

Improving the Heat Transfer of Batch-Fired Straw Boiler

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I. INTRODUCTION

Use of straw for farm heating system purposes is growing, as it reduces farmers' dependence on fossil fuels and associated costs, instead of creating a practical and environmentally friendly alternative fuels. In addition, they always have access to cheap fuel. Much of the farmers annually produce enough straw to ensure their heating systems with fuel. However, if they would have to buy straw, it usually pays off, as part of the agricultural straw waste is to be somewhere is to be exercised or converted into compost.

II. DESCRIPTION OF BOILER

Object that the researches are based on is classical round bale straw boiler, which is used for producing heat energy to provide temperature regime in greenhouse. Greenhouse is used for growing vegetables here in Latvia that are being sold in Latvian market.

The research object has a classical assembly installation where all system water is circulating through the accumulation tank to reduce temperature differences, so the heat exchanger is heating up all the amount of water in the accumulation tank. The accumulation tank has a huge heating surface of 45 m³ so it's not so energy effective. But this assembly still has a drastic temperature differences which are not acceptable.

According to the problem of temperature differences it's necessary to improve the classical assembly installation system to reduce fluctuations of temperature.

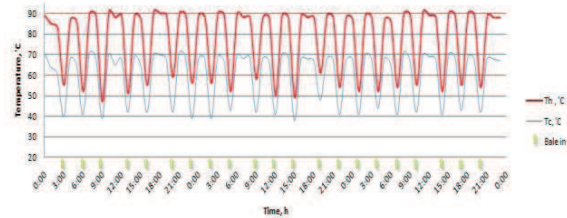
Boiler is able to operate for long periods at a steady mode. Critical are moments of time when a "portion" of straw is burnt out, and while the other is inserted into the furnace and until the furnace starts working at a nominal capacity. These time instants, last up to 20 minutes, which means that the accumulation tank has to ensure temperature uniformity of heating circuit for only 20 minutes.

The solution is following; during the time when the boiler is being burnt, the circuit is heated up directly from the boiler's heat exchanger. At the same time, separate accumulation tank with a relatively small volume is heated up through the flue-gas economizer and the door of boiler's furnace. The volume of this accumulation tank (20m³) is smaller than the one that's used in classical assembly installation and has small heat transfer surface. The boiler is not usually used with a nominal capacity, which results in excess heat energy, thereby economizer with the help of this energy is returns the heat to accumulation tank.

At a time when the furnace filled up with the next "portion" of fresh straw, temperature in the heat exchanger begins to reduce and the sensor gives an impulse to the boiler's control system to switch direction of 3-way valves and to start using the heat accumulated in the tank. When the furnace is burning again and the temperature of the heat exchanger reach the required operating temperature, sensor dives an impulse again

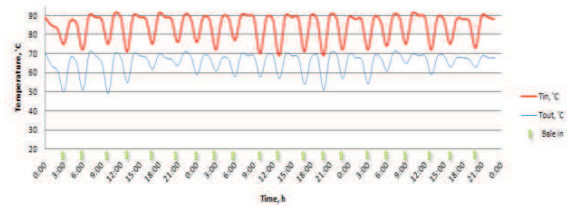
to boiler's control system and 3-way valves are switched to the standard mode.

III. RESULTS



T_h , °C – temperature of flow water;
 T_c , °C – temperature of return water;
 Bale in – time when fresh 2 bales are inserted.

Fig. 1. System temperature regime before improvements



T_h , °C – temperature of flow water;
 T_c , °C – temperature of return water;
 Bale in – time when fresh 2 bales are inserted.

Fig. 2. System temperature regime after improvements

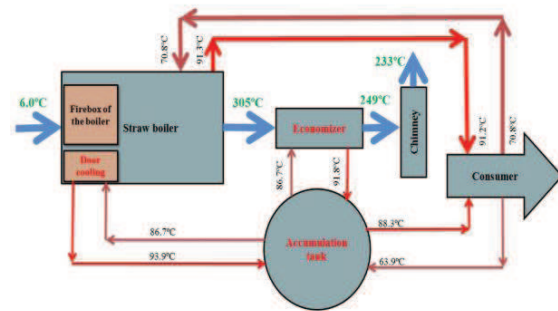


Fig. 3. Heat production process.

IV. CONCLUSION

There's one more way to improve the existing system. It's possible to increase diameter of the heating main pipes so that one could reduce system resistance and to increase a naturally insulated accumulation volume. This solution will be viewed in further researches.

V. REFERENCES

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