation of the energy needed for warming up of the carrying rubber band of flat wood details during their unilateral convective heating before lacquering, International scientific conference „Automatics and Informatics’ 17“: proceedings of papers, 4-6 October, Sofia, pp. 181-184, ISSN 1313-1850.

A mathematical model and a numerical approach for the computation of the specific energy consumption, which is needed for warming up of the carrying rubber band of flat wood details before their lacquering, have been suggested. The approach is based on the integration of the solutions of a non-linear model for the calculation of the non-stationary 1D temperature distribution along the thickness of the rubber band during unilateral convective heating of the lying on it flat wood details. With the help of a self-prepared software program, computations have been carried out for the determination of the change in the specific energy, which is consumed by the rubber band with thickness of 4 mm and width of 0,8 m during 10 min unilateral convective heating of the lying on it oak details with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, and length of 1,2 m by hot air with temperature of 100 °C and velocities of 2 m/s, 5 m/s, and 8 m/s.

72. Deliiski N., D. Angelski, N. Trichkov, **Zh. Gochev**, N. Tumbarkova (2018), Computation of the specific energy consumption for one sided heating of flat oak details before bending, International scientific conference „Automatics and Informatics’ 18“, proceedings of papers, 4-6 October, pp. 81-85, Sofia, ISSN 1313-1850.

A numerical approach for the computation of the total specific energy consumption, q_{total} , which is needed for one sided heating of 1 m² of flat wood details aimed at their plasticizing in the production of curved back parts for chairs, have been suggested. The energy q_{total} consists of two components: energy needed for warming up of the wood itself, q_w , and energy needed for the covering of the heat emission from the non-heated side of the wood details, q_e , i.e. $q_{total} = q_w + q_e$. The suggested approach is based on the integration of the solutions of own non-linear model for the calculation of the non-stationary 1D temperature distribution along the thickness of subjected to one sided heating

flat wood details. For the numerical solution of the model and for simultaneous determination of the specific energies q_w , q_e , and q_{total} a software program has been prepared, which has been input in the calculation environment of Visual Fortran. Using the program, computations have been carried out for the determination of the change in the specific energies q_w , q_e , and q_{total} , which are consumed by oak details with an initial temperature of 20 °C, moisture content of 0.15 kg/kg, and thicknesses of 12 mm, 16 mm, and 20 mm during their 30 min one sided heating at temperatures of the heating metal body of 80 °C and 100 °C when the temperature of the surrounding air is 20 °C.

73. Vichev P., Zh. Gochev (2018), Influence of the cutting mode on the surface quality during longitudinal plane milling of articles from Scots pine, 9th Scientific & Technical Conference „Innovations in Forest Industry and Engineering Design“, proceedings of papers proceedings of papers, 27-29 September, Sofia, pp. 367-373.

The current study investigates the changes in the surface quality of experimental samples of Scots pine (*Pinus sylvestris* L.) wood during a milling process, performed with different rotation speed of the cutting tool (n), feed rates (U) and different thicknesses of the removed layer (h). On the basis of the performed experiments, graphical dependencies, representing the relationship between the different factors have been derived. In order to achieve a higher quality of the milled (processed) surfaces, practical recommendations for the optimal values of the evaluated factors have been suggested. The surface roughness of the material (surface) was measured with a roughness tester, type „Surftest SJ-210“ (Mitutoyo, Japan).

74. Deliiski N., D. Angelski, N. Trichkov, Zh. Gochev (2018), Computation of the average mass temperature of the wood and the rate of its change during one sided heating of flat oak details before bending, Proceeding so 26th International Symposium „Management of Energy, Industrial and Environmental Systems“, 10.05 – 11.05.2018 г., Bankya, pp. 39-42.

An approach for computing the average mass temperature of the wood and the rate of its change during one sided heating of flat wood details, has been suggested. The approach is based on the use of the solutions of own non-linear model for the calculation of the non-stationary 1D temperature distribution along the thickness of subjected to one sided conductive heating flat wood details aimed at their plasticizing in the production of curved back parts of chairs. A software program has been prepared in the calculation environment of Visual Fortran for solving of the model. With the help of the program, the 1D non-stationary temperature field in flat oak details with an initial temperature of 20 °C, moisture content of 0,15 kg/kg, thickness of 12 mm, 16 mm, and 20 mm during their 30 min one sided heating at temperature of 100 °C of the heating metal body has been calculated. After integration of the temperature field, the average wood temperature and the rate of its change of the subjected to one sided heating oak details has been calculated. The obtained results are graphically presented and analysed.

75. Gochev Zh. (2006), Tempering of band saw blades after electric ARC welding with smelt electrode, The 5th International Scientific Conference: proceedings of papers, „Chip and Chipless Woodworking Processes“, Technical University, 12-14.X., Zvolen, Slovakia, pp. 143-150, ISBN 80-228-1666-3.

Electric arc welding of band saw with smelt electrode increasingly used in Bulgaria. The basic risk by welding of band saw blade made of low alloy tool steels is a possibility of shows up of hardened structures formation and cold cracks in the zone of heat influence. That reflected unfavourably on working capacity of the saw blade. Consequently, it is cracked or torn in the weld area under the influence of high inside tensions and outside loads. This article studied the processes of tempering of band saw blades after its welding using MIG/MAG methods with or without of heating in advance.

76. Gochev Zh., Z. Janjic, (2007), Determination of the Parameters on the Temperature-Field by Electric Arc Welding of Band Saw Blade with Smelt Electrode, Proceedings of International Symposium „Sustainable Forestry–Problems and Challenges Perspectives and Challenges in Wood Technology“, 60 years Faculty of Forestry and 35 years Wood Technology, October 24-26, Ohrid, Macedonia, pp. 359-364, ISSN 9989-132-10-0.

Electric arc welding of band saw with smelt electrode increasingly used in Bulgaria. This article investigates the basic parameters on the temperature-field by electric arc welding of band saw with smelt electrode. The temperature-field of two kind welding processes in gas-protected surround

was determined: MIG (metal-inert-gas) and MAG (metal-active-gas). The first one was in advance with warm up of band saw edges and the second without. Because of test, it is possible get a better understanding and using process of electric arc welding of band saw with smelt electrode.

