Volume: 3, Issue: 6
Page: 45 - 51
2021

ISSN: 2707-8965 (Online) & 2708-3772 (Print)

Euro Afro Studies International Journal®
(EASIJ.COM)

Methods for Determining Thermal Conductivity of Ventilation Radiators in Low-Temperature Systems and Their Analysis

Author(s), MO'MINOV OYBEK ALISHER UGLI[1],
O'TBOSAROV SHUHRATJON RUSTAMJON UGLI[2],
AND
MAQSUDOV RUSTAMJON ISMOILOVICH[3]

Abstract:

This article theoretically investigates the possibilities of heat transfer of ventilation radiators used in low-temperature heating systems, and methods of their implementation. It has been found that increasing, modifying, or adding convection fenders to existing radiators can improve thermal efficiency. The main focus of the project is on improving the heating efficiency of existing radiators, which is cheaper and easier. Direct ventilation air towards the radiator or compress air between the radiator and the panel, thereby increasing thermal efficiency.

EASIJ
Accepted 15 June 2021
Published 20 June 2021
DOI: 10.5281/zenodo.4999989

Keywords: radiator, heating systems, radiator surface, conductivity, solar panels,

About Author

Author(s): Mo'minov Oybek Alisher ugli[1],

O'tbosarov Shuhratjon Rustamjon ugli[2],

Maqsudov Rustamjon Ismoilovich[3]

[1]Doctorate, Department of Civil engineering construction, faculty of Construction Fergana polytechnic institute. Republic of Uzbekistan, muminovoybek2221@mail.ru

[2]Assistant, Department of Civil engineering construction, faculty of Construction Fergana polytechnic institute. Republic of Uzbekistan, shukhratjon.rustamovich@mail.ru

[3]Assistant, Department of Civil engineering construction, faculty of Construction Fergana polytechnic institute. Republic of Uzbekistan, maqsudov_r@mail.ru

Introduction

Improving the efficiency of radiators allows you to reduce the temperature of the water in the radiator circuits. This can lead to a number of positive environmental and economic aspects. These include the use of heat pumps, solar panels or similar energy-saving equipment, reducing heat losses in the district heating network, and creating an improved climate for the home [7, 11-12]. Studies have shown that indoor climate is more favorable for people when using low temperature heating systems, as these systems create a more stable and homogeneous indoor climate due to lower air velocity and temperature differences [1, 2]. The thermal power of radiators with natural or forced convection and vertical fins is calculated analytically, the main goal is to find ways to increase the thermal efficiency of radiators.

Main body

Water moves as a heat carrier inside the radiator. The transfer of heat from the heat carrier to the heat transfer medium or room is shown in Figure 1 and is given by the following formula (1).

$$\dot{m} \cdot C_p \cdot \Delta\theta = k \cdot A \cdot \Delta\theta_m \qquad (1)$$

The parameters on the left: m, Cp and Δθ are the mass of the water flow inside the radiator, the heat capacity of the water and the temperature difference between the water entering and leaving the radiator.

$$\theta_{water,in} - \theta_{water,out} = \Delta\theta \qquad (2)$$

The parameters on the right are the total heat transfer coefficient k, the total area of the heatsink A, Δθ- m is the average temperature difference between the heatsink and the connecting medium Δθ- m The expression is given below

$$\Delta\theta_m = \frac{\theta_{water,in} - \theta_{water,out}}{\ln(\theta_{water,in} - \theta_{air} / \theta_{water,out} - \theta_{air})} \qquad (3)$$

Where θ_{air} -(air) is the average air temperature in the room, k is the total thermal conductivity.

$$\frac{1}{k} = \frac{1}{\alpha_{ins}} + \frac{\delta}{\lambda} + \frac{1}{\alpha_{out}} \qquad (4)$$

The parameters on the right are the amount of heat transferred from the water to the inner surface of the radiator, δ is the wall thickness of the radiator, λ is the thermal conductivity, αins is the heat transfer coefficient between the water radiator of the coolant, α out is the heat transfer coefficient between the air and the radiator, The amount of radiant heat transferred to the surface of the radiator , α conv is the heat transfer coefficient from the radiator surface. This coefficient can be determined from the following expression (5).

$$\alpha_{conv} = Nu \cdot \frac{\lambda}{h} \qquad (5)$$

Here λ is the thermal conductivity of air (in this study, this figure is taken equal to (0.025 Wt^{-1} $^{o}C^{-1}$), h- is the height of the heated vertical surface, Nu is the number of invariant pieces on one vertical surface based on the number of rays in natural convection.

