OPINION

In the competition for taking the academic position "Associate Professor" in
the higher education area 5 – Technical Sciences; Professional field 5.3 – Mechanical Engineering,
Specialty - Industrial Heat Engineering
with a single candidate: Chief Assistant Professor Eng. Valentin Metodiev Petkov, PhD
Member of the scientific jury: Prof Stepan Garo Akerian, DSc, University of Food Technologies – Plovdiv

This competition, proclaimed in Bulgarian "State Gazette", Issue 58 of 23.07.2019 and at the site of the Technical university of Gabrovo, for the needs of the Department of Power Engineering to the faculty of Mechanical and Precision Engineering. The evaluation was completed on the base of documents and publications, presented by the candidate and the additional references and information submitted by him.

1. Scientific publications

1.1 General overview. Dr Petkov submitted for this competition: one monograph, written in English, 25 scientific works and three training manuals. His publications in international scientific journals are 14, as three of them are in the journals with IF by Clarivate.

1.2 Reflection of the candidate's scientific publications in the scientific community (known citations)

The candidate presented a list with 28 citations of eight of him publications. The total citations in abroad are 28 as ten of them are in the journals with IF. According to the database of Scopus his H-index is 3 for 28 registered citations. The Google Scholar points H-index 5 and 77 citations.

1.3 An overview of the content and results of the applicant's publications

The presented scientific production comprises investigations and estimations for the efficiency of heat transfer and hydrodynamics (i) in circular smooth horizontal tubes and tubes with inserts for flow turbulation and swirling; (ii) in non-circular shaped ducts at different boundary conditions and in laminar fully developed flow; (iii) in T- and Y-shaped assemblies of ducts at fully developed turbulent flow regime. These investigations were accomplished at different hydrodynamic conditions of fluid flow: laminar, tubular and transition flow regimes. The candidate also investigated the efficiency of solar collectors during the day hours and depending on the type of collectors' elements. All studies are in the scientific area, the professional field and the specialty of the current competition. Dr Petkov manifests earnest theoretical knowledge, expert analysis and optimization of thermal and hydrodynamic processes using different evaluation criteria. On the other hand, he demonstrates skills, accuracy and a patience of an adept experimenter.

2. General characteristics of the activities of applicant

2.1. Educational and pedagogical expertise and activities (training students and doctoral students)

According the information submitted by the applicant, he lectures four bachelor courses: Thermodynamics - general course; Thermodynamics – II part; Construction Heat Engineering; Fundamentals of ventilation and air conditioning. In the master degree Asst. Prof. Petkov reads the lectures of five courses: Architectural-constructional and thermal characteristics of buildings; Heat and mass transfer engineering; Secondary energy resources; Intensification of heat transfer; Thermodynamic fundaments of ventilation and air conditioning. These nine lecture courses are with a total workload of 300 h for full-time students and they are in the professional field and the specialty. Dr Petkov wrote two entirely authored training manuals and he is co-author of another guide for exercises. All these manuals have ISBN numbers. Chief Assistant Petkov supervised 42 students who prepared the diploma projects in the area of heating in-

stallations in the period of 2014-2019 as 18 of these students were in the master degree. He also reviewed 83 diploma projects in this period. Dr Petkov was the supervisor of four students reported their researches in student scientific sessions. The applicant has taken an active part in the creation and development of facilities in the laboratory for the intensification of heat transfer processes. The experimental set-up with a system for automatic measurement, data acquisition and primary data processing enables to investigate the effects of various techniques for enhancing the heat transfer. For testing protracted flat solar collectors an additional module was appended. Chief Assist. Prof. Petkov organizes and conducts practical classes with students in industrial and other enterprises equipped with specific and novel apparatuses and installations for heat and mass transfer processes. By keeping close contacts with leading companies in the branch, he organizes presentations, trainings for students and operating novel equipment and materials, using catalogs and software of these companies.

2.2. Research, scientific-applied and implementation activities

Dr Petkov took part in research projects within 13 contracts, subsidized by the Technical University of Gabrovo, as he was a supervisor of two projects in the frame of four contracts. These projects were directed to the intensification of heat transfer and in particular studying, intensification and the design of solar collectors. In the research projects led by Dr Petkov eight doctoral students and 12 students were involved. Eng. Petkov is a member of the chamber of engineers in the investment design, the division for heating, ventilation, air conditioning, refrigeration, heat and gas supply with full design competency. In this activity, he applies his theoretical and professional skills into the practice. The developments of Eng. Petkov for the intensification of heat transfer were implemented in seven industrial, public and household objects, manufactured and installed by the company "ZIP Engineering" Ltd, the town of Nova Zagora.

