THE FACULTY OF ENGINEERING, UNIVERSITY OF KRAGUJEVAC, SERBIA

THERMAL EFFICIENCY OF A DOUBLE EXPOSURE AND CONVENTIONAL FLAT-PLATE WATER SOLAR COLLECTORS – EXPERIMENTAL RESULTS

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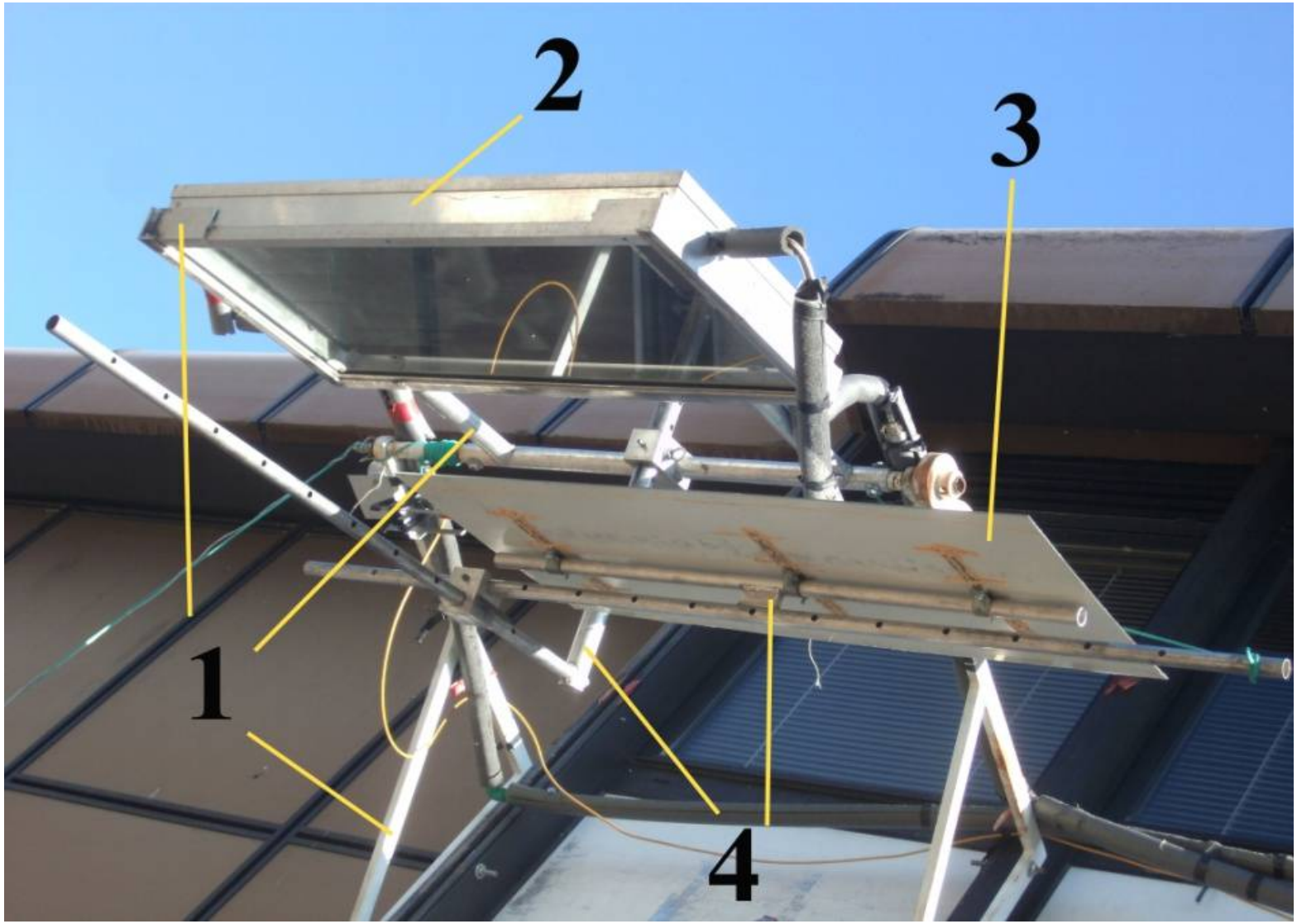
EXPERIMENTAL SETUP OF THE DEFPC_