77. Јањич З., Ж. Гочев, А., Кавалов, В., Кољозов, (2007), Метода за оценување на комплексната ефикасност при набавка на CNC обработувачки центри во претпријатијата за производство на мебели, Proceedings of International Symposium: „Sustainable Forestry – Problems and Challenges Perspectives and Challenges in Wood Technology“, 60 years Faculty of Forestry and 35 years Wood Technology: proceedings of papers, October 24-26, Ohrid, Republic of Macedonia, pp. 390-394, ISBN 978-608-4723-00-4.

During the last two decade in the furniture producing industry happened some large positive changes, which can be named as revolutionary. The essence of this changes is wide use in the new generation of wood processing machines, especially machines for furniture production, computer numerical control machines, called wood machining centres.

For that purpose, the aim of this paper is to review the technological capacities of the offered wood machining centres, and suggest a method for more accurate assessment of their complex influence to main technological and economic factors, important for every furniture producer.

78. Gochev Zh. (2008), Investigation on the grinding quality of planing knives made of high-speed steel (HSS) type M2 and specific consumption of cubic boron nitride (CBN), The 6th International Scientific Conference: proceedings of papers, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University- Zvolen, 11-13.IX. Šturovo, Slovakia, pp. 89-97, ISBN 978-80-228-1913-8.

This article presents experimental results in respect of planer knives sharpening made of high speed steel, type M2 with abrasive tools from cubic boron nitride (CBN). Specific consumption of CBN abrasive discs is determined. The grits of CBN abrasive were with common and heightened durability, silicate holding and organic bonded. Some qualitative indices when grinded planer knives were investigated. Certain Some qualitative indicators related to the process of planer knives sharpening were also investigated.

79. Gochev Zh., St. Stoilov (2008), Technologies for recovering for logging residues for biomass energy production, The 6th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University- Zvolen, 11-13.IX. Šturovo, Slovakia, pp. 327-334, ISBN 978-80-228-1913-8.

Potential wooden biomass sources include materials from thinning, selective silvicultural systems and regeneration, coppice stands and short rotation forests (SRF) as well as logging residue. Additional materials can also come from sawmill wastes. Forest biomass can be differentiated as logging residue and fuelwood. Logging residue (branches, tops and waste wood) is a by-product of conventional logging operations and its advantage is that in many cases the extraction costs are covered by Roundwood products. The volume of forest residue relative to the volume of timber harvested is very variable. Around 36% from coniferous and 42% from deciduous wood harvested in Bulgaria are potential fuel source for wooden biomass energy productive system. A principled technological outline for 2 MWh combined heating plant A general technological scheme for a 2 MWh combined heating and cogeneration plant is presented, based on undersized and residue wood coming from logging and wood procession, commenting to chips and converting them into steam and electricity is presented and described.

80. Stoilov St., Zh. Gochev, K. Marinov (2008), Biomass potential of Bulgarian forest-based sector for energy production, The 6th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University - Zvolen, 11-13.IX. Šturovo, Slovakia, pp. 381-386, ISBN 978-80-228-1913-8.

There are significant opportunities to gain different kind of energy utilizing of Bulgaria's wooden biomass. At present in Bulgaria fuelwood is with the highest contribution to energy balance from all Renewable Energy Sources (RES) with 3,6 % from primary energy consumption and 7,4% from final energy consumption. The future prospective based on the results obtained show significant technical potential of Bulgarian forest-based sector for woody biomass for energy purpose to reach up to 12% from final energy consumption in Bulgaria in 2020.

81. Marinov K., Zh. Gochev, St. Stoilov (2008), Analysis of main structural and technological parameters of the screw mechanisms, utilized at wood chips processing, The 6th International Scientific Conference, „Chip and Chipless Woodworking Processes“: proceedings of papers, Technical University- Zvolen, 11-13.IX. Šturovo, Slovakia, pp. 165-170, ISBN 978-80-228-1913-8.

The screw conveyors and screw processing machines for wood chips have wide application in forest and wood-processing industry. Many of the machines are assembled with screw mechanisms to perform the main operations. The utilization of these mechanisms is due to some advantages they ensure at executing the technological processes, as for example unceasing of the process, high productivity, low levels of noise, dustless work, etc. The design of screw mechanisms is in accordance with the determination of their main structural and technological parameters. Big part of the elaborated constructions is realized on the base of the practical experience. The relatively complicated transportation of products into the screw mechanisms makes difficult to express the process by mathematical means. This fact defines the problems with deducing of analytical relationships for determination of the main parameters of these mechanisms. In the present work some basic parameters of screw mechanisms used for transportation and wood chips density compression are deduced and proposed.

82. Gochev Zh., St. Stoilov (2009), Research on saw chains wearing and sharpening, Formec 2009, International Symposium on Forestry Mechanisation, Prague and Kostelec nad Černými lesy, Faculty on Forestry and Wood Science, Czech University of Life Sciences Prague, In Proc. of FORMEC 42nd International Symposium on Forestry Mechanization: proceedings of papers, Kostelec nad Černými lesy, June, 21st – 24th 2009, pp. 160-165, ISBN: 978-80-213-1939-4.

The paper deals with the linear and angular woodcutting parameters of saw chains new, during cutting, before sharpening and after sharpening by means of three different methods. During woodcutting the linear and angular parameters of saw chains worsen and compared to original parameters before sharpening top-plate filing angle is 80%, cutting angle is 86,7%, roundness radius is 200% and roughness is 167%. The results obtained revealed that most precise method is sharpening with chain grinder leading to recovery of following original parameters: top-plate filing angle 100%, cutting angle 98,8%, roundness radius 125% and roughness 96,4%, even better than that of new saw chain. When sharpening is manual the linear and angular parameters of saw chain are worse. Saw chain sharpening with file holders reaches the worst results in comparison with original parameters: top-plate filing angle 96,7%, cutting angle 95%, roundness radius 150% and roughness 138%. Saw chain sharpening with filing guide shows intermediate results compared to original parameters as follows: top-plate filing angle 100%, cutting angle 96,7%, roundness radius 150% and roughness 112%.

Therefore, machine sharpening provides most qualitative and productive work of saw chains as well as shorter duration of sharpening than manual one, but it is not suitable in forest condition. An indication of worn-out of saw chains is chip process. The large tape-like chips are symptom of well sharpening saw chain and normal woodcutting, while fine powdered chips show that saw chain is worn as well as needs for additional effort made by the logger.

83. Gochev Zh., K. Marinov, M. Lieskovský, M. Ferenčík, S. Stoilov (2013), Exploring the energy performance of industrial and laboratory produced pellets, International scientific conference „Wood Technology & Product Design“: proceedings of papers, S.S. Cyril and Methodius University, Skopje, Faculty of Design and Technologies of Furniture and Interior, Republic of Macedonia, 16-18 May 2013, University congress centre, Ohrid, pp. 10-17, ISBN 978-608-4723-00-4.

