ZÁPADOČESKÁ UNIVERZITA V PLZNI

FAKULTA STROJNÍ

KATEDRA ENERGETICKÝCH STROJŮ A ZAŘÍZENÍ

ZÁPADOČESKÁ UNIVERZITA V PLZNI

POWER SYSTEM ENGINEERING, THERMODYNAMICS & FLUID FLOW

2012

JEDNOTLIVÝ PŘÍSPĚVEK ZE SBORNÍKU

evropský sociální fond v ČR

EVROPSKÁ UNIE

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

OP Vzdělávání pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

TEMPERATURE ON THE SURFACE OF THE HEAT EXCHANGER MONITORING DURING REGULATION

ŠČIBRAN Petr

The purpose of this thesis is monitoring of tempereture distribution on the surface of a new heat exchanger and the burner for heating unit with premix burner. Next purposes are find the most suitable heat power range for each fan and watch minimum temperature at the critical points of the heat exchanger. Next purpose is to propose temperature value for the belaying parts. Several modes of heat power have been mentioned in this thesis. In the conclusion, a further works is suggested.

Key words: burner, heat exchanger, temperature

Introduction

The main reason for the new premix burner technology is better mixing of moist air and natural gas and thus lower air pollution (NOx < 30 ppm and CO = 0) and lower fuel consumption.

Compared to a premix burner a pressure burner works in a way that the air and natural gas are in fact mixed after the burner in the combustion chamber, where as the premix burner uses an airtight aspiration circuit in which air and natural gas are mixed and than this mixture of gases enters to combustion chamber.

The fact that the pressure valves are used in a premix burner also results in low emission. It is because the pressure valves supply different amount of combustion air for optimal burning when changing the heat output of the premix burner.

Fig. 1: Belaying parts

From previous measuring of the temperature distribution on the surface of the heat exchanger were found points for belaying parts (resistive thermostat PT1000 and thermostat with manual reset) shown on Fig.1.

2. Measuring and settings

The reason for temperature measuring is find the most suitable heat power range for each unit and combine right heat power range with right fan for each unit to obtain the highest efficiency. Next reasons are controlling important points on the heating unit and proposal of temperature value for the manual thermostat.

Fig. 2 shows points of measurement: 1) is air inlet temperature (to the burner), 2) temperature on the burner fan, 3) temperature on the burner flange, 4) PT1000 thermostat temperature, 5) manual thermostat temperature, 6) temperature on the combustion chamber and 7) point of material change. This point is the most important for heat exchanger temperature. There is place of material change (stainless steel to black steel).

Fig. 2: Points of measurement

mode	rpm [1/min]	heat power [kW]	implementation
A	740	25	ceiling
B	740	25	wall
C	460	45	ceiling
D	460	45	wall
E	0	25	ceiling
F	0	45	ceiling

Fig. 3: Table of modes

In this thesis are mentioned 6 modes. Differences are in stages of fan, heat power and in implementation. At the beginning of measuring all points have had room temperature. Measuring continued to steady state value or repeated cycling.

Burner with heat power 25-45kW and fan with 460 and 740 rpm were used.

These modes was chose due to they are limited states. According to previous measuring [7] were found heat power and fans for all unit sizes. Were found modes with minimum air volume and min. heat power and modes with max. air volume and max. heat power where all temperatures were in steady state.

The new regulation with a processor was used. This regulation protected the heat exchanger before overheating and condensation. The protection was realized by heat power decrease or increase to 50% of burner range and fan contact making or contact breaking when PT1000 measured 62°C (exhaust gas condensing temperature is 54°C).

3. Measuring results

Fig. 4 shows mode A and B. In these cases was risk of condensation – high air volume and low heat power was used. This is reason for heat exchanger protection.

