THE PLASTIC SOLAR ABSORBERS AND POSSIBILITIES OF THEIR UTILIZATION

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SUMMARY

Utilization of solar energy becomes the more topical. The most spread application is heating the water. This contribution deals with construction of plastic solar collector-absorber for low temperature utilization, especially for heating the water in swimming pools. This collector has a set construction. It enables the creation of required absorbing area on the surface of the ground without bearing constructions, and also the free movement of persons on the absorber surface. These solar absorbers also enable the other non-conventional possibilities of utilization. Carried-out measurements shown that solar absorbers are the most effective possibility of utilization of solar energy at present.

Keywords: *solar energy, plastic absorber, energy profit*

1. INDRODUCTION

Utilization of solar energy becomes the more actual for its advantages and perspectives. The present situation is characterized by spreading the possibilities of practical use of this renewable source from the most simple applications up to the most complex ones. Equipment that changes the solar energy on the other kinds of energy, reaches the outputs from some watts up to some megawatts. The main orientation is for the utility water heating and production of electrical energy. Solar collectors used for heating of the utility water are characterized with perfect construction and high effectiveness and also with the high production demands that are especially resulting from the high requirements on the quality of absorber [1]. The high quality of black absorption layer is reached by creation of coat with high absorptivity in the area of visible radiation and low emissivity in the area of infrared heating radiation. At low heat applications it is possible to simplify the construction in a great measure at preserving the required parameters by leaving out the transparent cover, supporting frame, heat insulator, or by decreasing the demands on absorption layer properties. The simplest solution is the utilization of single absorber that construction must be convenient for this application or must be adapted [3]. This utilization is especially suitable for heating of liquids to 30 °C i.e. in swimming pools where the required water temperature is 27 °C. For this application the textile-plastic absorber from firm Ekosolaris Kroměříž (Czech Republic) and new product Solar Plast (Slovak Republic) are suitable.

2. PLASTIC SOLAR ABSORBERS

In the last time more types of solar absorbers with utilization of plastics at their construction have been appeared on the European market. The most frequently used material is polyethylene. Advantages of plastics are simplicity of their processing, possibility of high production and low prizes. The high chemical resistance of polyethylene enables the aggressive heat-transfer media to be also heated. Disadvantages of the utilization of plastics are resulting from their low resistance to ultra - violet part of solar radiation, their lower mechanical resistance at higher temperatures and non - selective surface. The first disadvantage may be influenced by utilization of UV stabilizer in the form of additions into basic material, the second one by construction and the third one by suitable way of service.

It is obvious that plastic absorbers do not reach the parameters of solar collector absorbers, but the non-conventional possibilities of their applications and also their prizes effect their broader utilization. The greatest applications of plastic absorbers are for water heating in swimming pools.

3. SOLAR ABSORBER SOLAR PLAST

Absorber Solar Plast, that samples have been produced in the Slovak Republic, belongs to the group of plastic absorbers. It is all-plastic solar absorber produced on the basis of polyethylene of high density, with high mechanical, heat and chemical resistance. Construction is in the form of set consisting from basic components in the shape of square with dimensions: 295 x 295 x 30mm /Fig. 1/.

Front wall surface of absorber is shaped with aim to decrease the reflectivity of surface at low incidence angles of solar radiation. Components are vertically assembled into columns /Fig. 2/ and by their parallel arrangement the bigger areas are created /Fig. 3/. Number of components in column and number of columns may be changed. Above-mentioned enables us to adapt the shape of absorber surface to possibilities of place or space of utilization. Absorber is intended for low heat temperature application and therefore it is constructed without transparent cover, heat insulator, supporting frame and selective absorption layer.