This article presents the methodology and results of experimental testing of the calorific value and ash content of industrial and laboratory produced pellets. Studies were conducted in the Department of Forest Harvesting, Logistic and Amelioration of the Technical University in Zvolen.

84. Vukov G., Zh. Gochev, Valentin Slavov (2013), Investigation of the natural frequencies and the mode shapes of circular saw using finite elements method. Part I. Mechanic – mathematical model, International scientific conference „Wood Technology & Product Design“: proceedings of papers, S.S Cyril and Methodius University, Skopje, Faculty of Design and Technologies of Furniture and Interior, Republic of Macedonia, 16-18 May 2013, University congress centre, Ohrid, pp. 18-22, ISBN 978-608-4723-00-4.

This study focuses on an adequate mechanic-mathematical model for investigation of free vibrations of a circular saw. The model presents features in the construction of a kind of circular saws. It also gives an opportunity to make simulative investigations which can be used for studying circular saw's natural frequencies and mode shapes. The research is done by the Finite element method. As a result this study allows the determination of the resonant regimes. The determination of these regimes is important for introduction of adequate measures which can guarantee their using. It directly influences the reliability of the machine as well as the accuracy and quality of the production.

85. Vukov G., **Zh. Gochev**, Valentin Slavov (2013), Investigation of the natural frequencies and the mode shapes of circular saw using finite elements method. Part II. Numerical investigations, International scientific conference „Wood Technology & Product Design“: proceedings of papers, S.S Cyril and Methodius University, Skopje, Faculty of Design and Technologies of Furniture and Interior, Republic of Macedonia, 16-18 May 2013, University congress centre, Ohrid, pp. 52-59, ISBN 978-608-4723-00-4.

This paper shows the method and results of the simulative investigations of the circular saw. The natural frequencies and mode shapes of the circular saw are obtained as results from the investigations. The estimation is done by the application programme Cosmos Works. Physical and mechanical properties of the materials are taken into account. The adequate mechanic-mathematical model, which is described in details in the first part of this investigation, is used for the aims of the study. The typical characteristics of the construction of a kind of circular saws are taken into account in the model. The circular saw is drawn in 3D by the application programme Solid Works and it is modelled with four nodes 3D finite elements. The results of this investigation prove the practical significance of the model. They point the possibilities for determinations of resonant regimes and they are a base for their detail studying.

86. Vukov G., **Zh. Gochev**, (2013), Possibilities for improvement of the control of the technical state and determination of the serviceability of carved veneer machines, International scientific conference „Wood Technology & Product Design“: proceedings of papers, S.S Cyril and Methodius University, Skopje, Faculty of Design and Technologies of Furniture and Interior, Republic of Macedonia, 16-18 May 2013, University congress centre, Ohrid, pp. 93-98, ISBN 978-608-4723-00-4.

Some problems of improvement of vibration control methods and passing serviceability of a carved veneer machine are discussed in this paper. Criterion for estimation of the technical state and determination of passing serviceability is formed on the base of the investigation of torsional vibrations by using an original dynamical model. Special features in the construction and peculiarities of the work regimes in exploitation of these machines are modelled. Investigations indicate that regular diagnostics increase the reliability and the effectiveness and decrease the expenses of the repair and service. It guarantees the precision and the quality of the production with carved veneer machines at the same time.

87. Deliiski N., L. Dzurenda, N. Trichkov, **Zh. Gochev**, D. Angelski (2016), Computation of the heat transfer coefficients during unilatera convective heating of flat oak details with different lengths before lacquering, 10th International science conference „Chip- and Chipless woodworking processes“: proceedings of papers, 8-10 September, Zvolen, Slovakia, pp. 254-257, ISBN 978-608-4723-00-4.

Based on the differential equation of the thermo-conductivity, a 1D linear mathematical model of the unilateral convective heating process by air of flat furniture details before their lacquering has been presented. A software program has been prepared for the numerical solution of the model with the help of an explicit scheme of the finite difference method, which has been input in the calculation environment of Visual Fortran Professional. Using the program, computations have been carried out for the determination of the change in the temperatures and the convective heat transfer coefficients of both surfaces of flat oak details with an initial temperature of 20 °C, moisture content of 0,08 kg/kg, thickness of 16 mm, width of 0,6 m and length of 0,6 m, 1,2 m, and 1,8 m during their 10 min unilateral heating by hot air with temperature of 100 °C and velocity of 5 m/s.

88. Deliiski N., D. Angelski, N. Trichkov, **Zh. Gochev** (2016), Computation of the 1D temperature distributions in oak details with different lengths during their unilateral convective heating before lacquering, 10th International science conference „Chip- and chipless woodworking processes“: proceedings of papers, 8-10 September, Zvolen, Slovakia, pp. 255-262, ISBN 978-608-4723-00-4.

A 1D linear mathematical model for the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating of flat wood details before their lacquering has been presented. For the computation of the temperature distribution along the details' thickness at given temperatures and velocities of the circulated hot air a software program has been prepared in the calculation environment of Visual Fortran Professional. With the help of the program, computations have been carried out for the determination of the 1D temperature distribution along the thickness of oak details with an initial temperature of 20 °C, moisture content of 0,08 kg/kg, thickness of 16 mm, width of 0,6 m, and lengths of 0,6 m, 1,2 m, and 1,8 mm during their 10 min unilateral heating by hot air with 100 °C and velocity of 5 m/s at temperature of the surrounding air from the non-heated side 20 °C. The obtained results are graphically presented and analysed.

89. Vukov G., **Zh. Gochev**, V. Slavov, P. Vichev, V. Atanasov (2016), Mechanical-mathematical model for investigations of the natural frequencies and mode shapes of the free spatial vibrations of wood shaper and its spindle, 10th International science conference „Chip- and Chipless woodworking processes“: proceedings of papers, 8-10 September, Zvolen, Slovakia-608-4723-00-4, pp. 203-209, ISBN 978.

An original mechanical - mathematical model of wood shaper and its spindle, developed by the authors, is presented in this work. The model provides the opportunity to explore the free space vibrations of this type of machinery. It takes into account the characteristics in the construction of wood shapers. In this model the wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic elements with each other and with the motionless floor. The model takes into account the necessary mass, inertia and elastic properties of the elements of the considered system. It includes all necessary geometric parameters of this system. A necessary system of matrix differential equations is compiled and analytical solutions are presented. Numerical solutions can be obtained with their help by using the parameters of a specific machine.