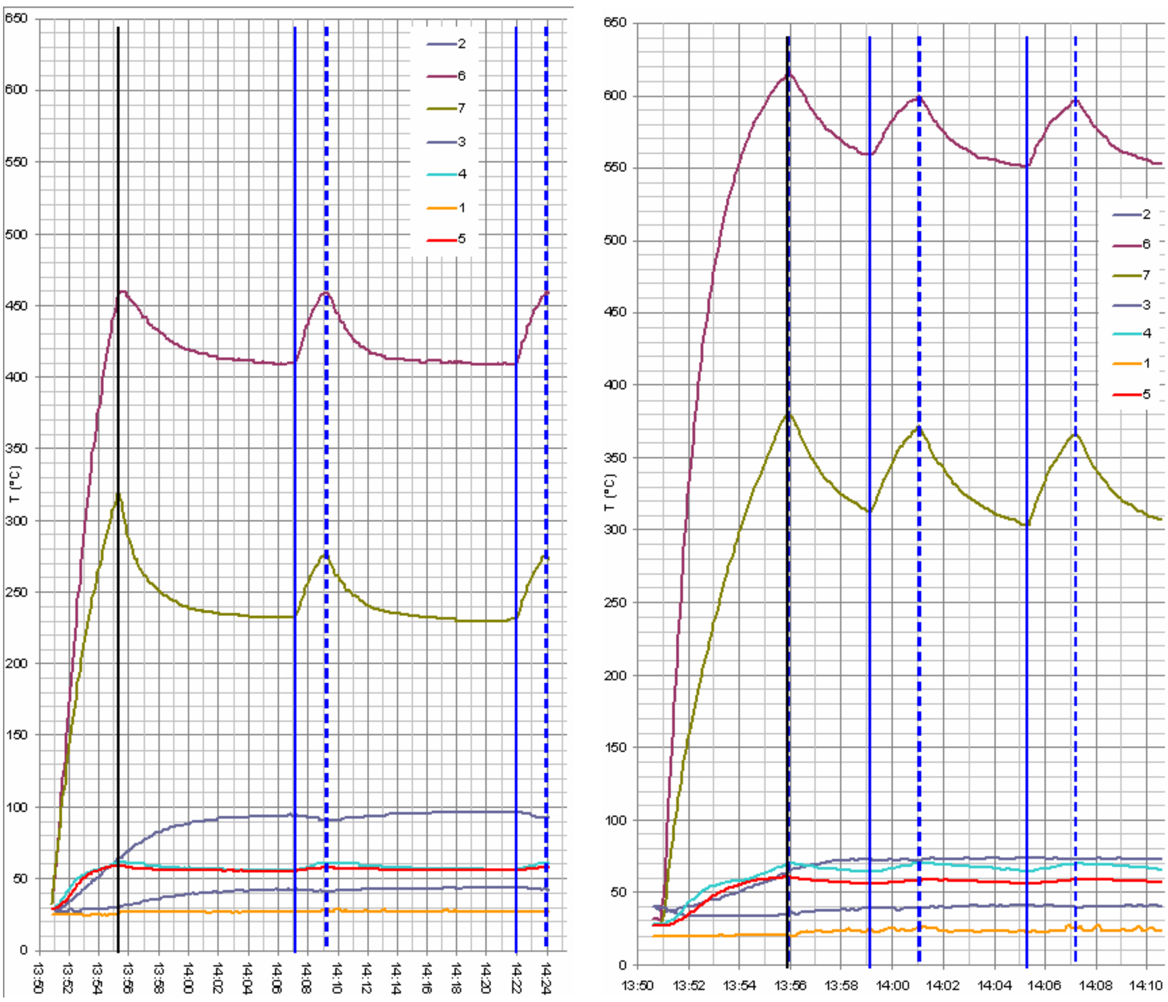

Fig. 4: Mode A (left) and mode B (right)

First black line represents fan start, blue lines represents heat power increasing (to 50% of range – in this case 35kW) and blue dash lines represent heat power decrease (back to min. 25kW).

Unit start and running was without problem. In measuring point 7 was low temperature - This point is the most important for heat exchanger temperature. There is place of material change (stainless steel to black steel) and limiting temperature is 530°C for black steel.

For mode A was heat power increasing time approximately 2 min and heat power lowered time was 13 min. For mode B was heat power increasing time 2 min and heat power lowered time was 4,5 min.

Belaying parts are on the first tube (air side). If unit is used like ceiling unit this tube is on the top position and more heat is flowing through this tube. The protection reactive earlier and the heat exchanger isn´t so warm. This is reason why are the temperatures in mode A lower.

