CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

PREPARATION OF NANOSIZED BISMUTH TUNGSTATE AND ITS PHOTOCATALYTIC ACTIVITY

M. Kodols, S. Didrihsone, J. Grabis
Riga Technical University
Kalku str. 1, LV-1658 Riga – Latvia

ABSTRACT

Many heterogeneous photocatalysts for environmental applications such as air pollution, water treatment, for hydrogen evolution from aqueous solution etc. are developed in recent years. The aim of the present work was to improve the synthesis method of bismuth tungstate (Bi_2WO_6) and evaluation of photocatalytic activities of product under UV irradiation by changing the degree of crystallinity of bismuth tungstate.

Bi2WO6 nanopowders have been prepared with wet chemical method – combustion method by using several organic additives. The bismuth nitrate solution was mixed with tungstic acid and definite amounts of glycine, ethylene glycol, citric acid or glycerine and HNO_3 were added. The reactants were stirred and heated in air for 2 - 4 h up to 350^{o}C until burning of the formed xerogel was started. As-prepared crystalline powder, besides Bi_2WO_6 depending on reaction conditions and used organic fuel contained some admixture phases – WO_3, $Bi_2W_2O_9$, $Bi_{14}W_2O_{27}$ and $Bi_{14}WO_{24}$. Additional calcination at 650 - 800^{o}C high temperature leaded to formation of the pure crystalline Bi_2WO_6. The calcinated bismuth tungstate nanopowders have high crystallinity and specific surface area (BET) in the range of 12 – 23 m^2/g depending on used fuel and calcinations temperature.

The photocatalytic activity of Bi_2WO_6 nanoparticles was determined by degradation of methylene blue (MB) solution under ultraviolet illumination. MB decomposition proceed as first order reaction and using MS Excel Solver, the kinetic rate constant was calculated for bismuth tungstate with different crystallinty and specific surface area. The degradation of MB strongly depended on crystallinity and specific surface area (BET). The Bi_2WO_6 nanoparticles with specific surface area 23,4 m^2/g and 13,3 m^2/g ensured 93% and 74 % degradation of MB during 3 hours respectively.

Keywords: bismuth tungstate, photocatalysis

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

IMPROVING THE EFFICIENCY OF PELTIER COOLING WITH RECUPERATIVE POWER MANAGEMENT

V. Jurkans
Institute of Radio Electronics
Riga Technical University
Azenes 12, LV-1048 Riga – Latvia

J. Blums
Institute of Technical Physics
Riga Technical University
Azenes 14, LV-1048 Riga – Latvia

ABSTRACT

Peltier elements claims new qualities in various cooling applications, but do not compare well with traditional cooling systems due to a low efficiency. This paper researches new approach to increase Peltier element based cooling system efficiency using advanced power management system. It is realized by using Peltier element as thermoelectric generator periodically turning excess heat to electricity. This method is potentially effective in several specific applications that suffer from weak heat dissipation or don't need constant cooling. Main advantages and drawbacks are presented, including further study opportunities. Research opens new direction for improving cooling ability of Peltier elements, thus bringing it one step closer to efficiency of gas compression based cooling systems.

Keywords: Peltier, recuperation, efficiency, excess heat, power management

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

SYNTHESIS AND PHOTOCATALYTIC PROPERTIES OF MODIFIED TiO_2 NANOPORES AND NANOTUBES

R. Drunka, J. Grabis
Institute of Inorganic Chemistry
Riga Technical University
Miera str. 34, LV-2169 Salaspils – Latvia

A. Patmalnieks
Institute of Microbiology and Biotechnology
University of Latvia
Kronvalda str. 4, LV-1586 Riga – Latvia

ABSTRACT

Titanium diokside is very promissing material for photocatalyse, degradation of organic compounds, splitting of water, for manifacturine self-cleaning materials and dye- sensitized solar cells. It is generally concluded that the photocatalytic activity depends on the specifice surface area, degree of crystalization of the titania particles, phase composion and presence of dopants, witch promotes absorbtion of visible light.

Self-organized TiO_2 nanotube-layers were formed by electrochemical anodization of titania foil in a $(NH_4)_2SO_4$/HF electrolyte. Doped with sulfur nanotubes and nanopores were prepared by their treatment at 380^0C in H_2S flow or by using method of micro arc oxidation in sulfur containing electrolyte. Doped with nitrogen nanotubes were obtained by their treatment at 500 ^{0}C per 2h in N_2 flow. Doped with tungsten oxide nanotubes were prepared by anodization of TiO_2 foil mechanically rubbed with tungsten particles or by additional anodization of the as-prepared TiO_2 nanotubes in peroxitungstic acid sol and ethanol-water electrolyte.

