

418 ANALYSIS OF THERMAL INSULATION OF PRE-INSULATED TRIPLE PIPES - PRELIMINARY NUMERICAL TESTS



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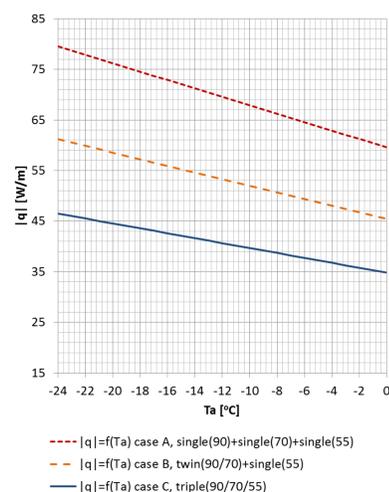
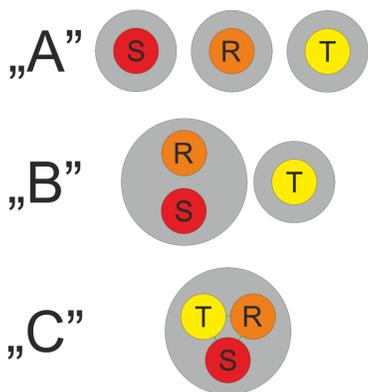
INTRODUCTION

Transporting heat energy is an important part in smart energy systems. Pre-insulated pipes are most often used in district heating networks. Currently, single and double pre-insulated pipes are most commonly used. Pre-insulated triple pipes (two supply pipes and one return pipe) are used much less often. The third pipe in the common thermal insulation can function as a service pipe.

The purpose of this work is to present a triple pre-insulated network as an alternative to single and double pre-insulated networks for industrial plants, on the example of a meat plant located in located in north-eastern Poland.

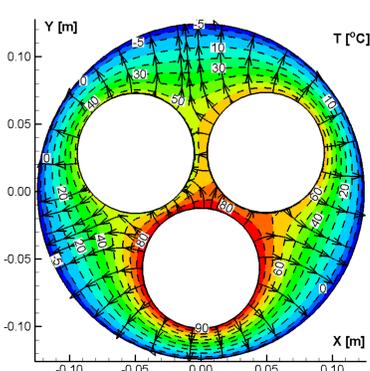
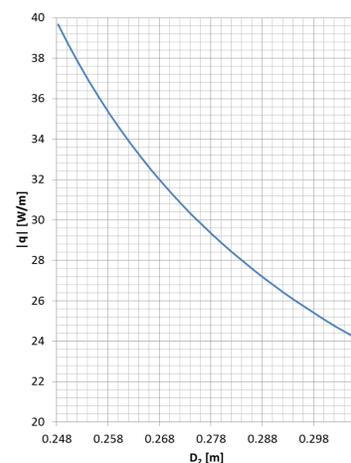
RESULTS

- In order to perform the heat exchange analysis in triple pre-insulated pipes, the geometry of the triple pre-insulated line was adopted.



The heat losses for a triple pre-insulated joint in common thermal insulation are about 42% lower compared to the variant A and about 24% smaller than the variant B.

- Increasing the diameter of the thermal insulation significantly reduces heat loss as shown in the right figure for an outside temperature of $T_a = -10^\circ\text{C}$.



- The main disadvantage is heat exchange between the three pipes. The left figure shows heatlines and temperature distribution for $T_a = -10^\circ\text{C}$.

CALCULATIONS

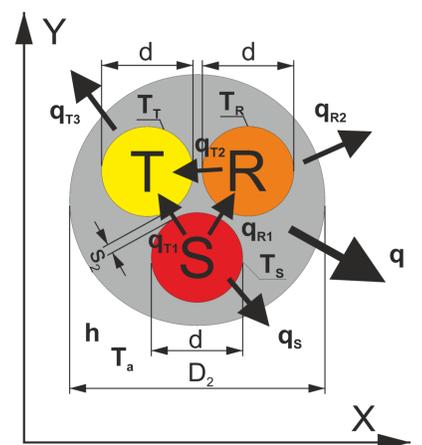
In order to determine heat losses through pre-insulated pipes, the Laplace equation was used to describe two-dimensional heat conduction in cross-section of thermal insulation:

$$k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right) = 0$$

Dirichlet boundary conditions was assumed on the inner wall of the thermal insulation in the form of the temperature of the transmitted heating medium T_s , return temperature, T_r , and hot technological water, T_T , while the outside of the insulation was assumed Robin with the formula:

$$q' = -k \frac{\partial T}{\partial n} = h(T - T_a)$$

The technological hot water temperature T_T is lower than the temperature of the heating medium supply T_s and return T_r . So, the diagram of heat transfer is give by the right diagram



CONCLUSIONS

The use of triple pre-insulated pipes can significantly reduce heat loss compared to double pre-insulated pipe and a single pre-insulated pipe (1.7 times lower in the case of the analysed network to the butcher plant), Further advantages of using triple pre-insulated pipes are the smaller volume and less space consumption for installation

ACKNOWLEDGEMENT

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