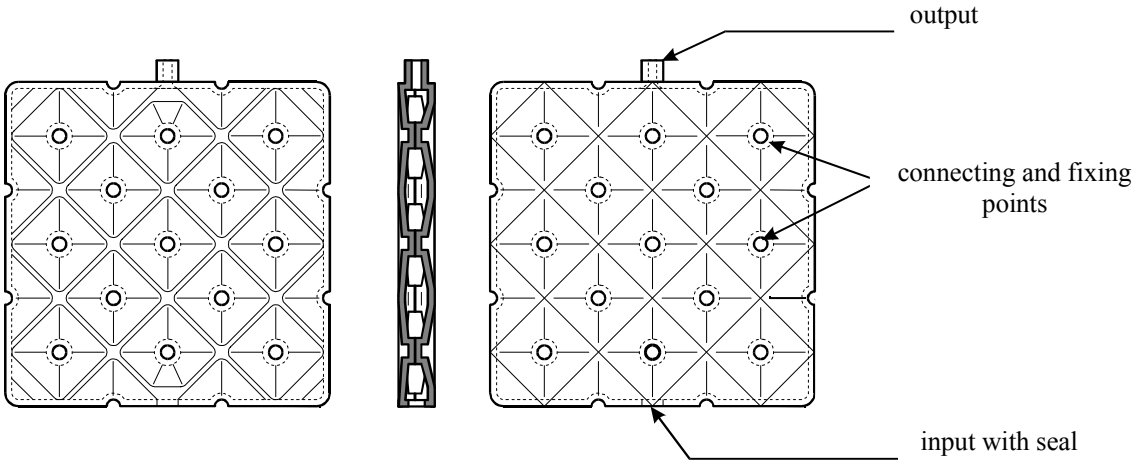

Fig. 1 Construction of absorber

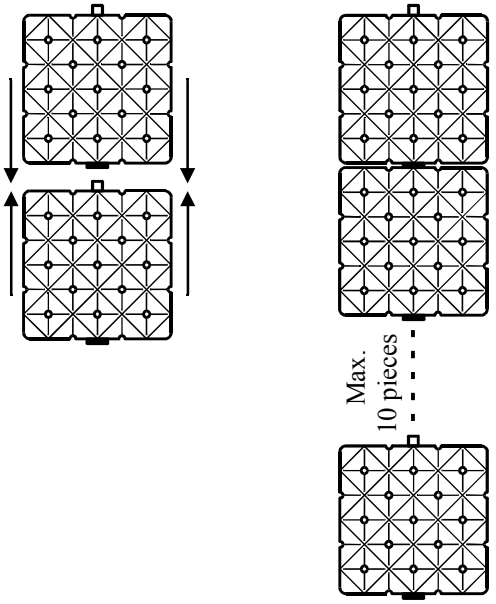

Fig. 2 Connection of absorber parts into columns

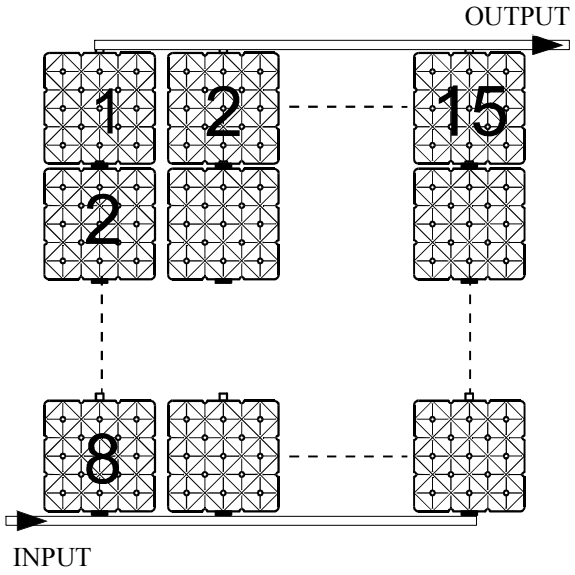

Fig. 3 Connection of absorber parts into plane

Mechanical properties of absorber are ensured by basic material properties and constructional solving of component. This component is mechanically strengthened in 13 points by press joints of front and rear walls. Achieved properties of absorber enable his location directly on the ground surface and free motion of persons on surface of absorption area filled with heat bearing medium. This predetermines its utilization in surroundings of swimming pools for creation of the access pavements and pass zones around swimming pool.