The catalytic activity was determined by degradation of MB solution under UV and visible light illumination. The photocatalytic activity of the prepared TiO_2 nanotubes depends on the preparation conditions, the presence of WO_3, S and N increases their activity. During illumination the degradation of MB reaches 85–90% depending on applied dopants. The prepared photocatalysts have higher activity with respect to pure TiO_2 nanotubes. Sulfur doped nanotubes have higher activity with respect to nitrogen and WO_3 doped nanotubes.

Keywords: titania nanotubes, sulfur, nitrogen, tungsten oxide dopants, methylene blue decomposition

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

IMPROVEMENT OF EXISTING METHOD OF NATURAL GAS FILTRATION AS A WAY TO MAKE BOILER STATION MORE ENERGY EFFICIENT

P. Skackovs
Riga Technical University
Azenes str. 16, LV-1048 Riga – Latvia

ABSTRACT

The natural gas which is transported through the gas lines almost always contains various hard admixtures (sand, dust, iron oxides and others). Before natural gas will enter the gas regulation point in the boiler room it is important to install the natural gas filer.

Natural gas filters can be classified based on the system they operate. There exist filters for gas - solid systems (mechanical gravity, mechanical interna, centrifugal force, hydraulic, sive, electrical) and filters for gas – liquid systems (condensation, coalescence, absorption, intertia, centrifugal force filters).

The main problem which take place with the natural gas filter, is the pollution of the filter. The main indicator of the gas filter pollution is the pressure drop. Polluted gas filter can course the following problems for the natural gas network in boiler room: flow decrease, outlet pressure decrise, boiler station power decrise, equipment life term decrise, change of exhaust gas composition, expenses increase.

Author of this work think that if before usual gas filter place the special equiepment with the magnet, it will helps to reduce the pollution of the gas filter downstream and prevent the problems mentioned before.

Some experiments were done on Latvian teritory with the help of NdFeB (Neodymium Iron Boron) magnet, and the result of it shows that in metalic gas lines metal parts weight of the total pollution is from 35% until 60%. It means that using of magnets during the natural gas filtration in boiler station can give us good results.

Keywords: natural gas, filter, magnet, Neodymium Iron Boron

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

THE MECHANISM OF HYDROGEN BONDING IN ZEOLITE – EXPERIMENTS AND THEIR EXPLANATIONS

P. Lesnicenoks
Riga Technical University
Azenes str. 14, LV-1048 Riga – Latvia

L. Grinberga, J. Kleperis
University of Latvia
Kengraga str. 8, LV-1063 Riga – Latvia

ABSTRACT

Growing demands of increase of volume for hydrogen storage, for launching hydrogen industry, leads to new developments in industry and scientific investigation. Due to its structural variety and almost 3 million theoretical structural possibilities to create zeolite structures, it is a promising material for hydrogen storage. Economical convenience is a good reason to seek simple and common materials for storage systems. Natural materials in this case are especially interesting.

Although there are couple of theories about hydrogen's bonding with zeolite, such as adsorption, mainly trough Langmuir equations, spillover effect – thanks to strong catalysts which manipulate hydrogen gas as well as atomic hydrogen, and basic filling of pores, also explained by Langmuir equations, results are not always consistent. While experimenting and using different methods to precise the mechanism of adsorption and measuring efficiency some irregularities has been found. Various experiments using mass spectroscopy, Sievert type – volumetric device and thermogravimetry are performed using natural zeolite (cliniptiolite). Angle of low pressure and normal temperature adsorption is investigated. Using these different methods for finding possible additive effects in hydrogen bonding process data is acquired and discussed.

Experimental documentation is encouraged for reassuring plane, expected and unexpected results, and personal experience about mishaps during experiments shared.

Keywords: zeolite, clinoptiolite, hydrogen storage, thermogravimetry

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

AN ENVIRONMENTALLY FRIENDLY METHOD FOR MICROFIBRILLATED CELLULOSE EXTRACTION FROM HEMP

A. Putnina, S. Kukle
Riga Technical University
Azenes str. 24, LV-1048 – Latvia

J. Gravitis
Latvian State Institute of Wood Chemistry
Dzerbenes 27, LV-1006 Riga – Latvia

ABSTRACT

Microfibrillated cellulose is a new biomaterial having astonishing intrinsic properties. It was first used in nanocomposites due to its environmentally friendly nature and mechanical reinforcement. It has found various other uses and particularly in a high-value applications [1]. That is why significantly has been increasing interest in development of environmentally friendly technologies of microfibrillated cellulose (MFC) extraction from plants.

