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THE ASSESMENT AND DESIGN OF WASTE HEAT RECOVERY TECHNOLOGY FROM THE SAND DRIER PROCESS IN THE FOUNDRY

Martin Zálešák
Zdeněk Bilenný
Tomas Bata Univerzity in Zlín
Faculty of Applied Informatics
Department of Automation and Control Engineering
Nad Stráněmi 4511, 760 05 Zlín
Czech Republic

ABSTRACT

The work deals with a possible solution on heat recovery related to the sand-drier SCH 5 in a foundry. The heat recovery applied on air entering the heating chamber is designed in this variant. The work consists of analysis of drying process including balance calculations, design with relevant calculations, including possible power savings, the way of control of the relevant foundry sand drier, used at present and possibility of visualization of the control system by means of Control Web programme. Further, possible technical solution and its economic evaluation are stated in the work.
Keywords: Drying, dryers, heat exchanger, Control Web

1. INTRODUCTION

The foundry processes are energy demanding. As the price of energy rises rapidly, it has a great impact on the price of the foundry products. In order to compete in the market, there is obvious effort in the foundry industry to save energy as much as possible. One of the energy demanding technology in foundries is the sand drying process. The sand is used in foundry for cast forms modelling. The sand is prior to forming process dried in the fluid type of sand drier SCH 5. The picture of the particular drier is shown on the Figure 1 and Figure 2. Wet sand is dried from the mass moisture content of 5,5 % on the drier inlet to the outlet mass moisture content of 0,1 %. The average sand flow is 3850 kg/h. Mixture of natural gas burner fumes and the air is used for the drying process. The two stage burner is used for the process. The fumes from the burner are mixed with the air from the hall. Required temperature of the drying process is 560 ^{o}C. The wet gas flowing from the dryer has temperature of 75 ˚C and it is draw through the separator of solid particles of cyclone type. The control systems used for driers is formed by PLC Millenia type. The task of the work was to decrease energy consumption of the dryer. Boundary conditions of the process are stated in the table 1.

2. THE SOLUTION

2.1. Aproach

The solution was divided in several partial tasks

- calculation of the energy distribution
- calculation of utilised energy of the outgoing air;
- design of main parameters of the heat recovery system;
- design of control and monitoring system;

- financial evaluation of the investment costs;
- economical evaluation of the project.

2.2. Energy distribution

The energy balance of the process is as follows

- mass and energy incoming to the process;
- heat loss of the dryer walls;
- mass and energy outgoing from the process.

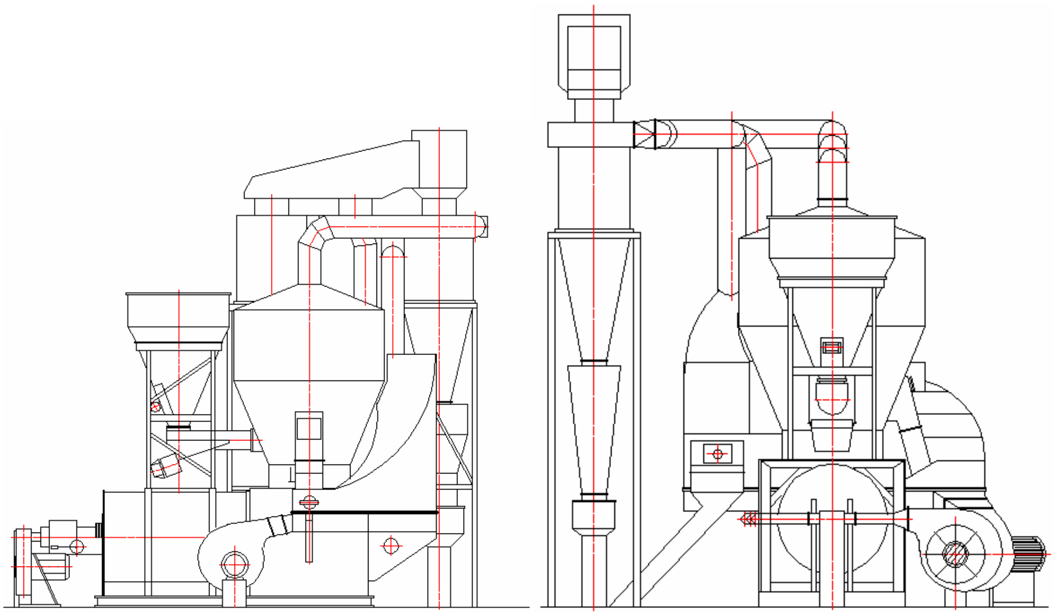

Figure 1. Schematic view on the sand drier

Figure 2. View on the drier

The scheme of the process is shown on the figure 3.

