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ALUMINIUM FOAM HEAT EXCHANGERS FOR FUTURE ZERO ENERGY BUILDINGS

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Abstract

Zero-energy demands for a building need to be secured to a large extent by renewable sources available in the building or its proximity. The design of the building has to be drafted with a targeted orientation of the glazed windows, exclusion of thermal bridges, controlled ventilation and heat recovery in order to use heat gains efficiently. The energy efficiency of residential buildings is today mostly improved by upgrading the energy performance of the building envelope and facilities. However, huge energy reductions can be achieved also by a focus on new innovative systems enabling to cover natural solar energy fall-outs resulting from generation much excess heat during the peak time (summer, day) which is almost not possible to use during periods of excessive energy consumption (winter, night). This drawback can be very efficiently solved by storing and later evolving of accumulated heat according to the day-night as well as the seasonal, i.e. summer-winter cycle.

This contribution deals with the system of thermo-active aluminium foam cladding for pitched roofs of the buildings covered by innovative coating sufficiently resistant to weathering, frost, intense solar radiation, summer heat, chemicals presented in the air, chemically polluted water vapour and to mechanical damage caused by adverse weather conditions (e.g. heavy rainfall, groats, etc.). The objective is to achieve excellent mechanical and physical properties related to highly energy efficient solar radiation and heat harvesting as well as the ability to dissipate an undesirable heat accumulated in the building interior to the surroundings of building via the roof surface during colder summer nights. This smart roofing system can be easily supplemented with the system of interior aluminium foam heating/cooling ceiling heat exchangers that allow short-term storage of the heat for at least several hours in the form of latent heat of phase transition of Phase Change Material (PCM) impregnated in the porous structure of aluminium foam for later use, or for removal of undesirable heat to the building surroundings.

This novel concept allows expanding the use of aluminium foam with a reinforced surface in the building industry thanks to technological options related to the achievement of its excellent surface quality suitable for mechanical load, corrosion, chemical environment, strong solar radiation, large temperature fluctuations between winter and summer season, etc.

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