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CALCULATION OF PREVENTION OF HEAT LOSSES IN HEATING SYSTEM PIPES.

Mamatiminov Abdulhamid Rahmonjon son
Andijan state technique institute Energy thriftiness and energy audit direction
4th year student .

Khakimov Temurbek Bohodirjon son
Andijan state technique institute Alternative energy sources department assistant
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Abstract: This article examines methods for reducing heat losses in heat supply system pipelines and evaluates their technical and economic efficiency. The study compares the performance of an existing deteriorated insulation layer with a proposed 50 mm mineral wool insulation for an external DN100 main pipeline. The calculation results indicate that the proposed insulation reduces heat losses by 51.5%, providing seasonal savings of 17,800 kWh of useful thermal energy for a 100-meter pipeline section. The economic analysis demonstrates that the investment required for pipeline re-insulation can be recovered within approximately 1.5 heating seasons, confirming the feasibility of the proposed measure.

Keywords: heat supply system, heat loss, thermal insulation, mineral wool insulation, energy efficiency, economic analysis, district heating pipeline, thermal energy savings, capital investment, payback period, energy conservation, pipeline modernization.

Introduction. The economic efficiency of thermal insulation renovation is assessed by the degree to which the thermal energy produced in the boiler reaches the consumer. If heat loss in the pipes is reduced, the boiler will consume less fuel to maintain the same internal temperature. As a result, operating costs will be reduced, and the investment in insulation renovation will pay for itself over a certain period of time. In the current case, the heat loss for 30 mm of old insulation on the external DN100 main pipe was assumed to be 60.8 W/m, and for the proposed 50 mm of new mineral wool insulation, it was assumed to be 29.5 W/m. This means that the heat savings per meter of pipe is 31.3 W/m.

In this paragraph, the economic analysis was performed for a 100 m long external DN100 main pipeline section. If the exact pipe length is remeasured at the facility, the results are directly recalculated using the formulas given below. This approach allows for a clear demonstration of the calculation methodology in the BMI case and subsequent refinement in practical conditions.

$$\Delta q_l = q_{there\ is} - q_{offer} \quad (1)$$

$$\eta_p = ((q_{there\ is} - q_{offer})/q_{there\ is}) \cdot 100\% \quad (2)$$

$$\Delta E_m = \Delta q_l \cdot \tau / 1000 \quad (3)$$

$$\Delta E_L = \Delta q_l \cdot L \cdot \tau / 1000 \quad (4)$$

$$S_{year} = \Delta E_L \cdot C_e \quad (5)$$

$$T_{cover} = K_{total}/S_{year} \quad (6)$$

$$E_{fuel}=\Delta E_L/\eta_{pot} \quad (7)$$

where: Δq_l - heat savings per 1 meter of pipe, W/m; $q_{there\ is}$ - heat loss with existing insulation, W/m; q_{offer} - heat loss with proposed insulation, W/m; τ - duration of the heating season, hours; L - calculated pipe length, m; ΔE_L - useful thermal energy saved during the season, kWh; C_e - calculated cost of 1 kWh of heat equivalent, soums/kWh; S_{year} - seasonal monetary savings, soums; K_{total} - total capital cost of insulation measures, soums; η_{pot} - useful boiler efficiency.

We calculate: $\Delta q_l = 60.8 - 29.5 = 31.3$ W/m. The degree of heat loss reduction η_{pot}= (31.3 / 60.8) 100 = 51.5%. Assuming the heating season duration τ = 5688 hours, the seasonal energy saving per 1 meter of pipe ΔE_m = 31.3 5688 / 1000 = 178.0 kWh/m. For 100 m of external DN100 pipe, ΔE_Lit is = 17,800 kWh/season.

Assuming $E_{fuel}$the boiler efficiency = 0.85, the equivalent fuel savings η_{pot}= 17,800 / 0.85 = 20,941 kWh of fuel energy. This value may vary depending on the actual boiler operation, fuel quality, and control status in the system [1].

