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USE OF HEAT INSULATION MATERIALS IN HEAT NETWORKS

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Abstract

Heat insulation of pipes is used to maintain the temperature of the heat carrier in the system and to protect it from freezing in the cold season of the year. As a heat insulating material, mineral wool, foam plastic, expanded polystyrene, foamed polyethylene, heat insulating paint, penofol, etc. are used. Insulation of heating networks is one of the main areas in the creation of energy-efficient technologies. Many of today's heat insulating materials and their rational use in various industries have been developed. Insulation of heat networks is becoming not only desirable, but a vital necessity. There are the following types of heat-insulating materials: granular, in rolls, combined, sheathed.

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Depending on the technical characteristics and parameters of the insulation, heat insulating material is used in the following sectors: ventilation, cold and hot water transmission, technical equipment, steam heating. The choice of heat-insulating material should be approached with great responsibility, because it is a guarantee of warmth and comfort in people's homes.

The most effective types of heat-insulating material are:

1. **Heat insulating paint.** This heat insulating material was developed based on the latest advances in science. One layer of this coating can replace several centimeters of foam polystyrene and mineral wool. At the same time, this material does not harm the environment, and this type of insulation of pipes resistant to high temperatures is used in difficult production conditions.
2. **Mineral wool.** This material is characterized by low thermal conductivity and fire resistance. For these reasons, it is widely used in the protection of heating systems. However, this type of protection is among expensive building materials.

Mineral wool can be of two types:

- Basalt fluff - works at a temperature of up to 650 ^{0}C and does not emit toxic substances. The material is made from rocks with maximum basalt content.
- Fiberglass fluff - made from quartz sand and glass. Works well at temperatures up to 180 ^{0}C.

Mineral wool is produced in rolls and packages in the form of mats. It does not melt or deform under the influence of high temperatures, so it is often used for thermal insulation in heat networks. The disadvantage of mineral wool is that it absorbs water and loses its thermal insulation properties. Therefore, it is not economically viable to insulate a large system with this material, since it will also be necessary to purchase protection against moisture penetration.

3. Polyurethane foam. The use of this material as a heat-insulating material has recently begun, but it is subject to evaluation of its effectiveness. Polyurethane foam insulation is suitable for outdoor metal and plastic heating systems. This material is suitable for insulating pipes of different diameters on the street, and it is also called "shell". To reduce the overall thermal conductivity of the coating, the material is covered with aluminum foil on one side. However, it should be noted that compared to other types of insulation, it is necessary to wrap the pipe with polyurethane foam 5-8 times. Although it looks good aesthetically, such costs are not justified. Another disadvantage of polyurethane foam is minimal protection from frost and heat loss.

4. Polystyrene. The reason for the widespread use of polystyrene in construction is that it provides good thermal insulation of the building, as well as the characteristic of carrying a significant mechanical load at a low density of the material. Installation of expanded polystyrene on the external walls of buildings under construction significantly reduces heat loss in them. According to its characteristics, polystyrene is significantly superior to traditional heat-saving materials, such as mineral wool, foam blocks, etc., besides, it is cheaper and easier to install. In terms of heat-saving properties, foam polystyrene with a thickness of only 120 mm is equal to a wooden wall with a chrim mter or a four-meter-thick steel-concrete wall.

It is known that the share of heat losses through engineering communications sometimes reaches 30%. For their thermal insulation, expanded polystyrene is used more and more. Thanks to the use of foam polystyrene to protect the pipes, it will be possible to lay them at a shallower depth. This reduces labor costs and the price of work. A big advantage of using expanded polystyrene to protect pipes from freezing is the possibility to give almost any shape to this material. The material is also increasingly used to insulate telephone and electrical cables.

Advantages of polystyrene:

- Works for a long time, does not rot, cracks do not appear. retains its main features even when used for 10-50 years;
- Very little water absorption - worldwide 0.5-4% moisture has almost no effect on thermal conductivity of dense foam polystyrene;
- Light material, easy to use, does not require serious skills in working with it;
- The price is not expensive, it quickly covers costs, the costs for heating and ventilation are reduced by approximately 3-4 times.

Disadvantages of foam polystyrene:

- Ultraviolet rays cause wear and tear of the material;
- The following substances cause decomposition: acetone, gasoline, kerosene, turpentine, toldol;
- Unmodified ordinary expanded polystyrene is a light flammable material (burning temperature 210-440 0C) and emits smoke and harmful substances when burning;
- Foam polystyrene with large pores and low density transmits water vapor and the vapor condenses, increasing its thermal conductivity by 5-10%. Condensate formed at negative temperatures freezes and destroys the material.