Hemp fibres are renewable, cellulose rich material that can be used for production in different areas. However, some of the applications in nanocomposites are limited by such components of the plant cell wall as hemicellulose, pectin/waxes and lignin.

In this article disintegration of hemp fibres from variety *Purini* grown in Latvian Agricultural Science Centre of Latgale by steam explosion and ultrasound treatment were investigated with the aim to evaluate steam explosion (SE) pre-treatment influence on hemp fibre microstructure and ultrasound treatment effectiveness investigation on cellulose disintegration processes into microfibrillated cellulose.

During the SE, the biomass is subjected to the treatment with high pressure saturated steam and rapid decompression resulting in substantial breakdown of the lignocellulosic structure, hydrolysis of hemicelluloses, depolymerisation of lignin components and defibrillation [2]. Removal of lignin by water and alkali treatment after SE used in this research makes the cellulose accessible for further ultrasound treatment and nanotechnologic processing.

The acquired results after steam explosion treatment and water and alkali treatment are discussed and interpreted by Fourier transform infrared spectroscopy (FTIR). Scanning electron microscopy (SEM) was used to examine the microstructure of hemp fibres before and after each treatment.

Keywords*:* steam explosion, hemp fibre, cellulose, microfibrillated celluloses

Literature:

1. Lavoine, N., Desloges, I., Dufresne A., Bras, J. Microfibrillated cellulose – Its barrier properties and applications in cellulosic materials: A review// Carbohydrate Polymers 90 (2012) 735– 764.

2. Kukle S., Gravitis J., Putnina A. Processing Parameters Influence on Disintegration Intensity of Technical Hemp Fibres // Journal of Biobased Materials and Bioenergy. - Vol.6, No.4. (2012) pp 440-448.

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

ANALYSIS OF USING DOUBLE BY-PASS IN THE AIR HANDLING UNIT'S WITH COUNTER FLOW HEAT EXCHANGERS

G. Plavenieks, A. Lesinskis
Riga Technical University
Azenes str. 16-20, LV 1010 Riga – Latvia

ABSTRACT

The European Union (EU) energy consumption is growing each year, and along with their dependencies on external oil and gas suppliers. EU buildings consume 40% of the total energy consumption in Europe. Predicts that by the year 2020, two times increase in energy consumption of air handling systems, and it should be limited to the higher standards for air handling units. Using counter flow heat exchanger in the ventilation system, it will reduce considerably heat energy consumption of ventilation, but the same time create pressure loses. The paper presents analysis of using double by-pass in the air handling units. In the article will be represented test data of measurements of air flow rate and pressure test model of air handling unit with double by-pass of counter flow heat exchanger. Objective of my work is to improve ventilation systems performances in terms of sustainability, indoor comfort and economics. Reduction of energy consumption, improvement of energy efficiency and optimization of air handling units is important to address the improvement of indoor air quality.

Keywords: counter flow heat exchanger, air handling units

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

INFLUENCE OF THE PRECIPITATION CONDITIONS ON THE MORPHOLOGY, PHASE PURITY AND PHYSICAL PROPERTIES OF MAGNETITE NANOMATERIALS

S. Lagzdina, A. Sutka, G. Mezinskis
Riga Technical University
Azenes str. 14, LV-1048 Riga – Latvia

J. Kleperis
University of Latvia
Kengaraga str. 8, LC-1063 Riga – Latvia

ABSTRACT

In the present investigation, influence of the synthesis conditions on the morphology, phase purity and physical properties of the magnetite (Fe_3O_4) nanosized particles obtained from only ferrous salt solutions were investigated. It was found, that particle size, its distribution and phase composition is strongly influenced by different reaction conditions such as cation salt/precipitation agent molar ratio and temperature. Obtained powder products were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM) analysis. By regulating synthesis conditions it is possible to obtain monophasic magnetite nanoparticles with spinel type structure and size <30 nm, as well as admixture containing different crystal phases such as maghemite (γ-Fe_2O_3), hematite (α- Fe_2O_3) or goethite (FeOOH). For synthesized compounds different physical characteristics such as magnetic, optical, photoelectrochemical and photocatalytic properties were studied. Saturation magnetization of magnetite nanopowders was close to that of bulk value, thus showing that synthesized Fe_3O_4 is close to its stoichiometric composition. Also, obtained magnetite nanosized particles show some photoelectrochemical and photocatalytic activity for water splitting under visible light for hydrogen production. Several factors like photocatalyst dose, illumination intensity, irradiation time, sacrificial donor and presence of co-catalyst were investigated to find out optimal reaction conditions what could lead to remarkable hydrogen evolution activity under visible light.