3. Contributions (scientific, scientific and applied, applied) **for science and practice, and their significance**

The contributions of applicant's researches, reflected in his scientific production, have mainly *scientific and applied character*. The most important contributions of Dr Petkov resulting from his theoretical researches, developments and analysis, I define as follows:

* An analysis and optimization of the passage geometry (cross-section shape, tube length, hydraulic diameter) of ducts and the temperature difference between the wall and the fluid flow were performed, using the entropy generation minimization method of Bejan (1982). In this regard, it was found that the cross-sections of ducts that minimizing the entropy generation are (i) circular cross-section in case of fully-developed laminar flow and (ii) flattened ellipse (a/b = 16) in case of fully-developed tubular flow [4(I)].

* A comparative analysis of heat transfer in ducts of various shapes (rectangular, trapezoidal, hexagonal and elliptical) in case of laminar flow and under different boundary conditions was performed on the base of extended criteria (Zimparov, 2000) for evaluating the performance characteristics taking into account the first and second law of thermodynamics simultaneously. Under the boundary condition of a constant wall's temperature, it was found that the rectangular, trapezoidal and hexagonal shapes of ducts can be more profitable in some cases than the use of circular tubes. On the other hand, it was found that the trapezoidal and hexagonal shapes of ducts able to be more competitive in some cases with than traditional circular tubes [4(II), 4(III), 4(IV), 4(V), 2.2.2, 2.2.4, 2.2.5, 2.2.7].

* The constructal theory of Bejan (2000) for minimizing the generated entropy was applied in case of fully developed turbulent flow in systems of ducts with tree-shaped T- or Y-shaped assemblies [2.2.10, 2.2.11].

* Correlations [2.2.1] between two dimensionless independent monomials with high correlation coefficients for determining the pressure drop in circular tubes with twisted-tape inserts in case of low Reynolds number were obtained on the base of the discriminated/vectorial dimensional analysis (Huntley, 1952; Palacio, 1963) applied.

* A dimensionless index i_E was proposed for preliminary evaluating the increase of heat transfer coefficient (Nu number, respectively) at low Reynolds numbers in circular tube in order to assess the efficacy of inserts applied for flow turbulation or swirling [3.2.2].

The more important contributions of the applicant, resulting from the experimental investigations, are as follows: determining the heat transfer coefficient and friction factor in circular tubes at transition flow regime (i) in smooth horizontal tubes without inserts for flow turbulating or swirling [2.2.8, 2.2.9] and (ii) in case of using various inserts for turbulating: wire coils [3.1.7, 3.2.1] and combinations of corrugated tubes with twisted-tape inserts [2.1.1].

In a separate group I may refer the thematic reviews with critical analysis of the achieved effects in case of using various turbulating inserts: (i) wire coils at transitional [2.1.3] and turbulent [3.1.6] flow regimes; (ii) twisted-tapes at turbulent flow regime [3.1.8].

As *applied contributions* I can point the following ones: determining the instant and integral thermal efficiency of protracted flat solar collectors with finned tubes [3.1.3], with finned heat pipes [3.1.4] and with vacuum heat pipes [3.1.5] and the effects of different investigated factors on this efficiency as well.

The co-authorship of Dr. Petkov with leading world scientists in the scientific field, his publications in leading scientific journals and the achieved scientometric indicators are convinced evidences for the high level of his researches and his achievements. On the other hand the widespread implementations of the results obtained from his researches in industrial and public practice speak for their significance.

4. Assessing the personal contribution of applicant

The candidate has presented an entirely authored monograph and five entirely authored research publications. Furthermore, he is the first author in eight scholarly articles as well. So, he fully accomplishes and exceeds the minimum requirements of the Technical University of Gabrovo. All this attests that he is already an accomplished scientist, who can develop by himself.

5. Critical remarks and recommendations

The monograph and training manuals will be assessed as more valuable, if they were issued in an academic publisher. In this regard the university publishing house “Vasil Aprilov” to the Technical University of Gabrovo would be an excellent alternative. It would be more relevant the applicant to be pointed as a compiler of the training manual “Thermodynamic tables for water, steam …”.

6. Personal impressions. I was not familiar with the colleague Petkov before the competition. According to the information collected for the procedure, I assess that he is a clever educator with a wide range of theoretical knowledge and practical experience. On the other hand, he manifests himself as a disciplined and consistent researcher as well as an engineer who maintains a constant connection with the practice and he offers adequate solutions to specific engineering problems of the practice.

7. CONCLUSION

Based on the submitted documents and the above analysis of the applicant activities, achievements and contributions, I find that it is reasonable to propose to the Scientific Jury and to the Faculty council Chief Assistant Professor Eng Valentin Metodiev Petkov, PhD to obtain the academic position “**Associate Professor**” in the higher education area 5 – Technical Sciences; Professional field 5.3 – Mechanical Engineering, Specialty - Industrial Heat Engineering.

November 5th, 2019, Plovdiv Member of scientific jury: /signature/

/ Prof. Stepan Garo Akerian, DSc /