4. MEASUREMENTS ON ABSORBERS SOLAR PLAST

The measurements of absorptivity and resistance tests against frost were carried out on samples of absorber. The energy profit was measured on absorber with area $1m^2$.

Technical data of absorber were completed with measured parameters. The value of absorption coefficient that was obtained at absorptivity measurement was $A = 0{,}93$ and that shows the excellent ability to absorb the solar radiation. Measurements of heat emissivity at temperature of working medium 80 °C have also shown the high degree of heat radiation from the absorber surface $E = 0{,}96$. The high emissivity of absorber surface effects that absorber reaches low stagnation temperature. This causes that system filled with water is not overheated even at the highest solar radiation intensity.

Test of absorber resistance to freezing were carried -out on the basic constructional component filled with water. This component was exposed to the influence of low temperature up to –30 °C. That has shown the resistance to possible frost during its service in spring or autumn.

Technical parameters:

Outer dimensions	295 x 295 x 30mm
Inside volume	1,8 l
Material	PE HD with additions
Maximum working temperature	90 °C
Resistance to freezing	–10 °C (–30 °C)
Working pressure	0,16 MPa
Testing pressure	0,5 MPa
Absorption layer	non-selective
Absorptivity A	0,93
Emissivity E (80 °C)	0,96
Quality of absorber Q	0,97
Temperature of stagnation	39 °C
Acceptance angle	125 °
Energy profit	945 Wh/m^2

Measured results of energy profit and directional characteristics measured during clear solar day are shown in Fig. 4.