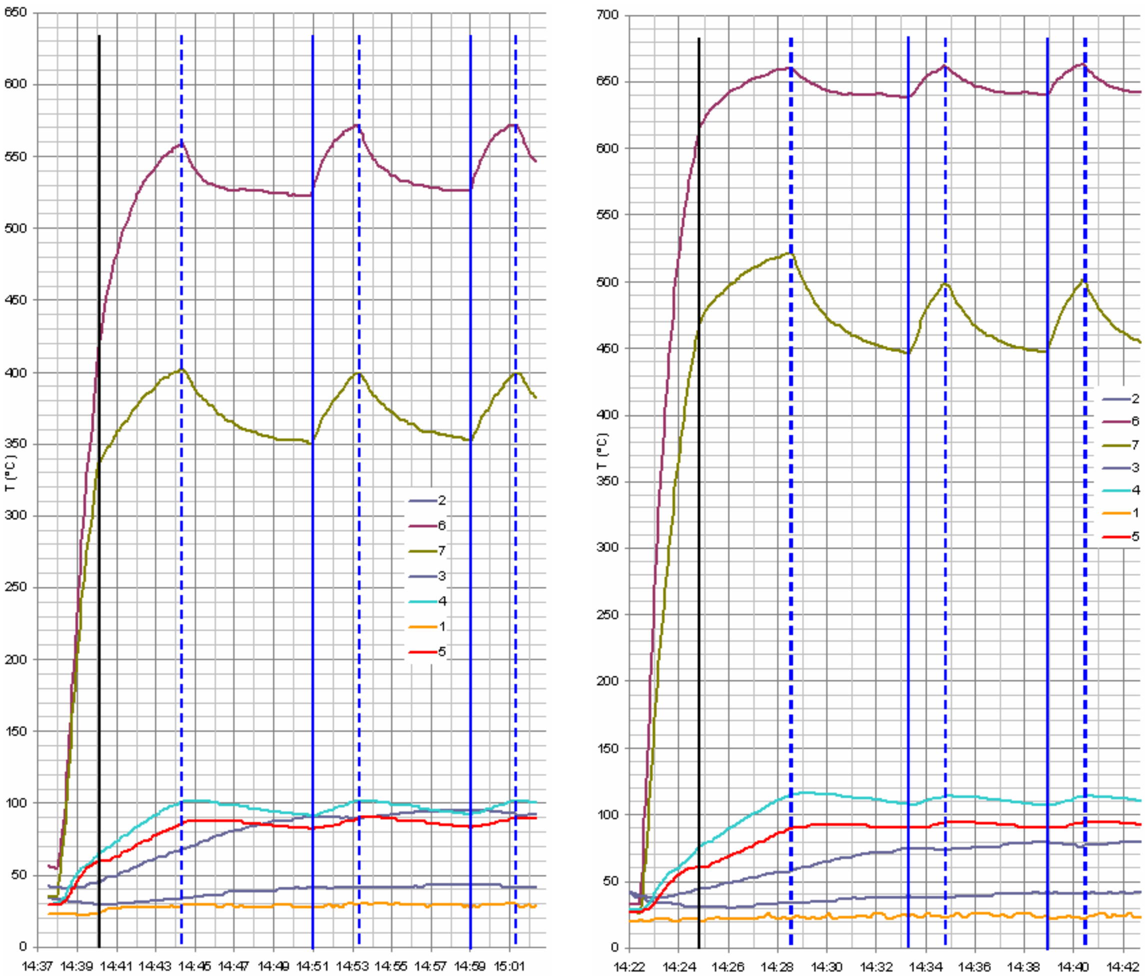

Fig. 5: Mode C (left) and mode D (right)

Fig. 5 shows mode C and D. In these cases was risk of overheating – low air volume and high heat power was used. This is reason for heat exchanger protection – specially measuring point 7.

First black line represents fan start, blue dash lines represents heat power decreasing (to 50% of range – in this case 35kW) and blue lines represent heat power increasing (back to max. 45kW).

Unit start and running was without problem. In measuring point 7 was low temperature (under 530°C).

For mode C was heat power decreasing time approximately 6 min and max heat power time was 3 min. For mode D was heat power decreasing time 4 min and max heat power time was approximately 2 min. This measuring was relized with air inlet temperature 23°C. With lower temperature will be max heat power time longer.

In mode B are the temperatures lower again (celing unit).