The collector-reflector system: 1-supporting construction, 2-DEFPC, 3-reflector and 4-construction for reflector movement

EXPERIMENTAL SETUP OF THE CONVENTIONAL SOLAR COLLECTOR

EXPERIMENTAL SETUP OF THE BOTH SOLAR COLLECTORS

EXPERIMENTAL SETUP OF THE BOTH COLLECTORS

- *The experimental tests of the DEFPC and FPC were performed during August, September and October of the 2012.*

- *Both solar systems were set up at the tilt angle G = 36˚ and orientation α = 147˚. They are of the same dimensions and absorber properties.*

- *The reflector was moved manually every hour during the testing.*

- *Every day of the testing the data about the instantaneous global horizontal radiation, the ambient temperature, the inlet and outlet water temperatures and the mass flow rates were collected simultaneously.*

THERMAL EFFICIENCY

The thermal efficiency of an solar collector is defined as the ratio of the useful energy transferred to the working fluid and inputted energy as a total solar energy received by the surface of the collector glazing.

FPC:

$$\eta_{k,e} = \frac{Q_{k,e}}{H'_{kG} \cdot A_k} = \frac{\dot{m}_k \cdot c_{p,k} \cdot \left(T_{k,i} - T_{k,u}\right)}{H'_{kG} \cdot A_k}$$

$$H'_{kG} = H'_{dir} \cdot \frac{\cos(i)}{\sin(\beta)} + H'_{dif} \cdot \frac{1 + \cos(G)}{2}$$

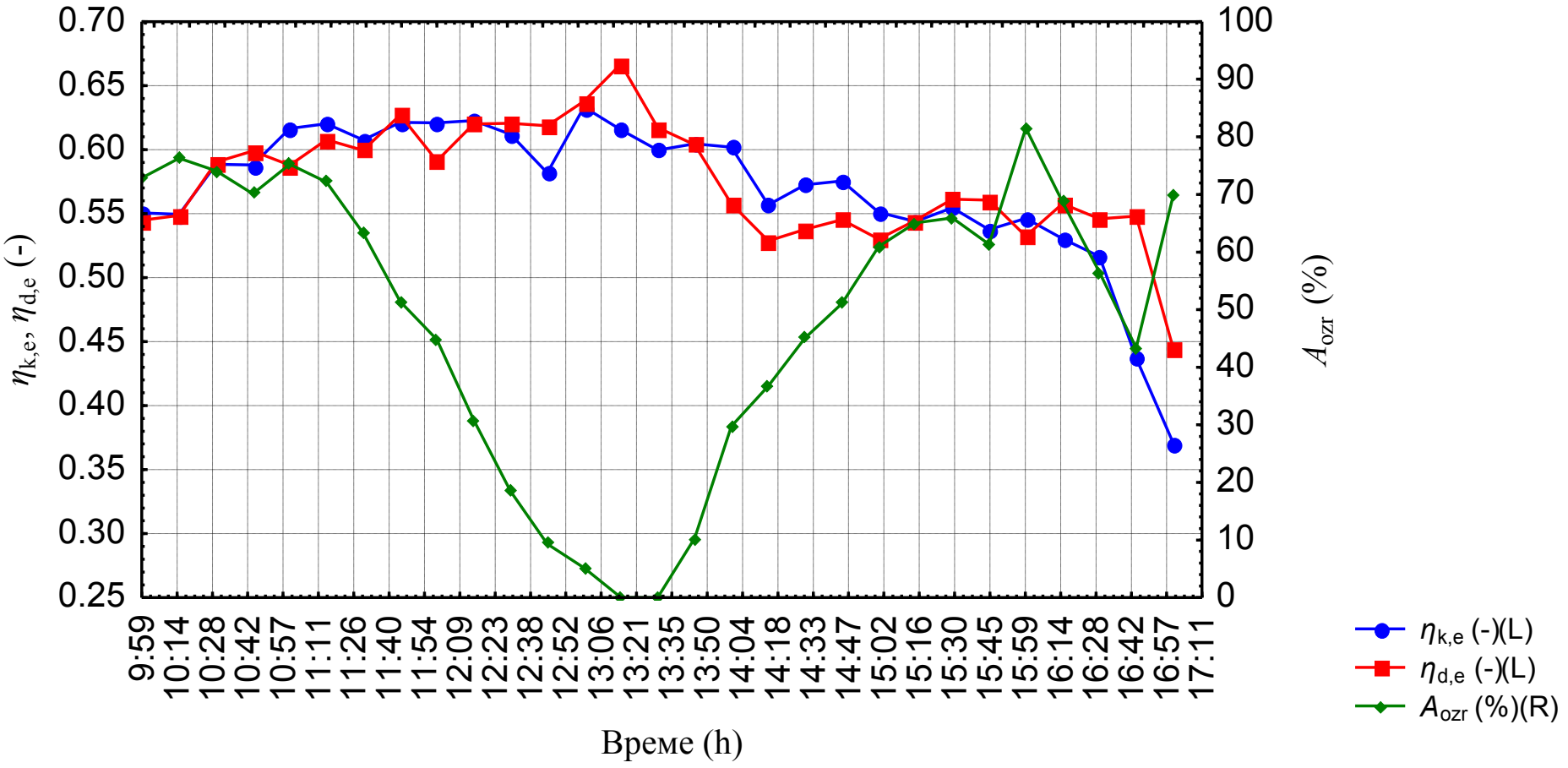
DEFPC:

$$\eta_{d,e} = \frac{Q_{d,e}}{H'_{dG} \cdot A_d} = \frac{\dot{m}_d \cdot c_{p,d} \cdot \left(T_{d,i} - T_{d,u}\right)}{H'_{dG} \cdot A_d}$$

$$H'_{dG} = H'_{dir} \frac{\cos(i)}{\sin(\beta)} + H'_{dif} \cdot \frac{1 + \cos(G)}{2} + \rho \cdot \left(H'_{dir} \frac{\cos(i_r)}{\sin(\beta)} \cdot \frac{A_{ozr}}{A_{dd}} + H'_{dif} \cdot \frac{A_r \cdot F_{rc}}{A_{dd}} \right)$$

EXPERIMENTAL RESULTS

*In this paper the experimental results of the thermal efficiency of the FPC ($\eta_{k,e}$) and DEFPC ($\eta_{d,e}$) for the dates when the achieved dayly irradiation of the lower absorber surface of the DEFPC was the lowest (**8th of August**) and the highest (4th of October) are presented.*



EXPERIMENTAL RESULTS

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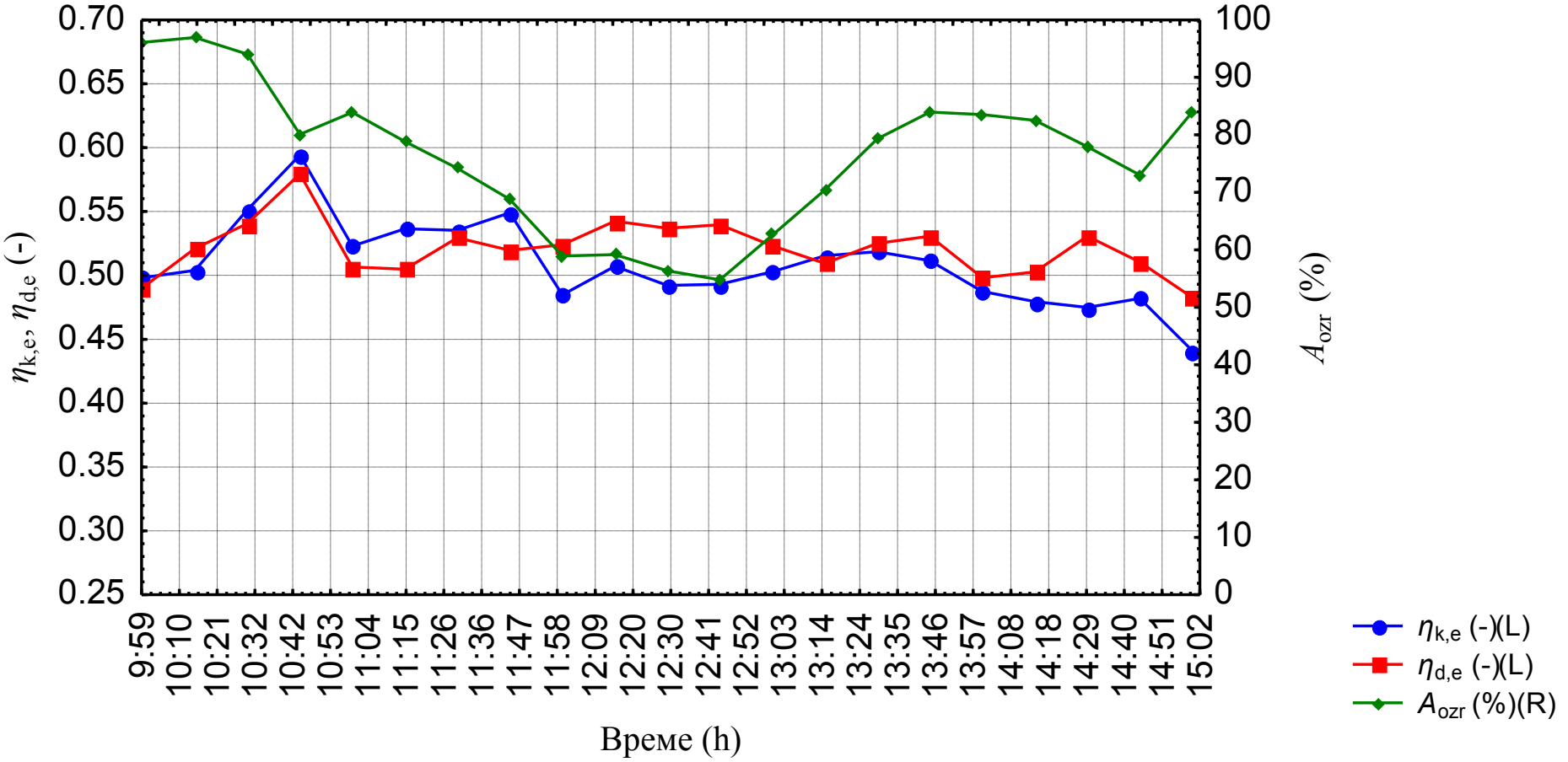

EXPERIMENTAL RESULTS - CONCLUSIONS

- The thermal efficiency of the DEFPC is the similar to that of the FPC. The mean dayly thermal efficiency of the DEFPC and FPC during the **8th of August** was 0.575 and 0.576 and during the **4th of October** 0.521 and 0.508, respectively.
- From 8th of August to 4th of October, 2012 the thermal power of the DEFPC is 41.79% to 66.44% higher than the same of the FPC with corresponding construction, respectively.
- The highest obtained daily relative difference ΔQ is 18.44% higher than the maximum achieved difference of 48% in the previous investigation of the DEFPC.
- Thermal efficiency $\eta_{d,e}$ obtained in this investigation was not compared with the thermal efficiency of the previously investigated DEFPC. The reason for this is incorrectly calculation of efficiency. It was calculated as a ratio of the obtained useful thermal energy and total absorbed energy, instead of the ratio of the obtained useful thermal energy and total energy incident on the glazing surface.

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THANK YOU FOR YOUR ATTENTION