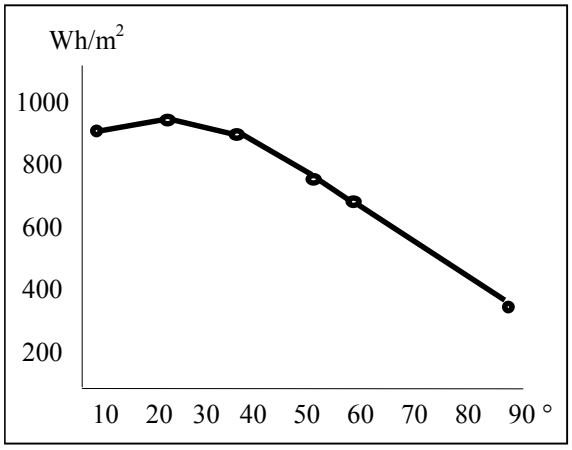

Fig. 4 Dependence of acquired energy amount Q_S on incidence angle of solar rays

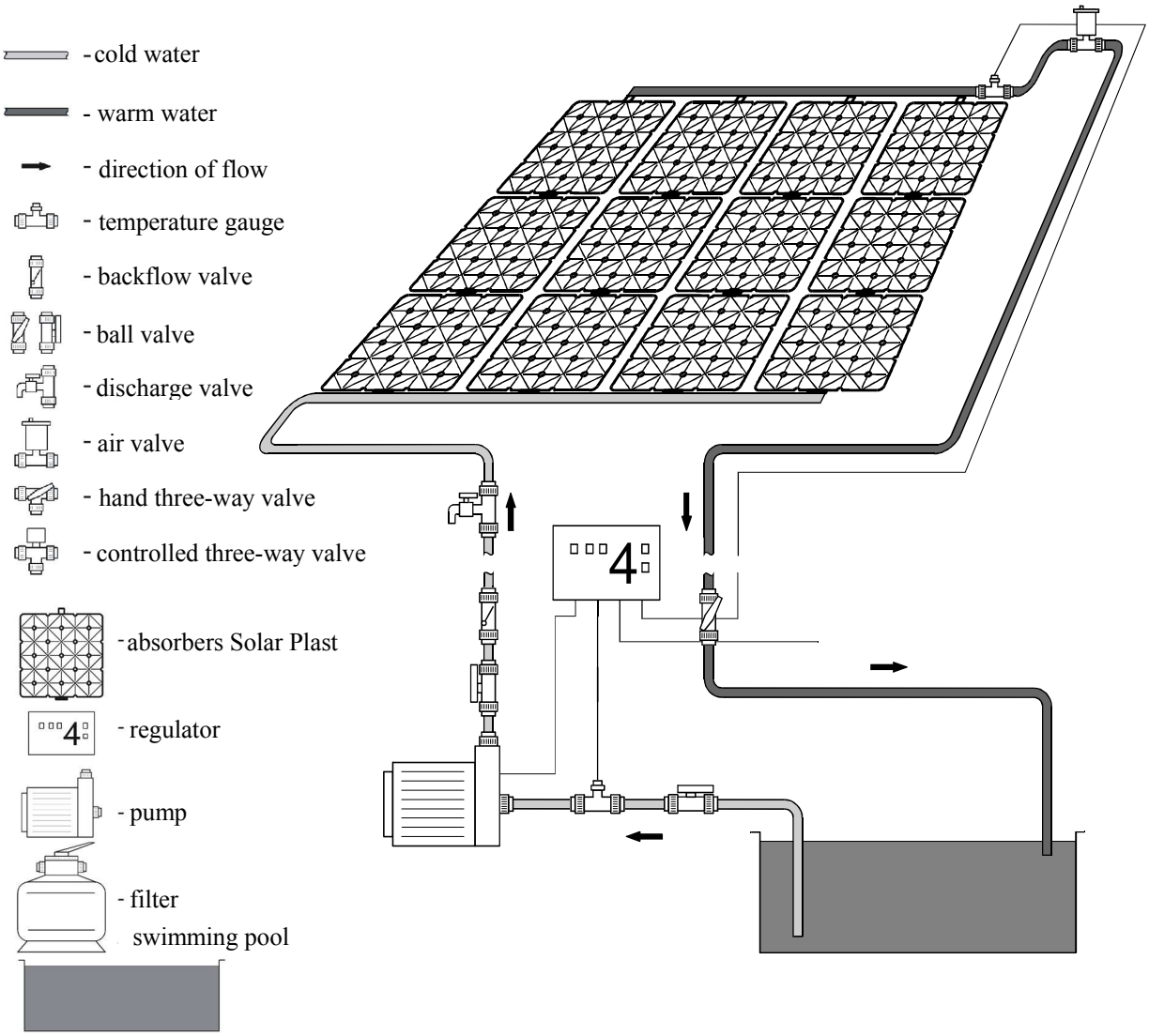

Fig. 5 Solar system with absorbers type Solar Plast

5. CONCLUSION

Solar absorbers Solar Plast are non-conventionally constructed multipurpose applicable absorbers working at water heating in swimming pools with high-energy profit 945 Wh/m^2. This energy profit is enabled by their construction and by method of service at low temperatures of working medium and comparable high or also higher temperatures of surroundings. Service of swimming pools has the positive influence on benefit of energy. In this case absorbers receive except solar radiation also heat from surroundings. This fact was verified also by measurement at deflection of collector about 90° from solar rays direction. Tested absorber has received also thermal energy by permeation of heat and reflected solar radiation from surroundings. In the case when the swimming pool is not covered during the night it loses practically the whole received energy [2]. In the morning the temperature of both water and the ambient air water is low therefore the absorber will work with high effectiveness. During day the temperature of water and ambient air gradually rises. From above mentioned it results that absorber activity may be assumed in the area of maximum energy profit. Solar system with absorbers Solar Plast is shown in Fig. 5.

Utilization of Solar Plast collector in the function of pavement, fencing or pass zone from surroundings to swimming pool and also the possibility of full recycling after finishing its life-time considerably increases its utility value. Carried-out measurements shown that solar absorbers are the most effective possibility of utilization of solar energy at present.

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BIOGRAPHY

Ján Tkáč was born in Vranov, Slovakia. He received his Ing. (MSc.) degree in 1976 at the department of Electric Power Engineering of the Faculty of Electrical Engineering and Informatics at Technical University in Košice. He defended his CSc. (PhD.) in the field of high voltage technique in the year 1986. Since 1978 he is working as assistant professor on the Department of Electric Power engineering. His scientific research is focusing from the year 1985 on solar energy and renewable energy sources.