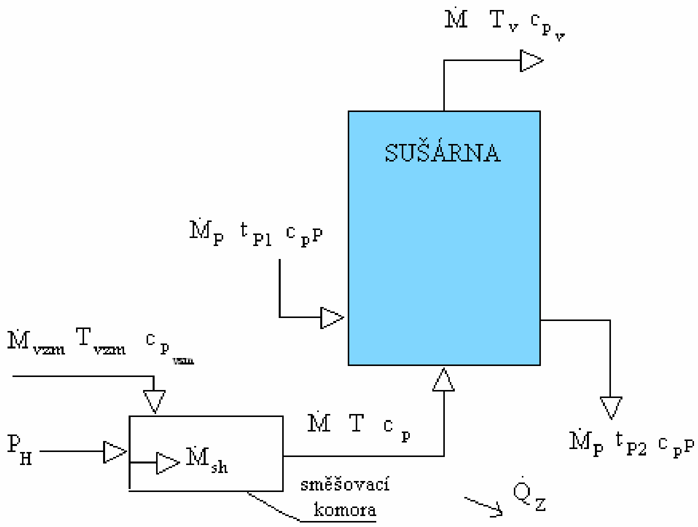

Figure 3. The scheme of the drying process

According to the scheme stated in the figure 3 and the known consumption of gas for burning, the sand flow and its parameters known , the results were calculated as follows
power of the burner , P_H = 231 kW; volume flow of air for burner, $\dot{V}_{vh}$ = 267 m^3/h; volume flow of fumes from the burning process $\dot{V}_{sh}^{V}$ = 289 m^3/h; mixing air volume flow $\dot{V}_{vzm}$ = 605 m^3/h; heat loss of the mixing and drying chamber $\dot{Q}_Z$ = 10,8 kW.

2.3. Proposal of the solution

The solution for the heat recovery was proposed in a way that the incoming air to the dryer mixing chamber would be preheated by the outgoing gas by plate type heat exchangers. The schema of the solution is stated in the figure 4.

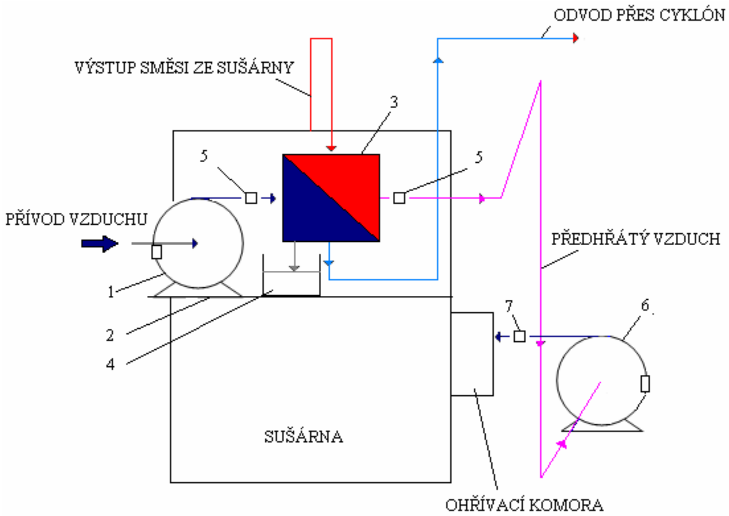

Figure 4. The scheme of the heat recovery

2.4 Energy exploitable of the outgoing air

The exploitable energy of the outgoing air depends on the type of heat exchanger and the temperature of the outgoing air allowed (moisture condensation problems).

2.5 Control system

There is used for the control of the drying process PLC automat Millenium. The foundry has created the control scheme by Crouzet Logic Software. This software is sufficient for purposes of controlling but not reachable from distant places and not enough friendly. The Control Web program was chosen for visualization, monitoring and control of the process. In this environment it is possible to create visualization, data archiving for the purposes of energy savings effects evaluation, setting up the users rights and the access via internet. An example of HTML application of the program ControlWeb is shown on the Figure 5.

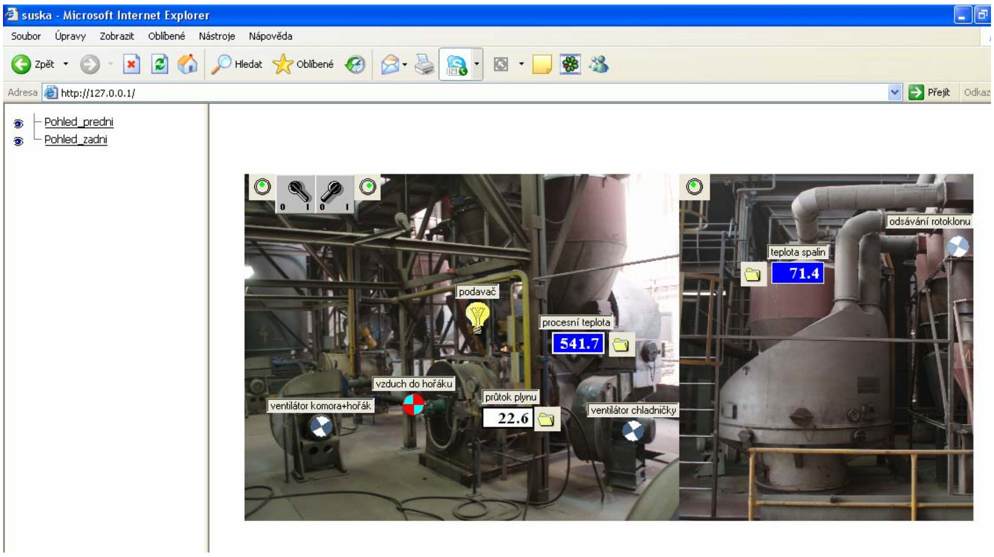

Figure 5. An example of HTML application of the program ControlWeb

2.6. Economical evaluation

The economical evaluation is based on calculated saved expenditure for energy for the process and investment costs.

Calculated economical parameters of the project

- real discount rate r = 10%;
- payback period T_s = 3, 3 years;
- discounted paybeck period T_{sd} = 4 years;
- net present value NPV = 10 000 Euro
- internal return rate IRR = 27 %

3. CONCLUSIONS

The project is under evaluation at present. The energy savings could contribute to decrease the cost of the foundry products.

4. ACKNOWLEDGEMENTS

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