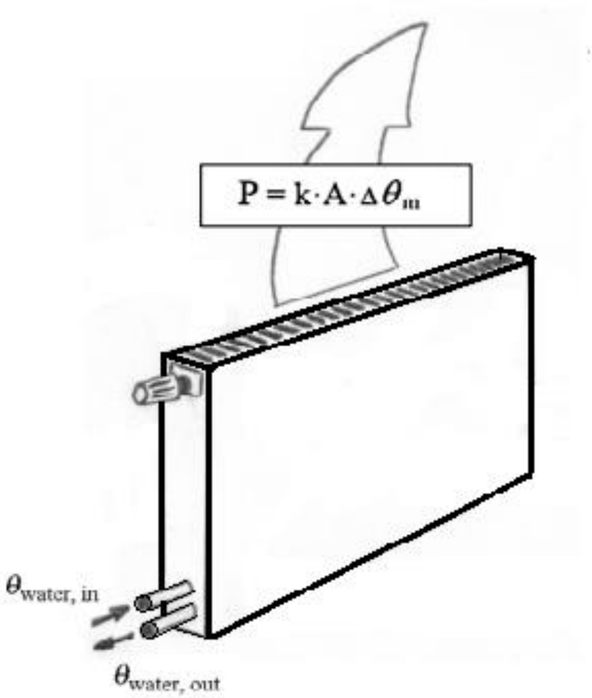

Figure 1. The process of transferring heat from the radiator.

The amount of heat produced, P, is the product of the parameters to the right of equation (1).

Ra as shown in the equation. (5a-c) below [3]. The following expressions are used to determine the Nuslet number.

$$Nu=1.10\,(Gr \cdot Pr)^{0.17} \text{ when } 10 < Ra < 10^4 \quad (5a)$$

$$Nu=0.48\,(Gr \cdot Pr)^{0.24} \text{ when } 10^4 < Ra < 10^8 \quad (5b)$$

$$Nu=0.16\,(Gr \cdot Pr)^{0.32} \text{ when } 10^8 < Ra < 10^{12} \quad (5c)$$

Here *Ra* is the result of the Grashof number, *Gr* is the Grashof number, *Pr* is the prandatl number. In this study, the Prandtl number is $Pr \sim 0.71$ depending on the applicable temperature range for air.

$$G_r = g \cdot \beta(\theta_{sur} - \theta_{air})\frac{h^3}{v^2} \quad (6)$$

Here β is the expansion coefficient, v is the kinematic viscosity, and the values are $3.73 \times 10^{-3}\ ^oC^{-1}$ va $1.83 \times 10^{-5}\ m^2s^{-1}$, respectively. Natural convection is allowed at $Gr/Re^2 \gg 1$, mixed convection at $Gr/Re^2 \approx 1$ and forced convection at $Gr/Re^2 \ll 1$. The Reynolds number determines the degree of turbulence in the existing environment. [5-10]

$$Re=\frac{u \cdot L}{v} \quad (7)$$

Here: u, L and v-velocity, length and kinematic viscosity, respectively. (8) and (9) give the number Nu of mixed and forced convection on vertical surfaces. [3].

$$Nu = 0.332 \cdot Pr^{1/3} \cdot Re^{1/2} \text{ (mixed convection on a vertical surface)} \quad (8)$$

Nu= 0.0296·Pr$^{1/3}$· Re$^{4/5}$ (forced convection on a vertical surface) (9)

The above equations are applicable when 0.6 <Pr <60. With forced convection, the number Nu for narrow channels is calculated by the formula. If the flow is laminar, it is calculated by (10); for turbulent flow, (12) is used. The equations are based on the Nu nuslet Granryd number [4] and include the effects of flow at the entrance to the channels. The hydraulic diameter d_h is used when the ducts are round. (13) Used by d_h.

$$Nu_{dh} \frac{0.0289 Gz^{1.87}}{1+0.0438 Gz^{0.87}} \text{ (duct; forced convection; laminar flow) (10)}$$

$$Gz = Re_{dh} \cdot Pr \cdot \frac{d_h}{L} \quad (11)$$

$$Nu_{dh} = 0.407 \cdot Re_{dh}^{0.55} (d_h/L)^{0.3} \text{ (duct; forced convection; turbulent flow) (12)}$$

The above equation can be used when 2500 <Re_{dh} <7000 и 3<L/d_h<20. The following expression is used to determine the hydraulic diameter. [13]

$$d_h = \frac{4A}{Lper} \quad (13)$$

Here: L_{per} -is the main perimeter

According to equations (1) - (13), if cold air is directed to the warm surface of the radiator, the power of the heat signal will automatically increase. This affects both the temperature and the flow rate of warm air. [14]

Conclusion

In conclusion, it should be noted that the use of ventilation radiators in a low temperature heating system can also have some effect on the ventilation system in the room, which means that the FIC can be increased by replacing existing radiators in the heating system with low temperature ventilation radiators. It is also possible to use alternative energy sources Using the formulas given in this article, it is necessary to take into account several factors that affect the heat transfer of radiators.

