

**IV International  
Scientific-Technical Conference**

**6–8 February 2020, Kielce**  
(Poland, Ukraine, Croatia, Slovakia, Sweden, USA)

**ACTUAL PROBLEMS OF RENEWABLE  
POWER ENGINEERING, CONSTRUCTION  
AND ENVIRONMENTAL ENGINEERING**

**Book of abstracts**

**Part I**

KIELCE 2020

6-8 February 2020, Kielce (Poland, Ukraine, Croatia, Slovakia, Sweden, USA)  
Under the general editorship Prof. doctor of science Anatoliy Pavlenko

**The organizers:**

- Kielce University of Technology, Faculty of Environmental, Geomatic and Energy Engineering (Poland)
- Koszalin University of Technology, Faculty of Civil Engineering, Environment and Geodetic Sciences (Poland)
- Ivano-Frankivsk National Technical University of Oil and Gas (Ukraine)
- The European Academy of Education and Science (Ukraine - Poland)
- KTH Royal Institute of Technology, Department of Chemical Engineering (Sweden)
- University of Zagreb Faculty of Metallurgy (Croatia)
- National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine)
- Smart Heat Corporation, Skokie, Illinois (USA)
- University of Žilina Department of Power Engineering (Slovakia)

**Scientific and organizing committee of the conference:**

**Co-organizers:**

- Prof. PŚk doctor of science LIDIA DĄBEK – Faculty of Geomatic and Energy Engineering, Kielce University of Technology (Poland)
- Prof. doctor of science ANATOLIY PAVLENKO – Department of Building Physics and Renewable Energy, Kielce University of Technology (Poland)
- Prof. PK doctor of science WIESŁAWA GŁODKOWSKA – Department of Concrete Structures and Concrete Technology, Koszalin University of Technology (Poland)
- Prof. doctor of science ALEKSANDER SZKAROWSKI – Department of Construction Networks and Systems, Koszalin University of Technology (Poland)
- Prof. doctor of science HANNA KOSHLAK – Department of Building Physics and Renewable Energy, Kielce University of Technology (Poland)
- Prof. doctor of science ENGVALL KLAS – Department of Chemical Engineering (Sweden)
- Prof. doctor of science LADISLAV LAZIĆ – Faculty of Metallurgy University of Zagreb (Croatia)
- Prof. doctor of science MILAN MALCHO – Department of Power Engineering (Slovakia)
- Doctor of science ANDREJ KAPJOR – Department of Power Engineering (Slovakia)
- Prof. doctor of science OLEG MANDRYK – Ivano-Frankivsk National Technical University of Oil and Gas (Ukraine)
- Doctor of science HELEN SKOP – Smart Heat Corporation (USA)
- Prof. doctor of science VALERII DESHKO – National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine)

© Copyright by Politechnika Świętokrzyska, Kielce 2020

ISBN 978-83-65719-84-3

Wydawnictwo Politechniki Świętokrzyskiej  
25-314 Kielce, al. Tysiąclecia Państwa Polskiego 7  
tel./fax 41 34 24 581  
e-mail: wydawca@tu.kielce.pl  
www.wydawnictwo.tu.kielce.pl

<b>IMPACT OF WEATHER CONDITIONS ON THE OPERATION OF FLUE GAS DUCTS AND THE GRAVITATIONAL VENTILATION IN ROOMS WITH GAS APPLIANCES</b> <i>Agnieszka Maliszewska</i> .....	81
<b>ENSURING COMPLIANCE WITH QUALITY STANDARDS FOR THE CURRENT AT THE POINT OF CONNECTION TO THE NETWORK OF THE COMBINED PHOTOVOLTAIC ELECTRIC POWER SYSTEM OF THE LOCAL OBJECT</b> <i>O.O. Shavolkin, M.O. Pidhainyi, Ye.Yu. Stanovskyi</i> .....	84
<b>RESEARCH AND DEVELOPMENT OF THE INSTITUTE OF ENGINEERING THERMOPHYSICS NATIONAL ACADEMY OF SCIENCES OF UKRAINE IN THE FIELD OF ENERGY EFFICIENCY IMPROVMENT IN BUILDINGS AND STRUCTURES</b> <i>B. Basok</i> .....	86
<b>HEAT AND MASS TRANSFER IN THE DIRECT CONTACT HEAT EXCHANGER OF GAS-DROPLET TYPE</b> <i>Artur Rachynskyi</i> .....	88
<b>THERMODYNAMIC ANALYSIS OF PERIODIC OPERATION AMMONIA-WATER ABSORPTION REFRIGERATION UNITS IN ATMOSPHERIC WATER GENERATION SYSTEMS</b> <i>M. Ozolin, O. Titlov, N. Bilenko</i> .....	90
<b>BUILDING HEAT STORAGE SYSTEM BASED ON THE USE OF RENEWABLE ENERGY SOURCES AND NIGHT FAILURE OF POWER CONSUMPTION</b> <i>B. Basok, T. Belyaeva, O. Lysenko, M. Khybyna</i> .....	92
<b>CFD SIMULATION OF NITROGEN OXIDE GENERATION IN THE BOILER OF DKVR E-10-13 WITH JET-NICHE SYSTEM</b> <i>A. Syrotiuk, A. Baraniuk, A. Siryi</i> .....	94
<b>ROBUST INTERCONNECTING REGULATOR FOR INCREASING RELIABILITY OF GAS TURBINE GENERATOR IN BIOGAS POWER PLANT</b> <i>Iuliia Kuievda, Serhii Baliuta</i> .....	96
<b>THE CONTACT COOLING EFFICIENCY INCREASE OF GAS TURBINE PLANT'S CYCLE AIR</b> <i>H. Kobalava, D. Kononov</i> .....	98
<b>COMBINED HEAT PUMP SYSTEM OF HEAT SUPPLY BASED ON GROUND HEAT EXCHANGERS</b> <i>I. Bozhko, O. Nedbailo, M. Tkachenko</i> .....	100
<b>METHOD OF CALCULATION OF MODES OF ABSORPTION WATER-AMMONIA REFRIGERATION MACHINES IN A WIDE RANGE OF WORKING TEMPERATURES</b> <i>N. Bilenko, E. Osadchuk, O. Titlov</i> .....	102
<b>HYDRODYNAMICS AND HEAT TRANSFER IN INTERGLASS SPACE OF MODERN DOUBLE-GLAZED WINDOWS</b> <i>B. Basok, B. Davydenko, V. Novikov, S. Goncharuk</i> .....	104
<b>DEVELOPMENT OF ENERGY-SAVING METHODS OF ABSORPTION REFRIGERATION UNITS' CONTROL</b> <i>L. Berezovska, O. Titlov, D. Adambaev</i> .....	106