5. Foamed polyethylene. This environmentally friendly material has a fine porous structure and is gray in color. This heat-insulating material is characterized by high quality, moisture does not pass through it, and it retains heat well. One of the main advantages of this heat insulating material is its elasticity and resilience.

The main technical characteristics of heat-insulating material are as follows:

- small pores, density from 25 to 40 kg/m^3;
- elasticity does not change at low and high temperatures;
- high thermal insulation and very low vapor permeability;
- the material shell carries a load of 0.3 MPa;
- good noise protection;
- Service life is more than 75 years.

When foamed polyethylene, foam polystyrene and foam polyurethane are used as thermal insulation for pipes, foamed polyethylene has the following advantages:

- resistance to stretching and restores the initial dimensions after deformation;
- Completely safe for humans and the environment. Therefore, this pipe insulation is used in industrial enterprises, at home, in medical institutions and in food production;
- the installation of this material is very easy, its parts can be assembled quickly without the use of tools;
- The price of the material is much cheaper than the price of similar materials.

For example, the price of foam rubber with similar properties is extremely high.

This heat-insulating material for pipes is sufficiently resistant to ultraviolet rays. It is a universal material; its properties allow isolation of various communications. Suitable for any external and internal system. However, when exposed directly to ultraviolet rays, it begins to break down. For these reasons, it is recommended to choose an option protected from ultraviolet radiation with a special film. It is very important to determine the normative heat losses from the surface of the pipe insulation. Normative heat losses take into account directly influencing factors: pipe length, diameter, heat carrier and ambient temperature. Normative heat losses should be calculated for the entire heat network. Determining the optimal thickness of the insulating layer, taking into account energy and economic indicators, is a very important issue. The process of calculating the thickness of the thermal insulation layer of pipes is complicated and time-consuming. The method of determining this parameter through normative heat losses is the most common. The values of heat losses are determined by construction regulations and depend on the methods of laying pipes of different diameters.

The basic formula for calculating pipe insulation has the following form:

$$ln\beta = 2\pi\lambda\left[\frac{k(t_T - t_o)}{q_L} - R_n\right] \ (1)$$

where: λ – thermal conductivity coefficient of the insulation; k – coefficient of additional heat losses; t_T – temperature of the selected environment (annual average); t_o – outdoor air temperature (annual average); q_L – heat flow rate; R_n – coefficient of resistance to heat transfer.

β the value of the indicator is determined separately:

$$\beta = (d_{из} + 2\delta)/d_{тр} \ (2)$$

where: δ – insulation thickness; $d_{из}$ – outer diameter of the pipe; $d_{тр}$ – outside diameter of the insulated pipe.

When the heat carrier with a high temperature (500-600 ^{0}C) moves along the pipe, the surface of the pipe is insulated with two layers of different materials. One of the layers acts as a barrier that protects the hot surface from the other, and the second layer protects the pipe from the outside air with a low temperature. In this case, the temperature at the boundary of the layers $t_{1,2}$, should not exceed the temperature allowed for the external insulation material of the pipe. The following formula is used to determine the thickness of the thermal insulation of the first layer:

$$\delta = k(t_T - t_o)/(q_F - R_n)$$

To determine the thermal insulation thickness of the second layer, instead of the pipe surface temperature t_T, the temperature at the boundary of both insulation layers is taken $t_{1,2}$. In some cases, it is necessary to deliver heat to the consumer at a certain temperature along the pipeline. Based on this condition, the thickness of the thermal insulation is calculated. First, the total thermal resistance of the insulation R_n is determined:

$$R_n = 3{,}6kL/GCln[(t_{\text{т.бош}} - t_o)/(t_{\text{т.ох}} - t_o)]$$

where: k - coefficient of additional heat losses; $t_{in.tem}$ – the initial temperature of the heat carrier; t_o – ambient temperature; $t_{\text{т.ох}}$ – the final temperature of the heat carrier; L – pipe length; G – heat carrier consumption; C – specific heat capacity of the heat carrier;

Then the thickness of the thermal insulation is calculated:

$$\delta = d_{\text{из}}(\beta - 1)/2$$

In many industrial enterprises, pipes are passed through the rooms where the workers are. In this regard, labor protection regulations impose high requirements on the temperature of pipes. For pipes with a diameter of more than 2 m, the thickness of the heat-insulating layer is determined according to the following formula:

$$\delta = \lambda(t_T - t_n)/\alpha(t_T - t_{\text{o}})$$

where: α – heat transfer coefficient; t_n – normative temperature on the insulation surface.