Ventilation-radiator with the narrowest possible air channel between the radiator panels is best done. The narrow air gap gave a higher air velocity in the ventilation duct, which increased heat transfer. The disadvantage of the design of the area is a narrower ventilation channel - the risk of drafts near the radiator.

Therefore, the desired volumetric flow rate should be the main factor in determining the geometry of the ventilation duct in relation to both the draft risk and the best filter type.

References

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

Abdukarimov, Bekzod, Shuhratjon O'tbosarov, and Axmadullo Abdurazakov. "Investigation of the use of new solar air heaters for drying agricultural products." E3S Web of Conferences. Vol. 264. EDP Sciences, 2021.

Abdukarimov, Bekzod Abobakirovich. "Research of convective heat transfer in solar air heaters." Наука, техника и образование 9 (2019): 16-18.

Абдулҳаев & М. М. Мадрахимов, "Гидротурбиналар ва Насосларда Кавитация Ҳодисаси, Оқибатлари ва Уларни Бартараф Этиш Усуллари" "Ўзбекгидроэнергетика" илмий-техник журнали, vol. 8, no. 4, pp. 19-20, 2020.

Abobakirovich A. B., Mo'minov O.A Calculation of the thermal performance of a flat solar air heater //Достижения науки и образования. – 2019. – №. 12 53).

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).

Абдукаримов, Б. А., О. А. Муминов, and Ш. Р. Утбосаров. "Оптимизация рабочих параметров плоского солнечного воздушного обогревателя." Приоритетные направления инновационной деятельности в промышленности. 2020.

Erkinjonovich, A. Z., Mamadaliyevich, M. M., Muxammadovich, A. A., & Axmadjon o'g'li, S. M. (2021). Heat Calculations of Water Cooling Tower. International Journal of Advanced Research in Science, Communication and Technology, 173–176. doi:10.48175/ijarsct-766

H.H.E.W. Eijdems, A.C. Boerstra, Low Temperature Heating Systems: Impact on IAQ, Thermal Comfort and Energy Consumption, Annex 37 Newsletter 1,2000.

M.A. Juusela (Ed.), Heating and Cooling with Focus on Increased Energy Efficiency and Improved Comfort, Guidebook to IEA ECBCS Annex 37, Low Energ Systems for Heating and Cooling of Buildings, VTT Building and Transport, Espoo, ISBN 951-38-6489-8, 2003.

I. Ekroth, E. Granryd, ''Applied Thermodynamics'' (in Swedish), Studentlitteratur AB, 2006, , ISBN: 9789144039800

Mamadalievich, M. M., & Erkinjonovich, A. Z. Principles of Operation and Account of Hydraulic Taran. *JournalNX*, 1-4.

М. М. Мадрахимов and З. Э. Абдулҳаев, "Насос Агрегатини Ишга Туширишда Босимли Сув Узатгичлардаги Ўтиш Жараёнларини Ҳисоблаш Усуллари," Фарғона Политехника Институти Илмий–Техника Журнали, vol. 23, no. 3, pp. 56–60, 2019.

P. Holman, Heat Transfer, 9th ed., McGraw-Hill Companies Inc., 2002, ISBN:0-07-240655-0.

Cite this article:

Author(s), Mo'minov Oybek Alisher ugli[1], O'tbosarov Shuhratjon Rustamjon ugli[2], AND Maqsudov Rustamjon Ismoilovich[3], (2021). "Methods for Determining Thermal Conductivity of Ventilation Radiators in Low-Temperature Systems and Their Analysis", **Name of the Journal:** Euro Afro Studies International Journal, (EASIJ.COM), P, 45 –51. DOI: www.doi.org/10.5281/zenodo.4999989 , Issue: 6, Vol.: 3, Article: 5, Month: June, Year: 2021. Retrieved from https://www.easij.com/all-issues/

Published By

AND

ThoughtWares Consulting & Multi Services International (TWCMSI)