90. Vukov G., **Zh. Gochev**, V. Slavov, P. Vichev, V. Atanasov (2016), Numerical investigations of the natural frequencies and mode shapes of the free spatial vibrations of a wood shaper and its spindle, 10th International science conference „Chip- and Chipless woodworking processes“: proceedings of papers, 8-10 September, Zvolen, Slovakia, pp. 211-216, ISBN 978-608-4723-00-4.

This paper presents the results of the numerical investigation of the natural frequencies and mode shapes of the free spatial vibrations of a wood shaper and its spindle. The study is based on a specific mechanical - mathematical model, developed by the authors, which allows the study of vibrations of this type of machinery. In this model a wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic elements with each other and with the motionless floor. This study renders an account the mass, inertia, and elastic properties and geometric parameters of the machine. The results of the numerical investigations are presented. They are obtained with modern software and by using parameters of a particular machine. The calculated natural frequencies are necessary for the definition of the resonant modes. The exact determination of these regimes is important in connection with the implementation of adequate measures to ensure their control. The results are applicable to the formation of specific, reasonable recommendations during the operation of the concerned machinery. These recommendations are targeted at the improving the reliability of the investigated machines, and at the same time they are targeted at the accuracy and quality of production of wood shapers.

91. Vukov G., **Zh. Gochev**, V. Slavov (2016), Torsional vibrations in the saw unit of kind of circular saw. Numerical investigations of the natural frequencies and mode shape, 10th International science conference „Chip- and Chipless woodworking processes“: proceedings of papers, 8-10 September Zvolen, Slovakia, pp. 217-224, ISBN 978-608-4723-00-4, ISBN 978-608-4723-00-4.

A numerical investigation of the natural frequencies and mode shapes of the circular's saw unit is presented in this study. The research is done on the base of an adequate mechanic-mathematical model for investigation of free torsional vibrations of a circular saw developed by the authors. The model presents features in the construction of a kind of circular saws. As a result this study allows the determination of the resonant work regimes. The determination of these regimes is important for introduction of adequate measures which can guarantee their using. The results of the investigation can be used as a base for making some recommendations concerning the increase of reliability of the machine as well as the accuracy and quality of the production.

92. Gochev Zh. (2016) Laser wood cutting and modification in its structure, II-nd International Furniture Congress: proceedings of papers, 13-15 October, Muğla Sitki Koçman University Faculty of Technology Department of Wood Product Industrial Engineering, Turkey, pp. 210-215.

In this article a comparison between the specific work of cutting (A) with classical cutting instruments and specific energy of laser cutting (E_c) of wood – main parameters that are characterizing this process - is made. Both, empirically and theoretically the specific energy of laser cutting of different coniferous and deciduous tree species is defined. Using the methods of infrared (IR) spectroscopy and raster electron microscopy (REM) the modifications to the chemical composition and the microstructure of the wood in the area of the groove performed by a CO₂ laser beam have been studied.

93. Vukov G., Zh. Gochev, V. Slavov (2016), Mechanical-mathematical model for investigations for investigations of the free damped spatial vibrations of wood shaper and its spindle, II-nd International Furniture Congress: proceedings of papers, 13-15 October, Muğla Sitki Koçman University Faculty of Technology Department of Wood Product Industrial Engineering, Turkey, pp. 216-219.

A mechanical - mathematical model of wood shaper and its spindle, developed by the authors, is presented in this work. The model provides the opportunity to explore the free damped spatial vibrations of this type of machinery. It takes into account the characteristics in the construction of wood shapers. In this model the wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic and damping elements with each other and with the motionless floor. The model takes into account the necessary mass, inertia, elastic and damping properties of the elements of the considered system. It includes all needed geometric parameters of this system. A necessary system of matrix differential equations is compiled and analytical solutions are presented. Numerical solutions can be obtained with their help by using the parameters of a specific machine.

94. Vukov G., Zh. Gochev, V. Slavov (2016), Numerical investigations of the free damped spatial vibrations of wood shaper and its spindle, II-nd International Furniture Congress: proceedings of papers, 13-15 October, Muğla Sitki Koçman University Faculty of Technology Department of Wood Product Industrial Engineering, Turkey, pp. 220-224.

This paper presents the results of the numerical investigations of the free damped spatial vibrations of a wood shaper and its spindle. The study is based on a specific mechanic - mathematical model, developed by the authors, which allows the study of vibrations of this type of machinery. In this model a wood shaper and its spindle are regarded as rigid bodies, which are connected by elastic and damping elements with each other and with the motionless floor. This study renders an account the mass, inertia, elastic and damping properties and geometric parameters of the machine. The results of the numerical investigations are presented. They are obtained with modern software and by using parameters of a real machine.

95. Deliiski N., R. Stanev, Zh. Gochev, N. Trichkov (2016), Modelling of the unilateral process of wooden walls by fire until starting of the wood ignition, 8th International Conference on Wood and Fire Safety: proceedings of papers, 08-12.05.2016, Štrbské Pleso, Slovakia, pp. 51-60, ISBN 978-80-554-1201-6.

Based on the differential equation of the thermo-conductivity, a 1D linear mathematical model of the unilateral heating process of wooden walls by fire until starting of the wood ignition has been suggested. The convective and radiation heat transfer have been taken into account. A software program has been prepared for the numerical solution of the model by means of an explicit scheme of the finite difference method, which has been implemented in the calculation environment of Visual Fortran Professional. Computations have been carried out by using the program for the determination of the 1D temperature distribution along the thickness of aspen walls with an initial temperature of 20 °C, moisture content of 0,06 kg/kg, and thickness 16 mm and 24 mm during 4 min unilateral heating until reaching by the heated side of the walls of the temperature equal to 396 °C, at which the wood ignition starts. The obtained results are graphically presented and analysed.

96. Deliiski N., N. Trichkov, Zh. Gochev, D. Angelski (2017), Computation of the energy and heat flux needed for covering of the emission in the surrounding air of subjected to unilateral convective heating wood details before lacquering, 3rd International Scientific Conference Wood Technology & Product Design: proceedings of papers, 11-14 September 2017 Ohrid, pp. 1-8, ISBN 978-608-4723-02-8.