Keywords: Magnetite, nanoparticles, precipitation, photoelectrochemical properties, photocatalytic activity

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

PHOTOVOLTAIC BATTERIES WITH MODIFIED GLAZING

P. Shipkovs, M. Vanags
Institute of Physical Energetics
Aizkraukles str. 21, LV-1006 Riga – Latvia

A. Snegirjovs
Riga Technical University
Azenes str. 16, LV-1048 Riga – Latvia

ABSTRACT

Photovoltaic (PV) battery's efficiency increasing is one of the central purposes of PV industry. It is possible to increase solar panel's production of electricity by improving characteristics of solar panel glazing.

Crystal anti-reflective thin film coating on glass was designed specifically for monocrystalline and multicrystalline silicon wafer modules. Developed glazing takes into consideration: silicon crystalline cell light wavelength sensitivity; temperature conditions and need to reject heat in the spectrum that cells do not use for energy production (near infrared radiation); the Sun's position over solar panel during the day and the year (angle of light beam incidence).

Efficiency of regular and modified glazing of PV batteries was investigated in real weather conditions in solar energy testing polygon. It was determined that PV batteries glazing types have different impact on PV batteries production in similar environment conditions. Efficiency increasing was in high solar radiation intensity conditions for modified glazing of PV batteries, because this glazing reduced PV batteries warming from infrared radiation. But difference of energy production was lower in cloudy days, especially when PV module's temperature was low. Annual energy production of modified glazed PV batteries in comparison with regular glazed PV batteries is about 2% higher.

Keywords: photovoltaic, renewable energy

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

THE GHG EMISSIONS MODEL STUDY FOR STRAW FIRED BOILERS

K.Vagoliņš, G. Frīdenbergs, P. Šipkovs
Riga Technical University
Azenes str. 16, LV-1010 Riga – Latvia

ABSTRACT

Latvia (EU) is obligated to report anthropogenic greenhouse gas emissions annually to the UNFCCC. Inventories of greenhouse gas emissions and methodologies used have to be well based and documented. The aim of this report is to give input to Latvia greenhouse gas inventory of straw fired boiler sector. The emission factors for the industrial processes used in the inventory are based both on plant-specific factors and the IPCC default values. Modeled emission factors for the non-CO_2 greenhouse gases from combustion are mainly based on studies in plant design and maintenance, operating conditions and composition of fuels. In addition, knowledge of emission generating processes has increased world-wide.

In this study, the non-CO_2 emission factors (mainly CH_4 and N_2O, and at a lesser extent, CO and NMVOC) for straw fired boiler used in the Latvian greenhouse gas inventory are evaluated based on domestic and international literature, available measurement data and calculated data.

Results of this study revealed many potential areas for improvements in the inventory. The time dependency and uncertainties of the emission factors are also considered. In addition, effect of load and straw mixes on emissions is examined. Areas for further research are also indicated.

Keywords: Straw boiler, GHG emission control, system improvement for emission control, emission factors for industrial processes

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

ADDITIONAL CRITERIA APPLICATION FOR THE POWER SYSTEM PLANNING TOOL

O. Kochukov, A. Mutule
Institute of Physical Energetics
Aizkraukles str. 21, LV-1006 Riga – Latvia

ABSTRACT

The main objective of this paper is to show ways of improving of power system long-term planning method by adding new criteria. Static stability is essential criteria of power system operation, especially observing dynamic processes, however its influence on long-term planning is poorly investigated. System functioning calculation methods that are being used in operational state optimization models have significant differences with algorithms and methods in planning models. From system development point of view, it is necessary to deliver sellable energy from power plant to consumer. In this case static stability can be expressed as necessary costs for its maintenance. The paper considers research of cost criteria for maintenance of static stability. In order to realize the influence of new criteria to final power system planning result, there is given a comparative example of different long-term planning approaches. The algorithm is based on earlier versions of LDM-TG software algorithms. Offered algorithm is included in newest development of Laboratory of Power System Mathematical Modelling - PSPLanner software that also is going to be briefly presented.