Table 1. Heat saving calculation results for external DN100 pipe:

Indicator	Marking	Value	Unit of measurement
Loss in existing worn insulation	$q_{there\ is}$	60.8	W/m
Loss in the proposed 50 mm mineral wool	q_{offer}	29.5	W/m
Heat savings per 1 meter	Δq_l	31.3	W/m
Reduced heat loss	η_p	51.5	%
Duration of the heating season	τ	5688	hour
Seasonal savings per 1 meter	ΔE_m	178.0	kWh/m
Seasonal savings per 100 m	ΔE_L	17,800	kWh
Pot FIK accepted value	η_{pot}	0.85	share
Fuel energy equivalent	E_{fuel}	20,941	kWh

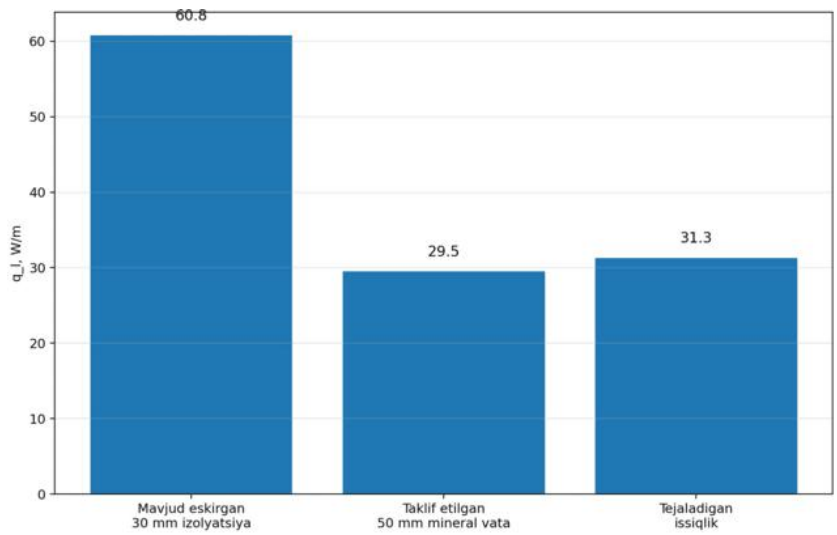

Figure 1. Comparison of existing and proposed insulation conditions on a DN100 external pipe.

To determine the economic efficiency in monetary terms, the calculated value of 1 kWh of useful thermal energy C_e was taken as = 600 sums/kWh. This value is specified in the final estimate documents based on the actual fuel type, the current tariff and the actual useful

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efficiency of the boiler. Within the framework of this BMI, the accepted value is used as a calculated k indicator for technical and economic comparison.

The seasonal savings for a 100 m external DN100 main pipe S_{year} = 17,800,600 = 10,680,000 soums. This value is determined based on the useful heat savings only and does not take into account the indirect savings in maintenance, ash removal, boiler cleaning, pump operating time, and operational labor costs resulting from reduced boiler operation [2].

Capital costs consist of insulation material, external protective coating, installation work and auxiliary materials. For the calculation estimate, the total cost of mineral wool sheathing, galvanized protective coating, fastening elements, sealing and installation work for 1 meter of DN100 external pipe was assumed to be 160,000 soums/m. The total capital cost for 100 m is 16,000,000 soums.

Table 2. Estimated costs for re-insulating 100 m of external DN100 pipe:

T/r	**Expense type**	**Unit price, sums/m**	**Length, m**	**Total, soums**
1	50 mm mineral wool shell	75,000	100	7,500,000
2	Galvanized or aluminum protective coating	35,000	100	3,500,000
3	Installation work	35,000	100	3,500,000
4	Tape, sealant, fasteners and auxiliary materials	15,000	100	1,500,000
5	Total capital expenditure	160,000	100	16,000,000

The payback period is equal to T_coverage = 16,000,000 / 10,680,000 = 1.50 heating seasons. This result shows that the insulation measure is economically feasible. In practical conditions, if energy prices increase or fuel quality decreases , the savings value increases and the payback period decreases. Conversely, if installation costs are high, the payback period increases [3].