Literature.

1. Абдуразаков, А. М. (2022). Моделирование Отрывных Течении В Каналах Или Руслах. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *3*(5), 395-404.
2. Abdulkhaev, Z. E., Abdurazaqov, A. M., & Sattorov, A. M. (2021). Calculation of the Transition Processes in the Pressurized Water Pipes at the Start of the Pump Unit. *JournalNX*, *7*(05), 285-291.
3. Акрамов, А. А. У., & Абдуразаков, А. М. (2019). Исследование обтекания автомобилей Chevrolet. *Достижения науки и образования*, (13 (54)), 17-20.
4. Abbasov, E. S., Abdukarimov, B. A., & Abdurazaqov, A. M. (2020). Use of passive solar heaters in combination with local small boilers in building heating systems. *Scientific-technical journal*, *3*(3), 32-35.
5. Abdukarimov, B., O'tbosarov, S., & Abdurazakov, A. (2021). Investigation of the use of new solar air heaters for drying agricultural products. In *E3S Web of Conferences* (Vol. 264, p. 01031). EDP Sciences.
6. Abdulkhaev, Z., Madraximov, M., Abdurazaqov, A., & Shoyev, M. (2021). Heat Calculations of Water Cooling Tower. *Uzbekistan Journal of Engineering and Technology*.
7. Abdullayev, B. X., & Rahmankulov, S. A. (2021). Modeling Aeration in High Pressure Hydraulic Circulation. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 127-136.
8. Abdullayev, B. (2022). MODELING OF COLLECTOR WATER DISCHARGE INTO THE WATER COURSE IN THE FERGANA VALLEY MODELING OF COLLECTOR WATER DISCHARGE INTO THE WATER COURSE IN THE FERGANA VALLEY. *Science and innovation*, *1*(A7), 827-834.
9. Abdullayev, B. X., & Rahmankulov, S. A. (2021). Movement of Variable Flow Flux Along the Path in a Closed Inclined Pipeline. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 120-126.

10. Abdullayev, B. X., Xudayqulov, S. I., & Sattorov, S. M. (2020). Simulation Of Collector Water Discharges Into The Watercourse Of The Ferghana Valley. *Scientific-technical journal*, *3*(3), 36-41.

11. Abdullayev, B. X., Xudayqulov, S. I., & Sattorov, S. M. (2020). Variable Flow Rate Flow Along A Path In A Closed Inclined Pipeline. *Scientific-technical journal*, *24*(4), 23-28.

12. Ismailov, M., & Xolmatov, I. (2022). OPTIMAL METHODS FOR DESIGNING SEWER NETWORKS. *Science and Innovation*, *1*(7), 744-749.

13. Рашидов, Ю. К. Орзиматов, Ж. Т. & Исмоилов, М. М. (2019). Воздушные солнечные коллекторы: перспективы применения в условиях Узбекистана. *ББК 20.1 я43 Э 40*.

14. Ismailov, M., & Xolmatov, I. (2022). КАНАЛИЗАЦИЯ ТАРМОҚЛАРИНИ ЛОЙИХАЛАШНИНГ АПТИМАЛ УСУЛЛАРИ. *Science and innovation*, *1*(A7), 744-749.

15. Karshiev SH.SH. & Ismailov M.M. (2022). Calculation of geometric dimensions and hydrodynamic characteristics of venturi pipes of a self-draining solar circuit. *International Journal of Computer Science Engineering and Information Technology Research (IJCSEITR)*, *2*(12), 120-126.

16. Xolmatov, I. R. (2022). The Effect of Multiplicity of Carrier Circulation on the Efficiency of Single-Contour Thermoisiphon Systems of Sollor Hot-Water Supply. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *3*(5), 334-340.

17. Rashidov, Y. K., & Ramankulov, S. A. (2021). Improving the Efficiency of Flat Solar Collectors in Heat Supply Systems. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 152-159.

18. Рашидов, Ю. К. Исмоилов, М. М. Орзиматов, Ж. Т. Рашидов, К. Ю. & Каршиев, Ш. Ш. (2019). Повышение эффективности плоских солнечных коллекторов в системах теплоснабжения путём оптимизации их режимных параметров. In *Экологическая, промышленная и энергетическая безопасность-2019* (pp. 1366-1371).

