home

about

publishers

editorial boards

advisory board

for authors

call for papers

subscription

archive

news

links

contacts

authors gateway

username

●●●●●●●

submit

Are you an author in Thermal science? In preparation.

Authors of this Paper

Related papers

Cited By

External Links

Mohammad Azizur Rahman

A NOVEL METHOD FOR ESTIMATING THE ENTROPY GENERATION RATE IN A HUMAN BODY

ABSTRACT

The main objective of this study is to show a method for calculating entropy generation (SBgenB) in a human body under various environmental and physiological conditions. The SBgenB in a human body is a measure of activeness of motions, reactions and irreversibility of processes occurring in a body and is a kind of holistic and thermodynamic index, which characterizes a human body as a whole. Human body at healthier and normal condition generates the least amount of SBgenB. Heat transfer over a human body, activity (at rest, SBgenB=0.21 J.secP-1P.KP-1 Por exercise, SBgenB=2.19 J.secP-1P.KP-1 P or at death SBgenB=0 J.secP-1P.KP-1P), ambient, body and mean radiant temperatures, emissivity and absorbity of human skin, internal heat elimination, body weight and height, and air speed effect much more on the SBgenB in a human body compared to the effects of mass exchange into and out of the body, internal heat production, cross sectional area of human body, clothing, altitude, and relative humidity of the surrounding air. Among these factors entropy production due to heat transfer over a human body plays a significant role in the total entropy generation rate (SBgenB).

KEYWORDS

entropy generation, human body surface area, heat transfer, age, metabolism

REFERENCES [view full list]

1. O.P. Fanger, (1970) Conditions for Thermal Comfort - Introduction of a General Comfort Equation. In: Hardy JD, Gagge AP, Stolwijk JAJ (eds) Physiological and behavioural temperature regulation, Thomas, Springfield, Ill., 152-176.

2. I.M. Kandjov, (1999) Heat and mass exchange processes between the surface of the human

body and ambient air at various altitudes, International journal of biometeorology, 43 (1) 38-44.

3. J.D. Hardy and E.F. DuBios, (1940) Differences Between Men and Women in Their Response to Heat and Cold, Proceedings of the National Academy of Sciences of United States of America, U.S.A., 26, 389-398.

4. J.D. Hardy and E.F. DuBios, (1938) Basal Metabolism, Radiation, Convection and Vaporization at Temperatures of 22-35°C, Journal of Nutrition, 15(5), 477-497.

5. I. Aoki, (1991) Entropy principle for human development, growth and aging. Journal of Theoretical Biology, 150 (2) 215-223.

6. I. Aoki, (1990). Effects of exercise and chills on entropy production in human body. Journal of Theoretical Biology. 145, (3) 421-428.

7. I. Aoki, (1987) Entropy balance of white-tailed deer during a winter night. Bulletin of Mathematical Biology. 49 (3) 321-327.

8. I. Aoki, (1989) Entropy flow and entropy production in the human body in basal conditions. Journal of Theoretical Biology. 141 (1) 11-21.

9. G. Nicolis and I. Prigigine, Self-Organization in Nonequilibrium Systems, NewYork Wiley-Interscience 1977.

10. ASHRAE, Standard 55-2004 Thermal Environmental Conditions for Human Occupancy.

11. J.D. Hardy, A.T. Milhorat and E.F. DuBios, (1938) The effect of forced air currents and clothing on radiation and convection , Journal of Nutrition, 15 (6) 583-595.

12. I. Aoki, (1994) Entropy production in human life span: A thermodynamical measure for aging. AGE: Journal of the American Aging Association, 17 (1) 29-31.

13. J.D. Hardy and A.T. Milhorat, (1939) Basal heat loss and production in women at temperatures from 23 to 36. Proceedings of the Society for Experimental Biology and Medicine. 41 (1) 94-98.

14. J.D. Hardy, (1934) The Radiation of Heat From the Human Body. The Journal of Clinical Investigation, 13 (4) 615-620.

15. B. Givoni and R. F. Goldman, (1972) Predicting rectal temperature response to work, environment, and clothing, Journal of Applied Physiology, 32(6), 812-822.

16. A.C. Burton, (1934) The application of the theory of heat flow to the study of energy metabolism, Journal of Nutrition, 7 (5) 497-533.

17. D. DuBois, and E.F. DuBois, (1916) A formula to estimate the approximate surface area if height and weight be known, Archives of Internal Medicine 17 (6), 863-871.

18. E.F. DuBios, F.G. Ebaugh, and J.D. Hardy, (1952) Basal heat production and elimination of thirteen normal women at temperatures from 22 degrees C. to 35 degrees C., Journal of Nutrition, 48 (2) 257-293.

19. I. Aoki, (1995) Entropy production in living systems: from organisms to ecosystems, Thermochimica ACTA. 250 (2), 359-370.

20. M.J. Moran, Availability Analysis: A guide to Efficient Energy Use, Englewood Cliffs NJ: Prentice Hall 1982.

21. A. Bejan, Entropy Generation Through Heat and Fluid Flow, New York, Wiley, 1982.

22. K.R. Koehler, Body Temperature Regulation, 1996.
http://www.rwc.uc.edu/koehler/biophys/8d.html

23. J.D. Hardy, A.T. Milhorat and E.F. DuBios, (1938) The effect of exercise and chills on heat loss from the nude body, Journal of Nutrition, 16 (5) 477-492.

24. J.D. Hardy and G.F. Soderstorm, (1938) Heat loss from the nude body and peripheral blood flow at temperatures of 22 degrees C. to 32 degrees C, Journal of Nutrition, 16 (5) 493-510.

25. A. Marsh and C. Raines, Human Comfort, Square One, Welsh School of Architecture, Cardiff University, July, 2004, http://www.squ1.com/comfort/comfort.html

26. J. Walker, Input/Output, Sausalito, California, January 1991,
http://www.fourmilab.ch/backdiet/www/tableofcontents1_6.html

27. G. Pezzagno, (1999) Heat Exchange between the Human Body and the Environment, 21(3), 159-205.

PDF VERSION [DOWNLOAD]

A NOVEL METHOD FOR ESTIMATING THE ENTROPY GENERATION RATE IN A HUMAN BODY