An approach for the computation of the specific (for 1 m²) energy consumption, q_e , and the specific heat flux, dq_e/dt , needed for covering of the emission in the surrounding environment of the subjected to unilateral convective heating flat wood details before lacquering, has been suggested in the present paper. The approach, which has been earlier suggested by the authors, is based on the use of numerical solutions of the second from two mutually connected 1D non-linear mathematical models. The first model allows the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating wood details before their subsequent lacquer coating. The second model, whose solutions are used for the determination of q_e and dq_e/dt , allows the computation of the non-stationary distribution of the temperature along the thickness of the carrying rubber band, on which the non-heated surface of the wood details lies.

A software program has been prepared for simultaneously numerical solution of the models aimed at the determination of q_e and dq_e/dt , which was input in the calculation environment of Visual Fortran Professional. By using this program, computations have been carried out for the determination of the change in the heat energy q_e and in the flux dq_e/dt , which are consumed by oak details with an initial temperature of 20 °C, moisture content of 8%, thickness of 16 mm, width of 0,6 m, and length of 0,6 m during their 10 min unilateral convective heating by hot air with temperature of 100 °C, which circulates above the details with a velocity of 2 m/s, 5 m/s, and 8 m/s aimed at improvement of the conditions for the subsequent lacquering. The rubber band had thickness of 4 mm, width of 0.8 m, initial temperature of 20 °C, and the temperature of the surrounding air from the non-heated surface of the band was 20 °C. The obtained results are graphically presented and analyzed.

97. Gochev Zh., G. Vukov, G. Kovachev, P. Vitchev, V. Atanasov (2017), Influence of the number of belts over the performance of the cutting mechanism in a woodworking shaper, 3rd International Scientific Conference Wood Technology & Product Design: proceedings of papers, 11-14 September 2017 Ohrid, pp. 48-54, ISBN 978-608-4723-02-8.

This study presents the influence of the number of belts over the performance of the cutting mechanism in a woodworking shaper. The motion of the cutting mechanism was investigated by means of one and two V-belts. The vibration speed (r.m.s.) of the cutting mechanism was measured in three directions both empty and in stroke. The conducted experimental research provides a comparative analysis of the impact of the numbers of belts over the performance of the cutting mechanism. The obtained results can be used to optimize the number of the belts used to drive the cutting mechanism of the woodworking shapers.

98. Gochev Zh., G. Vukov, P. Vitchev, V. Atanasov, G. Kovachev (2017), Study on the vibration severity generated by woodworking spindle moulder machine, 3rd International Scientific Conference Wood Technology & Product Design: proceedings of papers, 11-14 September 2017 Ohrid, pp. 55-60, ISBN 978-608-4723-02-8.

The aim of this study was to investigate and determine the vibration severity, generated by a woodworking spindle moulder machine at different rotation frequencies and with different cutting tools. The assessment was based on the root mean square value of the vibration velocity (v) mm/s (r.m.s.) measured in two mutually perpendicular radial directions in each of the bearing housings of the driving shaft of the machine (four measuring points).

99. Panayotov P., Zh. Gochev, G. Krastev (2017), Adhesion of gluing and finishing films to chestnut solid wood, 3rd International Scientific Conference Wood Technology & Product Design: proceedings of papers, 11-14 September 2017 Ohrid, pp. 121-129, ISBN 978-608-4723-02-8.

This report refers to the experimental examination of the adhesion of gluing and finishing films. The gluing films are formed by reactive acid-curing urea-formaldehyde resin: Prefere 4114 and acetate polymer adhesive: Jowacoll 124. The Strength of adhesion of gluing films is determined under regulations BDS EN 302 and BDS EN 205 (ASTM D 905). Protective-decorative films was formed with acrylic water-deluted varnish and Deva D3 reactive acid-curing varnish (butanolysis melamineurea-formaldehyde resin). For this aim are used test samples from of chestnut (*Castanea sativa L.*) solid wood. The purpose of research is to study the influence of surface roughness on the adhesion. The Strength of adhesion of finishing films was determined by methods of pull out of glued metallic-stem under regulation BDS EN ISO 4624(BDS 13088). The obtained results indicate, that the surface roughness influence on the strength of adhesion of gluing and finishing films on chestnut

solid wood. The coarser grind surface generally had the best adhesion. The highest adhesion strength of gluing was obtained with 40-grit sandpaper (6,34 N/mm² for PVA glue and 8,88 N/mm² for MUFRR glue). For varnishes, the maximum adhesion strength was obtained for Deva D3 varnish (4,49 N/mm²), followed by acrylic (2,64 N/mm²) and water-based (1,87 N/mm²).

100. Vukov G., V. Atanasov, V. Slavov, Zh. Gochev (2018), Investigation of spatial vibrations of a wood milling shaper and its spindle, caused by cutting force, Proceedings of the 5th International Conference on Processing Technologies for the Forest and Bio-based Products Industries (PTF BPI 2018) Freising/Munich, September 20-21, 2018, pp. 144÷152.

This paper presents the results of the investigation of the spatial vibrations of a wood milling shaper and its spindle during its work. It considers forces on the cutting tool from its interaction with the processed material - force of milling, tangential and radial force. The study is based on a developed by the authors' specific mechanical - mathematical model. This model renders an account the mass, inertia, elastic and damping properties and geometric parameters of the machine. The results of the numerical investigations are presented. They are obtained with modern software and by using parameters of a particular machine.

IX. Scientific, scientific-applied and educational projects (21)

101. Gochev Zh., P. Denev, K. Dragnev, Contract № 98. (2005), Investigation of the processes of electric arc welding of band saw blades with smelt electrode and their teeth stelling. Collective with head **Assoc. Prof. Zh. Gochev, SRS/UF.**

The main objective of the project is to experimentally investigate the processes of electric arc welding in inert environment of band saw blades and welding of their teeth with a hard alloy "stellite" for more efficient use of these methods in production conditions.

They have been studied under the manufacturing conditions of the arc welding processes in an inert environment of MIG bandsaw blades: in a medium of pure argon and in a mixture with carbon dioxide; without and with preheating of the edges of the band saw blades.

A macro- and microstructural analysis of the welding seam was made and in the area of the belt retraction:

Mechanical rover test, HRC (C-scale), to determine the hardness at the site of the strip welding and in the area of its recovery.

Rational modes for arc welding in inert environments of band saw blades using the MIG method have been developed.

In production conditions are studied the processes of stellite tipped of band saw blade teeth.