Keywords: future electric power systems, transmission planning, cost-benefit analysis component

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

DEVELOPMENT OF THE MODEL FOR SMALL SCALE ASYNCHRONOUS GENERATOR CONNECTION IMPACT ASSESSMENT ON DISTRIBUTION NETWORK

A. Ļvovs, A. Obushevs, A. Mutule
Institute of Physical Energetic
Aizkraukles str. 21, LV-1006 Riga – Latvia

ABSTRACT

It is expected that the production of electrical energy from renewable energy sources and liberalized market further development can cause changes in the distribution network operating modes, as with time more small scale power plants will operate in liberalized market rather than ones with subsidies. Such situation can cause more frequent starts and stops of power plants comparing to current situation. To assess the impact of asynchronous generator connection to the existing network, taking into account technical limitations, there was created small scale HPP electric model, which simulates asynchronous machine transition processes.

In paper there are proposed the original basic principles of HPP working conditions. Mathematical model of small scale HPP was developed for simulation of HPP electricity production. The developed model consists of generator and network parts and is capable of modelling various generation and load interaction scenarios. Different generation and load scenarios have been modelled to evaluate generator connection impact on the existing network, taking into account technical constraints.

Load – generating interaction scenario modelling was implemented in Matlab environment. Power flow model was tested in Power World environment in order to verify the accuracy of its operation. Network and HPP simulations were carried out using the widely accepted IEEE 37 node test feeder.

Paper also includes description and results of case study performed to test proposed mathematical model. The elaborated model can be used for representing wide range of HPPs in assessment analysis of distribution network, as well as adapted for modelling of other types of power plants that use asynchronous generators.

Keywords: Hydroelectric power generation, mathematical model, power distribution

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

COMPARISON OF AC AND DC OPTIMAL POWER FLOW MODELS FOR APPLICATION IN LONG-TERM DEVELOPMENT PLANNING

A. Obushevs, I. Oleinikova
Institute of Physical Energetics
Laboratory of Power System Mathematical Modelling
Aizkraukles str. 21, LV-1006 Riga – Latvia

ABSTRACT

Increasing integration in the Baltic electricity market and Europe-wide interconnection establishment makes it necessary to consider markets principals for power system development planning. The Optimal Power Flow (OPF) is one of the fundamental problems in power system analyses. Long-term development planning typically requires a large number of repetitive OPF solutions. In this comparison, the calculation speed of the OPF solutions beside their accuracy is observed. The full alternating current OPF is accurate, but takes long solution time. The direct current OPF is a simple approximation of OPF that is very fast but is not so accurate.

The paper first provides a general explanation of proposed method of zonal prices determination, which is based on Interior Point Method (IPM) for finding maxima of Social Welfare or minima of production costs subject to power system constraints. Comparison of ACOPF and DCOPF models was implemented in Matlab environment.

The paper second part provides case studies using both a small 4 bus system and a somewhat larger 98 bus model of the Baltic Ring transmission grid. Results are provided comparing both the accuracy (generation levels, line flows, and voltage angles) and the computational requirements of the two models.

Keywords: electricity market, optimal power flow, power system, power system development

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

RESEARCH OF ENERGY EFFICIENT ALGHORITMS FOR BUILDING MANAGEMENT SYSTEM

R. Beļinskis, A. Klūga, A. Krūmiņš
Riga Technical University
Kalku str. 1, LV-1658 Riga – Latvia

ABSTRACT

This paper investigates building management system (BMS) as a tool for energy consumption decrease in construction store in Latvia. Building management system was renovated in these stores. The energy monitoring was done before and after renovation of BMS.

HVAC (Heating Ventilation Air Condition) systems in buildings must be complemented with a good control scheme to maintain comfort under any load conditions. Efficient HVAC control is often the most cost effective option to improve the energy efficiency of a building. However, HVAC processes are nonlinear, and characteristics change on a seasonal basis so the effect of changing the control strategy is usually difficult to predict.

The use of optimization and adaptation principles in regulation systems permits to construct the most modern automatic climate control systems. However, under different conditions systems can produce different results, so developers face a new challenge – a choice of the most effective adaptation method under certain circumstances.

Results of our investigations are definition of all necessary BMS functions and unit control algorithms. Paper results can be used for installation of new BMS in office and trading centre buildings. The research results show that BMS control algorithms plays significant role in Building energy consumption.

This research main deliverable is the recommendation to the building owner to consider improvements of existing BMS. The recommendations include definition of main BMS functions, it's influence on energy consumption, decrease of maintenance costs and payback period.

