SUMMARIES OF MAIN RESULTS AND SCIENTIFIC CONTRIBUTIONS

of senior assistant prof. eng. Kalin Simeonov Krumov PhD,
submitted for participation in a competition for the academic position of "Associate Professor" in the scientific code 5.4 Energetics / Industrial thermal engineering, announced by UCTM in the state newspaper issue 67 / 04.08.2023

The scientific researches of the applicant in the period of 2010 – 2023 were implemented mainly in the following directions:

- multiphysical processes, energy and technological efficiency of industrial furnaces, dryers and facilities;
- heat exchange and hydrodynamic processes during ventilation of industrial buildings;
- heat exchange, heat load and passive utilization of solar energy in modern transparent building envelopes;
- development of ecological solid rocket fuels and biodegradable composites for the elements of rockets for civilian use.

The candidate's research results have been published in 43 papers, including:

- 17 printed papers in journals, referred and indexed in world databases of scientific information. Ten (10) of them are presented as "Habilitation thesis", in the form of scientific papers in journals, referred and indexed in world databases of scientific information;
- 25 publications in bulgarian and international peer-reviewed journals and in edited collective volumes;
- co-authorship in the publication of "Manual for the design of thermal units and equipment for the silicate industry".

Eleven (11) scientific articles have been noticed by the scientific community and have been cited in 30 scientific publications, referenced and indexed in world-renowned scientific information databases or in non-refereed peer-reviewed journals. .

The numbering of the papers in the attached list to the documents for the competition is observed at the descriptions of the results of the researches in the directions above.

I. Multiphysical processes and efficiency of industrial furnaces, dryers and facilities

Results and contributions from the investigations in this direction are summarized in Table 1.

Table 1

№	Results and contributions	№ in the list
Theme 1: Conjugate heat exchange in high-temperature ceramic furnaces		
1	A validated algorithm has been developed for modeling and numerical investigation of transient conjugate heat transfer in high-temperature chamber gas furnaces for ceramic firing. It enables the analysis and improvement of coupled combustion processes and conjugate heat exchange in multi-component turbulent gas domains and solid domains in thermal units.	4.1, 4.7, 7.2, 7.3, 8.6, 8.12, 8.22
2	A design solution for improving the conjugated heat exchange in a high-temperature chamber furnace for firing technical ceramics is proposed by reconstructing the heat unit and the combustion plant in order to improve its energy and technological efficiency.	4.1, 4.7
3	Mathematical models for numerical prediction of thermo-mechanical processes in ceramic products during firing have been developed and validated. The models allow efficient organization of the temperature and gas regime in the furnaces.	4.7
Theme 2: Transport and mechanical processes in convective drying of ceramics		
4	Validated mathematical models and algorithms have been created for the numerical investigation of the coupled mass transfer and mechanical processes in ceramic products during convective drying in industrial drying installations with continuous operation in order to effectively organize the drying regime in dryers.	4.1, 4.4, 4.5, 4.10, 8.11
Theme 3. Heat transfer in thermal probe for temperature measurement in bulk layer		
5	Mathematical models for the numerical investigation of heat exchange in the thermoprobe for measuring temperature in a bulk layer under different mounting schemes and thermal loads have been developed, which allow refinement of the construction and materials of the thermoprobe.	8.10
Theme 4. Efficiency of photovoltaic systems		

6	An approach to numerically determine of the periods of periodic change of a photovoltaic system orientation to increase electricity production is presented.	7.4, 8.3
Theme 5. Effective solutions for ventilation of industrial buildings		
7	Models have been developed for predicting of heat exchange during free and forced air movement, and when fires occur in logistics halls and warehouses, which models allow effective organization of the processes at the design stage.	4.8, 4.9

Research on Theme 1 is a continuation of the work on the PhD thesis "Improvement of heat transfer in high-temperature chamber furnaces for firing ceramics" of Senior Assist. Prof. Eng. Kalin Krumov, under the guidance of Prof. Dr. Eng. N. Penkova.

For the research on Theme 2, the drying installations of Winerberger AD, Lukovit were used for testing and validating the mathematical models. Two of the publications on the subject [4.1 and 4.5] are co-authored by the company's technical director.

Themes 3 and 4 are developed for solving the real problems of bulgarian enterprises. Publication [8.10] is co-authored by the technical manager of Tehkeramik-M AD.

The experience gained in model researches has been used to develop new disciplines related to modeling and computer simulation of processes and lection notes used in teaching these disciplines (according to the attached lists).

II. Heat exchange, heat load and passive utilization of solar energy in modern transparent building envelopes

The candidate's research activity in this direction is the result of his participation in a national project financed by the The Bulgarian National Science Fund (BNSF). The results of the research were used by the participants in developing of an algorithm for analyzing the thermo-mechanical behavior, efficiency and reliability of transparent structures under different loads.

Table 2

№	Results and contributions	№ in the list
1	Mathematical models for numerical prediction of the conjugate heat transfer and heat loads in flat and curvilinear window systems under operational and standard test conditions are developed and validated.	4.2, 7.1, 8.1, 8.4, 8.7, 8.20, 8.21
2	Guidelines for precise selection of double-glazing are formulated for different orientations of facades and climatic based on model investigations of heat transfer, efficiency and reliability of various structures and configurations of double-glazed insulating glass units and window systems.	4.2, 8.2, 8.8, 8.9

The results of the conducted research were used to create modern disciplines in the field of building thermal engineering and passive solar systems.

III. Ecological solid rocket fuels and biodegradable composites for the elements of rockets for civilian use

Research in this direction was prompted by the need to replace harmful perchlorate-based solid rocket fuels with fuels that are considered environmentally friendly. At the same time, the creation of biodegradable composites as a building block for the individual components of civil rocket is aimed.

Table 3

№	Results and contributions	№ in the list
1	Theoretical developments were made and experimental stationary and flight tests were carried out to determine the optimal characteristics of the rocket elements. Certain perspective fuel compositions and innovative biodegradable composite materials have been tested.	4.3, 8.12, 8.13, 8.14, 8.15, 8.16, 8.17, 8.18, 8.19

As a result of the initial tests performed and the results obtained, a participant in the research team is currently developing a doctoral dissertation at UCTM.