The quality of dental implantation, as well as the lateral alignment and sharpening of the teeth are examined.

It has been developed rational modes for stelling of band saw blade teeth.

102. Gochev Zh., P. Nikolov, P. Denev, D. Kojnov, Contract № 122 (2008), Comparatively investigations on working capacity of wide band saw blades with part-set, swage-set and stellite tipped teeth. Collective with head **Assoc. Prof. Zh. Gochev, SRS/UF.**

The project was developed in the following directions: comparatively experimental investigations on working capacity of wide band saw blades with part-set, swage-set and satellite tipped teeth by sawing of pine and poplar logs.

The experimental studies were conducted in the production conditions of companies from the woodworking and furniture industry. The received results give answer to the questions what teeth do we use in the band saw blades: part-set, swage-set and stellite tipped teeth when sawing of poplar and white pine wood and what are their advantages and defects as well. The quantitative and qualitative analyses according to cutting processes and wear-resistance of teeth were made.

The results will be exploited as in the practice, so in the instructional process as well.

The technology modes and the directions on the efficient use will be developed based on the investigations of the wide band saw blades with part-set, swage-set and satellite tipped teeth, according to the concrete production conditions.

103. Gochev Zh., P. Nikolov, D. Kojnov, G. Kovachev, P. Vitchev, M. Tevosyan, M. Marinov, Contract № 45 (2009÷2010), Investigation on CNC machines, technologies and tool. Collective with head **Assoc. Prof. Zh. Gochev, SRS/UF.**

The CNC machines, technologies and tools in the woodworking and furniture industry of Bulgaria, the CAD/CAM systems for their management have been studied and the most effective solutions are presented, allowing for greater competitiveness at the expense of the larger number of operations performed in a shorter time.

The technological process and the place of the CNC machines in it, their efficient use and the overcoming of the critical points and the current problems are clearer.

A system of indicators for machine selection, its kinematic features and technological possibilities, the choice of cutting tools, the cutting patterns and modes, the quality and the accuracy of the processed surfaces were developed.

The possibilities for choosing CAD systems and CAM modules for graphic programming for CNC machines and the applicability of their application in practice and the learning process have been studied.

Based on the results of the project a curriculum for the discipline "CNC machines, tools and technologies" was developed for the students of "Technology of Wood and Furniture" educational qualification degree "Master".

104. Gochev Zh., G. Vukov, P. Vitchev, V. Atanasov, G. Kovachev, D. Karashki, V. Spasov, M. Todorov, Contract № 22 (2016÷2017), Modelling and experimental study of the processes in longitudinal milling of solid wood. Collective with head **Assoc. Prof. Zh. Gochev**, SRS/UF.

The possibilities for increasing the quality of milling of furniture pieces were studied through modelling, numerical and experimental study of the milling processes.

A mechano-mathematical model of a woodworking shaper machine and its spindle has been developed to study the free spatial vibrations of this type of machine. The forced spatial vibrations of the machine and its spindle, caused by the unbalance of the cutting tool, were investigated. A mechano-mathematical model is developed, which takes into account the specific features of the construction of this type of machine. A numerical study of the forced spatial vibrations of the machine has been carried out. The results are obtained with a modern software and the parameters of a specific machine.

Experimental studies have been carried out on the power-energy performance of the machine under consideration.

Also, the general vibration of the machine is examined, depending on the basic parameters characterizing the cutting mode: cutting speed, feed speed and thickness (area) of the captured layer during milling. Based on the results obtained, the degree of influence of the individual factors studied on the vibrations intensity in this type of machines was determined. The influence of spindle speed without a mounted cutting tool, as well as with various cutting tools mounted, is determined.

An experimental study was also carried out on the influence of the milling speed of the milling cutter and the feed rate of the material on the roughness of the treated surfaces.

105. Panayotov P., Zh. Gochev, G. Blaskova, N. Bardarov, K. Kalmukov - Experimental station for fast growing forest-wood species, Svishtov, I. Valchev – CHTMU, B. Rosnev – Forest Institute at the Bulgarian Academy of Sciences, P. Petkov – Forest Institute at the Bulgarian Academy of Sciences, Sofia, P. Denev – student, Contract № 742. (2004), Comparative studies of the properties of wood acacia *Robinia pseudoacacia forma rectissima* and traditionally used (wild) white acacia *Robinia pseudoacacia L.* Collective with head Prof. P. Panayotov, DUNAV-AGRO Ltd., Byala, SRS/UF.

The aim of the project is to make comparative studies of the properties of wood acacia *Robinia pseudoacacia forma rectissima* and traditionally used (wild) white acacia *Robinia pseudoacacia L.*

The physico-mechanical characteristics of the acacia species mentioned have been investigated. Anatomical and chemical analysis has been done. The resistance of wood to mushrooms has been investigated. Research has been carried out on mechanical machining with different types of machines and tools as well as on the more important technological properties. Guidelines have been developed for the use of the parasitic white acacia.

106. Contract - no-2006 IRL/06/B/F/NT-153170 (2006÷2008), InnovaWoodEDU - Expanding good practice in Education in the Forestry-Wood Chain sector through the InnovaWood network, InnovaWood - Ирландия/ЛТУ, 13 EU Partners: InnovaWood (IE); Lesotechnicheski Universitet

(BG) – Gochev Zh., V. Brezin; European Network for Forest Entrepreneurs(DE); Aidima (ES); Teak oy –Teuve Adult Education Center (FI); Center de Formation Professionelle Forestiers CFPPF (FR), Waterford Intitute of Technology (IE); Lietuvos Misku Institut (LT); Latvian University of Agriculture (LV); Warsaw Agriculture University (PL); Instituto Superior de Agronomia ISA (PT); Institut National al Lemnului (RO); Slovenski Lesarski grozd (SI), Berner Fachhoshschule Hochschule fr Architektur bau und Holz HSB (CH).

Employer: European Commission, InnovaWood-Leonardo da Vinci Programme

Manager: InnovaWood - Ireland

InnovaWoodEDU is an eighteen month Transnational Network project involving 14 organisations in 13 countries. The Project targeted educational establishments; students and employers, within the Forest-Wood Chain sector in all 27 E.U countries.

The main objectives of the project were:

- The building of a learning network, in which the knowledge of the member-organisations is pooled for use by all members;
- The identification of skills gaps in Vocational Education and Training in the sector;
- The merging of this Transnational Network with the existing European InnovaWood Network;
- The development of a web-based information source to facilitate the exchange of experiences and good practice in VET in the forestry-wood chain (FWC) sector;
- The organization of a European Workshop highlighting examples of good practice in Education in Europe in the FWC sector in the area of quality assurance;
- The development of an InnovaWood Virtual Training Centre (dissemination platform).

