https://doi.org/10.7250/CONECT.2023.011

HEAT ACCUMULATION WITHIN BUILDING ENVELOPES TO SUPPORT TRANSITION TO LOW-TEMPERATURE DISTRICT HEATING (LTDH)

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Abstract – The novel feature is to consider the transition process when the low-temperature mode is switched to the ordinary high-temperature operation. It takes place when time of relatively high heat demand starts – in the beginning of winter. The contribution to the pool of knowledge is that we consider building envelopes that have previously been charged before the system starts operating at a full load; this results in relatively low indoor temperature drop compared to the reference scenario. The control logic formulated considers low temperature concept and other technologies available (e.g. heat accumulators) running at the same time. This pattern is compounded by the recommendation to set 50 °C during fall and spring, when the average outdoor 5-day temperature is 0 °C and above. The main result is O&M cost reduction by 19 %, achieved by incorporating low-temperature with 50–60 °C operating temperatures and using centralized storage. The maximum storage capacity ensures a 16-h long delay in transition to the normal operating mode, if all the studied buildings are involved to limit drastic flow rate increase and minimum indoor temperature is 0 °C to prevent damage to SH system. However, such low values are never encountered in practice and represent the upper threshold only, since usually supply temperature increase takes up to 5 hours. Besides, the weather forecast is typically accurate, and all the actions are typically taken in advance – several hours prior to the outdoor temperature drop. The considerations are general enough to be applied to other areas of the DH system. To sum up, the operational pattern of the supply temperature for 6 typical buildings located in Omsk was studied using the reference-group based approach. As DH systems are in a transition phase to 4GDH, there is a tremendous potential and possibility for emerging novel DH designs, which address all the issues and expectations of future distribution networks including competitive performance and cost-effectiveness. The similarities among buildings were measured on the basis of pointwise and the same distributional distance based on their indoor temperature data. The methodology suggested in this paper, which uses reference-groups, has been proven as a pertinent solution and highly efficient; however, it can still be further improved to be not sole, but rather incorporated in the idea of combined low- and temperature-flexible operation. So far, the analysis based on the stability proportion criterion was performed to recommend the best substation's valves adjustments and identify the best combination of material/height/substation type for constructing office or residential buildings.

Keywords – Demand; district heating; efficiency; heat consumption; load; optimization; space heating; supply; temperature; thermal