Table 3. The main results of economic efficiency:

Indicator	**Value**
Estimated pipe length	100 m
Seasonal useful heat savings	17,800 kWh
Estimated energy price	600 sums/kWh
Seasonal money savings	10,680,000 sums
Capital expenditure	16,000,000 sums
Payback period	1.50 heating season
Reduced heat loss	51.5%

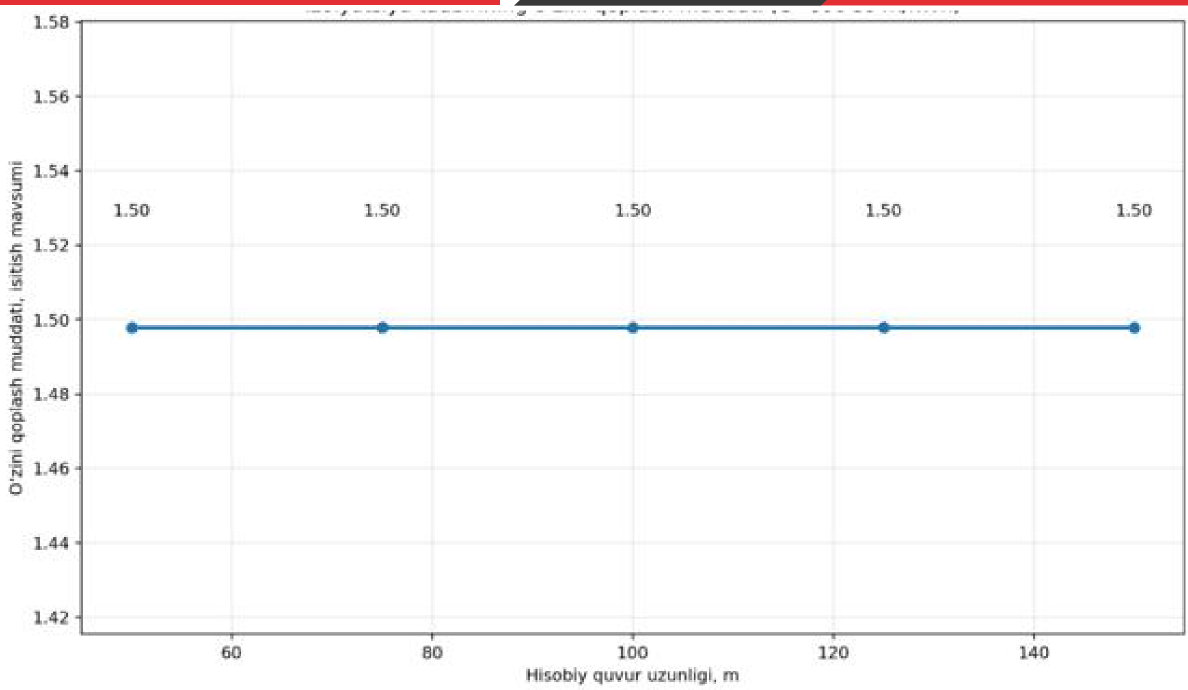

Figure 2. Payback period depending on the length of the pipe.

Sensitivity analysis is also important in the economic assessment. If the energy equivalent is 500 sum/kWh, the seasonal savings for 100 m of pipe will be 8.9 million soums and the payback period will be 1.80 seasons. If the energy equivalent is 800 soums/kWh, the savings will reach 14.24 million soums and the payback period will be reduced to 1.12 seasons.

This situation shows the sensitivity of insulation measures to energy prices. As energy prices increase, the economic attractiveness of measures to reduce heat loss increases. Therefore, insulation work should be considered as an integral part of the boiler room modernization or preparation program for the heating season [4].

References.

1. Zuhritdinov Alisher Farakhidin o'g'li, Yo'lchiyev Mash'albek Erkinovich, Khakimov Temurbek Bahodirjon o'g'li. (2023). Study of the temperature dependence of the linear expansion coefficient of solids. International Bulletin of Applied Science and Technology, 3(5), 888–893. https://doi.org/10.5281/zenodo.7969053
2. Khakimov Temurbek Bohodirjon o`g` li, Rahmonov Asliddin Abdulhamid o'g'li. (2024). Selection of inverters and controllers for solar cells . luchshie intellektuellnye isledovaniya. 149-152.
3. Muhiddin Atajonov , Kudratbek Mamarasulov, Odilbek Dekhqonboyev , Temur Khakimov. (2024). Research on the model of solar panels based on photovoltaic modules . https://doi.org/10.1063/5.0241785 . Applied science and of the technique modern to the problems dedicated international scientific conference AIP Conf . Proc .
4. Khakimov Timur , Abdumutalipov - Orzumurod son Shahobiddin .(2024). Production release in comparisons energy efficiency increase for energies management system to eat The best intellectual investigation ISSN: 3030-3680. 81-86.