The project specifically addressed the issues of knowledge deficit, developing methods for the analysis of existing skills requirements and forecasting the future need for new skills.

107. Gochev Zh., Member of Management Committee, COST Action FP1004, Enhance mechanical properties of timber, engineered wood products and timber structures COST Grant System, Start date: 30/05/2011, End date: 29/05/2015, Action FP1004, Forests, their Products and Services, Brussels. 73 Partners from 28 Countries

Employer: COST – Brussels

Manager: Prof. Richard Harris (UK)

The main objective of this action is to enhance the performance of structural timber products and structures and thereby improve the competitiveness of timber structures. In order to reach this objective, specific objectives and deliverables have been defined in the MoU:

- A state-of-the-art report and a best practice guide on how to achieve enhanced properties of wood-based products and improve the performance of connections and timber structures;
- Summarise and explain various novel modelling techniques for weak zones in timber structures and improve the performance of these structures;
- Improve maintenance of existing timber structures and make them fit for purpose future use (residual strength, methods of strengthening and ductility of strengthened components);
- Optimise collaboration of scientists and engineers in the field of timber structures, exchange information on national ongoing projects and future research programmes;
- Provide new network constellation for collaboration within ongoing projects financed by various national bodies;
- Exchange students, post docs and research activities through short-term scientific missions;
- Provide combined information and disseminate the most up-to-date results to the industry, code writers, policy makers and society;
- Contribute to the improvement of design codes (revision of Eurocodes within 5 years) - Improve knowledge and competitiveness of timber structures throughout Europe;
- Encouraging greater use of timber enhancement techniques – dissemination to users, at workshops and seminars;
- More industry involvement for product development;
- Establishing basis for further research – reporting of findings.

108. Gochev Zh., K. Marinov, S. Stoilov, Contract DNTS/Slovakia 01/8, Theme № 863 (28.11.2011÷02.10.2014), Complex biomass utilization for energy, Agreement on bilateral scientific

and technological cooperation between the Republic of Bulgaria and the Slovak Republic, MEYS – Fund Scientific Research, DNTS/Slovakia 01/8, MEYS/ SRS-UF.

Employer: MEYS – Fund Scientific Research, Bulgaria - Slovakia bilateral cooperation

Scientific leader: **Assoc. Prof. Zhivko Gochev**

The main characteristics of wood biomass have been studied according to: its energy indicators; its origin; sources and methods of its use.

The normative base and standards for biomass as a raw material for energy production have been studied.

The current state and prospects for the use of biomass as a renewable energy source in the EU, the Slovak Republic and the Republic of Bulgaria are being studied.

Experimental research has been carried out to determine the energy characteristics of wood chips produced from different varieties of Euro-American hybrid poplars grown in Bulgaria, as well as wood of poplar and willow extracted from experienced energy plantations in Slovakia.

The subject matter of the research is the calorificity, the relative humidity and the ash content in the biomass of one year old shoots.

The most important qualitative parameters of wood pellets and briquettes produced in Bulgaria and Slovakia were evaluated and compared on an experimental basis. The measured values of relative humidity, heat of incineration, heat capacity and ash content are compared with the Slovak standard STN EN 14961-1: 2010.

109. Assoc. Prof. Zh. Gochev - Academic Tutorial on Project BG051PO001-3.3.07-0002 „ Student practices“, The project is implemented with the financial support of the Operational Program "Science and Education for Smart Growth", co-financed by the European Social Fund of the European Union, Duration 2012-2015.

Employer: MES - Operational Program "Human Resources Development"

Manager: Prof. V. Brezin

Through this project, students are given the opportunity to engage in practical training in a real work environment under the direct guidance of academic mentors who carry out activities to assist, monitor, control, report and certify practical training.

This will increase the practical orientation of higher education and the flexibility of graduates to the dynamics of the labour market by improving their practical skills in a real working environment during their training in higher schools and creating conditions for building stable partnerships between educational institutions and employers.

The overall activity is assisted by functional experts, who organize and monitor the implementation of the project activities in the respective higher education institution - partner of the project.

110. Project BG051PO001-4.3.04-0052 "Development of Center for Electronic Forms of Distance Learning at University of Forestry", financed by Operational Program "Human Resources Development", headed by Prof. V. Brezin and participants: Assoc. Prof. N. Trichkov, Prof. N. Deliiski, Prof. D. Ivanova, Prof. S. Sokolovski, Assoc. Prof. M. Mladenova, Assoc. Prof. J. Mihaylova, Assoc. Prof. N. Bardarov, Assist Prof. P. Antov, Assoc. Prof. N. Staneva, Assoc. Prof. L. Valcheva, **Assoc. Prof. Zh. Gochev**, Assoc. Prof. Y. Genchev, Assist. Prof. D. Angelski, Assist Prof. V. Savov, Assist. Prof. R. Chipev, Assist P. Vodenova, Assoc. Prof. S. Lozanova, Assoc. Prof. R. Raycheva, Prof. E. Pisareva, Assist. Prof. D. Angelova, Assist. Prof. V. Merdzhanov, Assst. Prof. I. Radkova, Assist. Prof. M. Coklinova, Assist. D. Mladenova, Assist. D. Koynov, Assist P. Vitchev, Assist. P. Nikolov, Assist. M. Kyuchukova and others, duration: 2013÷2015

Employer: MES - Operational Program "Human Resources Development"

Manager: Prof. V. Brezin

Objective of the project: Development of the lifelong learning system by the introduction of electronic forms for distance learning at the University of Forestry.

Specific aims of the project:

- Improvement and enhancement of the existing organization and structure for distance learning at the University of Forestry in accordance with the new legislation and existing good practices;

- Construction, installation and integration of entire electronic infrastructure at the University of Forestry, providing all the necessary functionalities and technical capacities for the application of the qualitative and modern distance learning;
 - Establishment of the team of highly-qualified specialists capable of implementing and developing electronic forms for distance learning at the University of Forestry in a short and long term;
 - Establishment of electronic storage of standardized training components and virtual libraries connected with the electronic learning platform;
 - Dissemination of the electronic forms for distance learning at the University of Forestry
 - Improvement of the qualification of lecturers, administrative and technical staff by:
 - Using and applying modern platforms for electronic training;
 - Introducing interactive methods of teaching and creating electronic forms for the purposes of the distance learning;
 - Developing programmes for electronic forms of distance learning;
 - Creating prerequisites for accreditation of the distance learning form of education on the basis of the developed programmes;
 - Exchanging experience and good practices with representatives from leading companies;
 - Involvement of members of the target groups in different electronic forms for distance learning;
 - Approbation and confirmation of the functionality and scope of the platform for electronic learning, quality of the developed electronic resources and activities, as well as the possibility for application of electronic forms for distance learning.

