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EDITORIAL

Glazing Systems for Reaching Net Zero Energy Buildings Target

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The increasing trend of global energy demand due to rising population, comfort expectations and living standards has caused a prevalent concern about the state of the supply-demand chain of energy in the upcoming years. Considering that the building sector is responsible for about one-third of the final energy demand and related greenhouse gas emissions, it is important to take actions in order to reduce the energy demand of building sector and consequent release of greenhouse gas emissions [1]. Moreover, energy need of the globe is expected to be doubled by 2050. In this context, the concept called Net Zero Energy Buildings (NZEBs) stands as a promising solution to the problem since it offers energy-efficient and high-performance buildings, and healthy indoor environments. Furthermore, NZEB can significantly cut down the indirect greenhouse gas emissions due to the reduction in energy demand.

Utilization of renewable energy systems, such as solar energy, as well as reducing energy consumption of the buildings through improving thermal resistance of the building envelope is an essential need for NZEBs. The overall heat transfer coefficient (U-value) of both opaque and transparent building envelope has a significant role in the cooling and heating consumption of buildings. The U-value of opaque building envelopes such as external wall, roof, and floor of buildings can be easily reduced by installing insulation materials. On the other hand, this is more challenging for the glazing units which are essential construction components of the buildings, providing natural lighting, visibility, and spacious feeling. The thermal performance of conventional glazing systems is low due to their low thermal resistance, in comparison with other opaque envelope elements. Moreover, thermal mass of glazing systems is much lower than these building components. Since glazing units can account up to about 30-50% of heat loss from a building [2], a significant

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amount of research has been focused on improving their thermal performance. Regarding this focus point, the most common technique to reduce heat transmission through windows is to use double glazing systems instead of single glazing ones, which can easily decrease heat transfer more than 50%. Optimizing the air layer between panes to hinder air movement thus maximizes the thermal resistance. With this aim, replacing the air by noble gasses (such as argon, krypton) whose thermal conductivity is lower than that of the air, increasing number of panes (i.e., triple and even quadruple panes), and coating the glazing surfaces to control solar heat gain are among the most used techniques.

Filling the gap between multiple pane windows with aerogel or phase change material (PCM) is relatively a novel technique. Although the discovery of aerogel dates back to 1930s for space applications, the interest in usage of these materials in buildings has been emerging since 1980s [3]. Aerogels have significantly low thermal conductivities and high transparency, making them attractive materials for glazing systems. PCMs can absorb or release a significant amount of thermal energy during the melting or solidification process due to the latent heat of fusion. The temperature of PCM remains nearly the same during the phase change process. This feature makes them a promising option for glazing units. Thus, incorporating PCM in the glazing systems helps improving effective utilization of solar energy through absorbing solar energy (melting process) during the daylight hours and releasing it during the nocturnal hours (solidification process). Moreover, apart from reducing energy consumption and improving thermal comfort in the indoor environment, it helps shifting the cooling and heating energy consumption of buildings to off-peak periods, increases thermal mass of the glazing unit, and providing flexibility for energy usage in buildings. The phase transition temperature should be selected properly considering the climatic conditions in order to effectively exploit the latent heat of PCM. Optical properties of PCM should also be considered for applications particularly where the visual transmittance of PCM is important since the visual transmittance of the solid state of the PCM (such as paraffin) decreases from 90% to 40% in the liquid state [4]. Optical properties are significant for smart glazing systems where the light and solar energy transmission can be changed. Apart from the aforementioned purposes, windows can be used for harvesting solar energy also through integrating photovoltaics into windows.

To sum up, although a considerable enhancement in the thermal performance of glazing units has been achieved through the above-mentioned methods, there is still a considerable room for further improvement. Therefore, more effort is needed within the context of the net positive-, net zero-, or nearly zero energy buildings.

Conflict of Interest

There is no conflict of interest.

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