19. Abdukarimov, B. A., O'tbosarov, S. R., & Tursunaliyev, M. M. (2014). Increasing Performance Efficiency by Investigating the Surface of the Solar Air Heater Collector. *NM Safarov and A. Alinazarov. Use of environmentally friendly energy sources*.

20. Madaliev, M. E. U., Rakhmankulov, S. A., & Tursunaliev, M. M. U. (2021). Comparison of Finite-Difference Schemes for the Burgers Problem. *Middle European Scientific Bulletin*, *18*, 76-83.

21. Tursunaliev, M. (2022). RUBBER COMPOUND FOR RUBBER-METAL PRODUCTS, PRESSURED. *Science and innovation*, *1*(A7), 808-813.

22. Tursunaliev M.M. (2021). Application of Thermal Insulation Materials in the Heat Supply System. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 244-248.

23. Mamatisaev, G., & Muulayev, I. (2022). ECOLOGICAL AND TECHNOLOGICAL PROBLEMS IN WATER COLLECTION FACILITIES. *Science and innovation*, *1*(A7), 767-772.

24. Mullaev, I. (2022). ҚУЁШ-ҲАВО ИСИТИШ ҚУРИЛМАСИНИНГ САМАРАДОРЛИГИНИ ОШИРИШ. *Science and innovation*, *1*(A7), 756-761.

25. Abobakirovich, Abdukarimov Bekzod, Abbosov Yorqin Sodikovich, and Mullayev Ikromjon Isroiljon Ogli. "Optimization of operating parameters of flat solar air heaters." *Вестник науки и образования* 19-2 (73) (2019): 6-9.

26. Mullaev I.I. (2022). Heat - technical calculation of the solar collector. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 244-248.

27. Madaliev, M. E. U., Maksudov, R. I., Mullaev, I. I., Abdullaev, B. K., & Haidarov, A. R. (2021). Investigation of the Influence of the Computational Grid for Turbulent Flow. *Middle European Scientific Bulletin*, *18*, 111-118.

28. Abdukarimov, B. A. (2021). Improve Performance Efficiency As A Result Of Heat Loss Reduction In Solar Air Heater. *International Journal of Progressive Sciences and Technologies*, *29*(1), 505-511.

29. Abdukarimov, B., Abbosov, Y. S., & O'tbosarov, S. R. (2020). Hydrodynamic Analysis of Air Solar Collectors. *Int. J. Adv. Res. Sci. Eng. Technol*, *7*(5), 13545-13549.

30. Abdukarimov, B. A. (2019). Research of convective heat transfer in solar air heaters. *Наука, техника и образование*, (9), 16-18.

31. Abbasov, Y. S., Abdukarimov, B. A., & ugli Usmonov, M. A. (2022). Optimization of Working Parameters of Colorifiers used in Heat Supply Systems. *Central Asian Journal of Theoretical and Applied Science*, *3*(6), 399-406.

32. Абдулхаев, З. Э. Мадрахимов, М. М. & Иброхимов, А. Р. (2021). Сув узатиш тармокларида хосил буладиган гидравлик зарб ходисасини математик моделлаштиришни тадкик этиш. *Узбекгидроэнергетика" илмий-техник журнали*, *2*(10), 33-35.

33. АБДУЛҲАЕВ, З. & МАДРАХИМОВ, М. (2020). Гидротурбиналар ва Насосларда Кавитация Ҳодисаси, Оқибатлари ва Уларни Бартараф Этиш Усуллари. *Ўзбекгидроэнергетика" илмий-техник журнали*, *4*(8), 19-20.

34. Madraximov, M. M., Abdulkhaev, Z. E., & Ilhomjon, I. (2022). Factors Influencing Changes In The Groundwater Level In Fergana.

35. Madraximov, M. M., Nurmuxammad, X., & Abdulkhaev, Z. E. (2021, November). Hydraulic Calculation of Jet Pump Performance Improvement. In *International Conference On Multidisciplinary Research And Innovative Technologies* (Vol. 2, pp. 20-24).

36. Madaliev, M. E. U., Abdulkhaev, Z. E., Toshpulatov, N. E., & Sattorov, A. A. (2022, October). Comparison of finite-difference schemes for the first order wave equation problem. In *AIP Conference Proceedings* (Vol. 2637, No. 1, p. 040022). AIP Publishing LLC.