COMPARING NUMERICAL AND ANALYTICAL METHODS FOR HEAT LOSS DETERMINATION OF DISTRICT HEATING SYSTEMS

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Abstract – Energy efficiency assessment considers the heat losses in district heating systems. For instance, life cycle assessments of such engineering structures require knowledge of the heat losses during their use phase. Therefore, it is essential to have the most accurate knowledge of the heat losses of a district heating system. In this study, three different methods for the determination of specific heat losses for buried preinsulated steel pipes are compared. The first method involves an analytical calculation in accordance with EN 13941, while the second utilizes an equivalent circuit approach. The third method employs finite element analysis. The objective was to evaluate the accuracy of the methods, the achievable range of results, and the effort required to solve the respective calculation algorithms. Therefore, typical 2-dimensional cross sections including different pipe diameters were selected. In situ measurements were not part of this study. Consequently, the analysis centres on the deviation between the methods. All three methods determine the heat loss in both the supply and return pipes. While the analytical calculation method cannot determine temperatures in the soil, the equivalent circuit method can handle more complex tasks and gives detailed results at predefined points in the model. With the finite element method, a high degree of detail can be achieved, but the requirements for solving the algorithms increase. An emerging trend in district heating involves reducing operational temperatures in both new and existing networks. This will change the relation between heat losses and heat delivered to the customers. Subsequently, an increasing interest in the actual heat losses and the precision of calculation is expected within this development. Therefore, it remains essential to evaluate the performance of different models.

Keywords – Equivalent Circuit Method; district heating; heat losses; finite element analysis
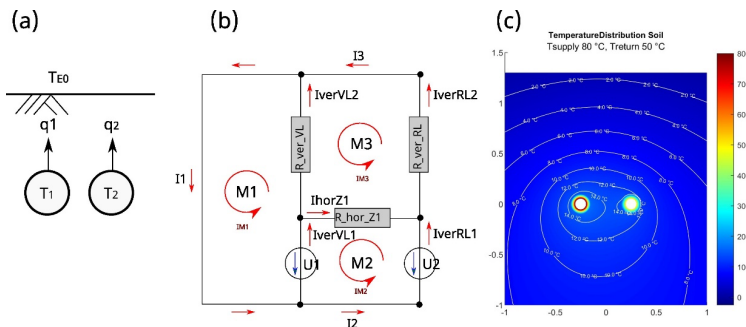
(a) Analytical method, (b) Equivalent circuit method, (c) Finite Element Analysis.