111. Assoc. Prof. Zh. Gochev - Functional Expert on Project BG05M2OP001-2.002-0001 Student Practices - Phase 1, The project is implemented with the financial support of the Operational Program "Science and Education for Smart Growth 2014 ÷ 2020", co-financed by the European Social Fund of the European Union, Duration: 2016÷2018
 Employer: MES - Operational Program "Human Resources Development"
 Manager: Prof. V. Brezin

The aim of the project is to help improve the quality of higher education by providing opportunities for acquiring practical experience and improving the practical skills of students in line with the needs of the labour market.

The project is in line with the measures envisaged in the Strategy for Higher Education in the Republic of Bulgaria for the period 2014-2020 to build a sustainable and effective relationship between HEIs and the labour market. It aims to support and encourage the establishment of stable partnerships between higher education institutions and business, to increase students' incentives to participate in further practical training in a real work environment and to assist them in finding a job immediately after their graduation.

The implementation of the project envisages the participation of 431 students from the University of Forestry in practical training in a real working environment. Employers can be business and non-profit organizations, state and municipal administration, schools and training organizations, employers' organizations and other legal entities.


In order to be respected for successfully completed practice, students must be trained in a real working environment 240 astronomical hours. For the practice, the student will receive a scholarship of 480 leva.

112. Project BG051PO001-3.3.06-0056 „ Supporting for development of young people at the University of Forestry“, Funded by the Human Resource Development Operational Program, Headed by Professor Brezin and 12 approved participants from FFI - 6 PhD students, 1 young scientist, 3 post-doctoral students and 2 postgraduates (Prof. D. Ivanova, Assoc. Prof. Zh. Gochev, Assoc. Prof. M. Mladenova, Assoc. Prof. N. Staneva, Assist. Prof. D. Angelski, Assist. Prof. D. Angelova, Assist. Prof. V. Merdzhanov, Assist. P. Vitchev, Assist. P. Vodenova, Assist. Prof. R. Chipev, Assist. P. Nikolov, Assist. M. Kuchukova, Ph.D. student D. Elenska, Assoc. Prof. V. Jivkov, Ph. D. student D. Hristodorova, Ph. D. student T. Petkov, Ph. D. student Ts. Evstatiev, Ph. D. V. Atanasov, Ph. D. G. Kovachev, Ph. D. N. Tumbarkova and others), Duration: 2013-2015.
 Employer: MES - Operational Program "Human Resources Development"

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<p>Manager: Prof. V. Brezin</p> <p>The aim of the project is to increase the interest of young people towards realization in the sphere of education and science and to increase the quality of the scientific developments, by improving the working conditions of</p> <p>PhD students, post-doctoral students, post-graduate students and young scientists.</p> <p>The implementation of the envisaged activities will stimulate the development of the scientific potential in higher schools and scientific institutions.</p> <p>The specific objectives of the project are:</p> <ul style="list-style-type: none">▪ To increase the motivation of PhD students in the University of Forestry (UF) by creating better conditions for solving the scientific tasks for building a knowledge-based economy. <p>To develop the scientific potential in the UF by creating opportunities for further qualification of young scientists, post-doctoral students and postgraduates.</p>
<p>113. Assoc. Prof. Zh. Gochev - Participation as a mentor of a young scientist - Assistant Georgi Kovachev, PhD, Project BG05M2OP001-2.009-0034 "Support for the Development of Scientific Capacity at University of Forestry", financed by the Operational Program "Science and Education for Smart Growth", Co-financed by the European Union Structural and Investment Funds.</p> <p>Employer: MES - Operational Program "Human Resources Development"</p> <p>Manager: Prof. V. Brezin</p>
<p>Supporting the research activity of a young scientist, Assistant Georgi Kovachev, PhD, "Investigation of the vibrations of the cutting mechanism of a woodworking milling machine according to the working regimes", within project BG05M2OP001-2.009-0034.</p>
<p>114. Gochev Zh., N. Ilkova, P. Vitchev,</p> <p>Infrastructure project: "Performing repairs and partial renovation of a research and educational laboratory (№ 12) at the Department of Woodworking Machines" - Lab. 12, building A - Department "Woodworking machines", 2011 – Team Leader Assoc. Prof. Zh. Gochev</p> <p>Employer: SRS-UF</p> <p>Manager: Assoc. Prof. Zh. Gochev</p>
<p>The laboratory, which is the subject of this project, was created for the purpose of studying the interior transport, heating and ventilation in the field of woodworking and furniture industry and is presently only at the University of Forestry, Sofia.</p>
<p>115. Gochev Zh., Contract № DPMNF 01/5 of 23.07.2018, Scientific forum on the topic - International Science and Technology Conference "Innovation in Forest Industry and Engineering Design - INNO 2018".</p> <p>Employer: MES – Fund Scientific Research</p> <p>Manager: Assoc. Prof. Zh. Gochev</p>
<p>The International Scientific and Technical Conference „Innovation in Woodworking Industry and Engineering Design“ is one of the major events in the scientific activities of the Faculty of Forest Industry at the University of Forestry. The financial support of the conference will contribute to its wider popularization among the foreign scientific community and to the assertion of the positions of the University of Forestry in quantity and quality of the internationally visible scientific production; will enable the dissemination and exchange of academic knowledge; will create a partnership environment between University of Forestry and branch organizations and woodworking and furniture companies to promote applied research and stimulate private investment in science.</p>
<p>116. - 121. Gochev Zh., Contract: FFI-2016-18-Yu-1; FFI-2016-18-B-1, Methodological Issues Concerning the Exploitation of the Woodworking Training Center to the Experimental Forestry-Yundola and the Experimental Forestry-Barzia.</p>
<p>Methodological guidance and support for the production of wood processing bases in the Experimental Forestry of Yundola and Barzia.</p>

June 2019
Sofia

Prepared: 
/Assoc. Prof. Zhivko Gochev, Ph.D./