# **DEVELOPMENT OF ENERGY-SAVING METHODS OF ABSORPTION REFRIGERATION UNITS' CONTROL**

L. BEREZOVSKA, O. TITLOV, D. ADAMBAEV

*Odessa National Academy of Food Technologies  
1/3 Dvoryanska Str. Odesa, 65082, Ukraine  
e-mail: titlov1959@gmail.com*

Modern requirements for refrigerants in terms of ozone safety and minimization of the contribution to the greenhouse effect have opened up great opportunities for absorption-type refrigeration units or devices with absorption-diffusion refrigeration units (ARU) working with ammonia-water solution as a working medium. The main disadvantage of ARU, which holds their wide distribution back, is low energy efficiency. This factor not only determines increased costs compared to compression analogues, but also the corresponding contribution to the greenhouse effect.

Studies results of experimental and serial models of refrigeration devices with ARU showed that their increased level of energy consumption is predetermined by the existing calculation methodology and by the method of control during operation.

As shown by the exergy analysis of the ARU cycle, the greatest success in energy saving can be achieved by optimizing the thermosiphon (TS), in which the exergy loss reaches 60% of the total.

Analysis of the main areas of energy saving showed that the greatest success with a minimum of costs can be achieved through the use of optimal control systems for devices with ARU. In particular, due to a change in the amount of heat supply to TS depending on the temperature conditions at the characteristic points of the refrigeration chamber and ARU.

Energy saving problems in TS are connected with partial condensation of vapors in the lifting part of the dephlegmator. It can be solved by distributing the heat input to TS depending on the ambient temperature and the temperature in the refrigeration chamber. The energy-saving effect in this case is 15-16%.

The development of this direction was associated with the installation of an additional heat-insulating cover on the ARU dephlegmator. The energy-saving effect in this case amounted to: 21% (Kiev-410); 12% ("Crystal-408"); 17% ("Stugna-101"). To implement such energy-saving modes, it is necessary to control the steam temperature at the exit of the dephlegmator – it should not exceed the saturation temperature of ammonia at a working pressure in ARU (about 50°C).

When developing energy-saving methods of control, it was supposed that in the non-working period the temperature of the ARU drive circuit elements (thermosiphon, rectifier, dephlegmator), due to heat losses to the environment, decreases.

This is accompanied not only by cooling strong and weak WAS, but also by partial condensation of the vapor in the dephlegmator and the ARU condenser. In the case of vapor condensation, inert gas, which is previously located in the natural circulation circuit (NCC), takes its place. Obviously, the longer the non-working period, the lower the temperature will drop and the greater the volume of inert gas in the ARU deflegmator.

When a thermal load is supplied, inert gas is pushed into the NCC by the dynamic pressure of the vapor stream, the value of which will depend on the amount of the vapor phase. When it is ARU starting moments, a certain amount of steam generated in TS will be spent on heating the structural elements of the rectifier, deflegmator and condenser. Other conditions being equal, the transit time of the steam flow to the condenser will be determined by the degree of cooling of the drive circuit elements in the non-working period, i.e. by the non-working period. This suggests that the well-known position – “the longer the non-working period, the greater the economy”, is not always applicable for household and commercial absorption refrigeration units.

To increase efficiency, it is necessary to prevent significant overcooling of structural elements of the ARU drive circuit.

It is possible to reduce the degree of overcooling of transport elements of the ARU drive circuit both by increasing the thermal resistance of the thermal insulation of the generator unit and by partially heating them during the non-working period.