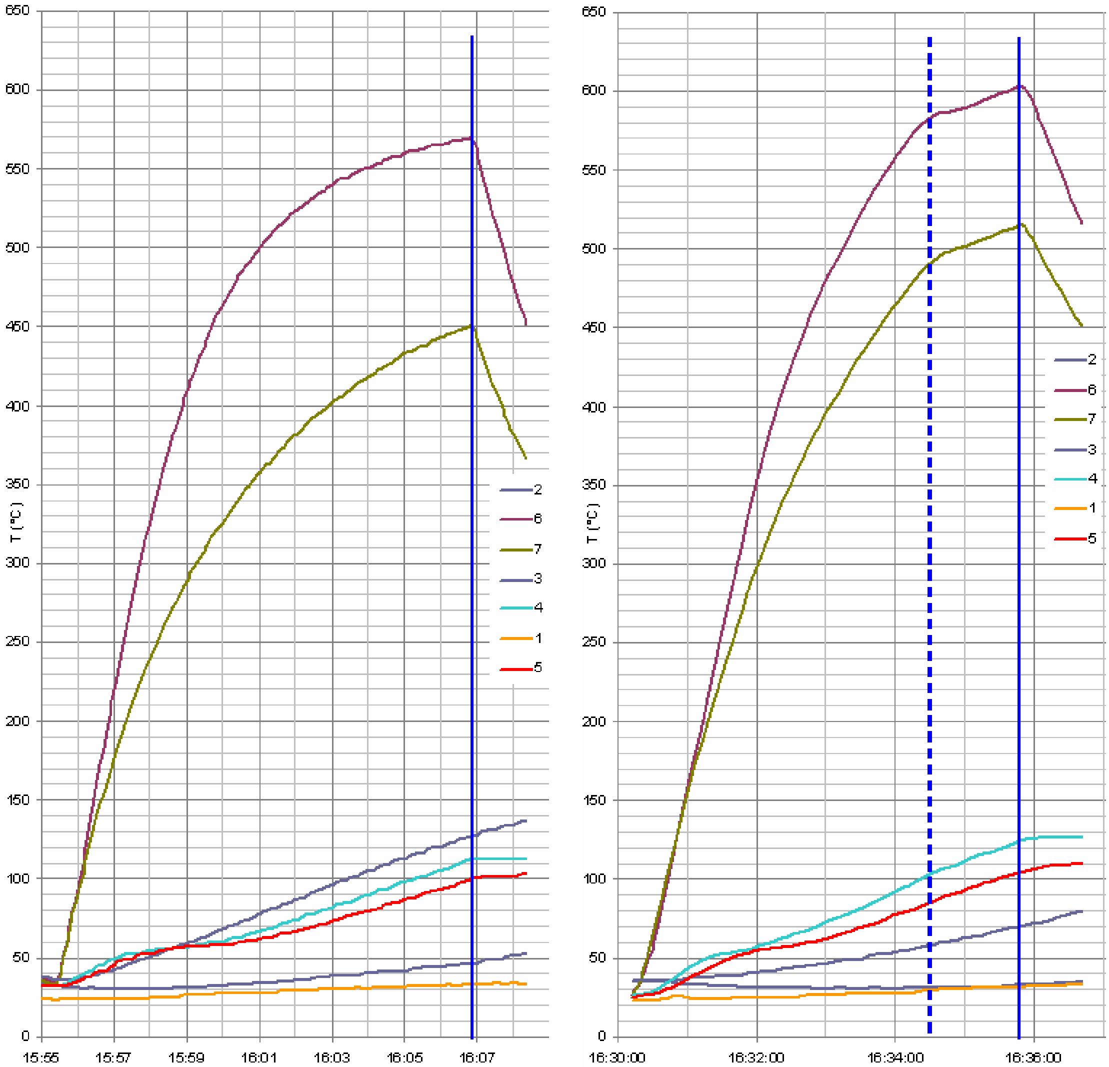

Fig. 6: Mode E (left) and mode F (right)

Fig. 6 shows mode E and F. It is start without fan. Blue line represents central stop by manual termostat and blue dash lines represents heat power decreasing (to 50% of range).

In mode E is lower temperature rising than mode F. In mode F make react heat power decreasing by probe PT1000 before central stop by manual termostat. In measuring point 7 was low temperature (under 530°C).

Conclusion

A few modes of the new heating units were measured with new regulation. The temperature was measured in several places.

Regulation works well. In this heat power range and when the current fan was used, the heat exchanger wasn´t overheated in this critical point.

In all modes weren´t measured temperatures dangerous for the heat exchanger (point 7). On the surface of the burner weren´t measured temperatures dangerous for burner´s electronic (max 70 ° C).

Furthermore, the temperature was measured on the place where the future manual thermostat will be mounted. For this value was selected thermostat temperature 130°C for safety reasons (sudden outage etc.).

Unit testing with thermostat designed will continue (with different initial conditions). Testing with other burners and motors will continue in future.

References

[1] VÍZEK, J.; LOUDA, J. Protokoly z měření, Liberec, GEALVZ, a.s., 2006-10

[2] PÍRKO, Š. Protokoly z měření. Liberec: GEALVZ, a.s., 2011

[3] ŠČIBRAN, P.; DVOŘÁK, V. Proposal of the heat exchanger with premix burner. Plzeň: ES2010, 2010

[4] ŠČIBRAN, P.; DVOŘÁK, V. Development of the heat exchanger for heating unit with premix burner. Rožnov p. Radhoštěm, 2010

[5] ŠČIBRAN, P.; DVOŘÁK, V. Measuring of temperature distribution on the surface of the heat exchanger. Liberec, EFM2010

[6] ŠČIBRAN, P. Proposal of the heat exchanger for smaller heating unit with premix burner. Plzeň, 2011

[7] ŠČIBRAN, Petr. Temperature control on the surface of the heat exchanger and burner during heat power regulation, Liberec, EFM 2012

Acknowledgements

This work was financial supported from the particular research student grant SGS 2823 at the TU of Liberec.

Ing ŠČIBRAN Petr, Technical Univerzity of Liberec, Mechanical faculty, Department of Power Engineering Equipment, Hálkova 6, Liberec 1, Tel.: +(420) 485 353 479, email: petr.scibran@seznam.cz