Keywords: BMS, HVAC, energy consumption

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

INVESTIGATION OF ELECTROMAGNETIC HARVESTER WITH FLAT STRUCTURE AND LOW VOLTAGE RECTIFIER

I. Gornevs, J. Blums
Riga Technical University
Azenes str. 12, LV-1048 Riga – Latvia

ABSTRACT

As electronics decrease in size, power consumption moves toward the level of energy found in environmental vibration sources, making energy harvesters more promising as renewable energy sources. Wearable and portable electronics considerable as main field for such research, because of requiring compact energy sources which can be exploited effectively. Depending on available volume and frequency range, different physical principles are used to convert mechanical energy to electrical. Harvesters using electromagnetic inductance produce higher power in low frequencies, therefore they were chosen for current research. It is shown that flat construction inductors have low occupied volume and it is possible to estimate shape of generated voltage pulses as well as produced power, considering inductor`s shape, conductor and relation between size of magnet and inductor. Accordingly it is possible to find best fitting parameters of harvester for needed results in specific situation. Generated voltage level of harvesters in many occasions is low and fully dependent on effective transformation. To increase effectiveness, low voltage rectification system is under investigation. It utilizes field effect transistors, creating diode`s equivalent with threshold voltage level under 100 mV.

Keywords: energy harvesters, electromagnetic harvester, low voltage rectification, efficiency, power management

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

HEAT RATE OPTIMIZATION OPPORTUNITIES

K. Grinbergs
Institute of Physical Energetics
Aizkraukles str. 21, LV-1006 Riga – Latvia

P. Shipkovs
Riga Technical University
Kalku str. 1, LV-1658 Riga – Latvia

ABSTRACT

Heat generation at industrial boiler houses is extremely unstable. This is due to external air temperature parameters, which require a large capacity reserve. Evaluation of deviation in boiler house heat loads from average heat consumption throughout the year, one must conclude that generated heat either considerably exceeds or falls short of average consumption. These deviations from the average are a normal reaction to fluctuations in external air temperature and may be disregarded; however, in the long term, it is possible to work on balancing heat consumption demand between calendar months. Having analyzed this, the question arises about what impact the selection of boiler house capacity has on heat tariffs. A boiler house should be designed considering the peak load reserve, although this reserve is often so high that capacity would be sufficient for heating considerably larger areas. It would be failure to provide insufficient boiler house capacity for cold periods in winter, but how it impacts heat consumer. Consider the example of the traditionally more expensive heat energy source: natural gas. Failure to save on natural gas represents an enormous financial burden on the consumer. We will analyze the situation with a certain operating natural gas boiler house, evaluating expenses related to creating and operating this boiler house. Two more options will be considered – one where the capacity of the boiler house is reduced to the requirement for the current year, and one where the capacity will be selected after excluding the peak loads for a given year. The goal is to evaluate the amount overpaid by an ordinary heat consumer for the “excess” capacity in centralized heating networks based on expense positions which eventually contribute to the heat supply tariff. Based on expense data for the current boiler house, similar data will be sought for a reduced-capacity boiler houses.

Keywords: Heat rate**,** heat tariff

CYSENI 2013, May 29-31, Kaunas, Lithuania
ISSN 1822-7554, www.cyseni.com

SUPPLY WATER PARAMETERS INFLUENCE ON IEAC THERMAL PERFORMANCE

G. Frīdenbergs, A. Lešinskis
Riga Technical University
Azenes str. 16, LV-1010 Riga – Latvia

ABSTRACT

This paper reported a review, calculations and measurements based study into working water flow parameters influence on the Indirect Evaporative Air Cooling (IEAC) thermal performance, which was undertaken from a variety of aspects including background, history, current status, concept, standardization, system configuration, operational mode, research and industrialization, market prospect and barriers, as well as the future focuses on R&D and commercialization. Calculation model has been obtained from the governing equations of heat and mass transfer in primary and secondary air and water flows. Parameters of water affecting on evaporative cooling performance such as mass flow rates and flow configuration has been obtained. Model was validated against theoretical data from the literature and good agreement between the prediction and measurement was achieved. The calculated results show that closed cycle working water flow characteristics affects supplied air parameters less than 4%. It effect cooling efficiency, which mostly depends on mass flow rates ratios of primary and secondary air flows and spacing between plates of wet and dry passages.

Keywords: IEAC, Indirect evaporative air cooling, working water flow influence, heat transfer, thin wall