



## Discussion of “A Multi-Objective Comprehensive Evaluation of Heat Transfer Performance of a Direct-Contact Heat Exchanger” (Li, B., Yang, P., Li, Z., Xu, J., and Wang, H., 2023, ASME J. Therm. Sci. Eng. Appl., 15(1), p. 011014)

M. M. Awad

Mem. ASME

Mechanical Power Engineering Department,  
 Faculty of Engineering,  
 Mansoura University,  
 Mansoura 35516, Egypt  
 e-mail: m\_m\_awad@mans.edu.eg

*The units of entransy dissipation (G) in Nomenclature are wrong. Also, an opinion on the concept of entransy is presented.*  
 [DOI: 10.1115/1.4065635]

Li et al. [1] introduced the optimal direct-contact heat exchangers design. The researchers included the entransy dissipation in their analysis. They found that the lower the entransy, the higher the heat exchanger effectiveness.

Li et al. [1] defined the entransy dissipation rate (Eq. (8) in Ref. [1]) as [2]

$$G = \frac{1}{2} m_c C_{c,v} (T_{c,in}^2 - T_{c,out}^2) + \frac{1}{2} m_d C_{d,v} (T_{d,in}^2 - T_{d,out}^2) \quad (1)$$

Using the units of all terms on the right-hand side, we have  $[G] = \text{kJ K/min}$ .

However, Li et al. [1] mentioned that the units of entransy dissipation ( $G$ ) in Nomenclature are kJ. Thus, the units of entransy dissipation ( $G$ ) in Nomenclature are wrong.

Also, the entransy concept is incorrect. It is the against-nature claim that a heated block of solid stores energy in the same way as a spring stores energy. During stretching, the spring resists with a force proportional to the displacement. If entransy is to be taken seriously, then during heating the body accepts only a heat increment proportional to the body's Kelvin temperature! This is contradicted by all observations of heating.

This falsehood was explained in numerous publications. For example, Professor Adrian Bejan mentioned this fact in his papers and books [3–5]. In addition, the present author stated the truth about the entransy concept in seven different journals in the period 2014–2020 [6–13]. As shown by Bejan [14], Awad [13] indicated that the entransy concept publishing is regional not global. As indicated in the article on 70th birthday of Professor Adrian Bejan, it is written about him: “He sounds the alarm

against publishing practices that give the impression of false science, citations cartels, nationalism, groupthink, unoriginal work, and lack of credit given to the original sources” [15].

In 2021, Professor Adrian Bejan showed that although some ideas in thermal sciences are wrong, the spreading of these wrong ideas is simplified by the national preferences of writers, editors, and organizations [16].

In 2022, Professor Rajesh Ransing [17] showed that there is a decay in number of publications and citations of papers about entransy at the end of December 2021 according to The Clarivate Web of Science. This is due to Liu et al. [18] who implied that entransy dissipation rate is a matter of the first law of thermodynamics rather than the second law of thermodynamics. The current author is unsure how their claim was allowed to get published in *International Journal of Heat and Mass Transfer*.

### Acknowledgment

The author acknowledges the support of the Faculty of Engineering, Mansoura University, Mansoura, Egypt.

### Conflict of Interest

There are no conflicts of interest.

### Data Availability Statement

No data, models, or code were generated or used for this paper.

### References

- Li, B., Yang, P., Li, Z., Xu, J., and Wang, H., 2023, “A Multi-Objective Comprehensive Evaluation of Heat Transfer Performance of a Direct-Contact Heat Exchanger,” *ASME J. Therm. Sci. Eng. Appl.*, **15**(1), p. 011014.
- Qian, X. D., and Li, Z. X., 2011, “Analysis of Entransy Dissipation in Heat Exchangers,” *Int. J. Therm. Sci.*, **50**(4), pp. 608–614.
- Bejan, A., 2014, “‘Entransy’, and Its Lack of Content in Physics,” *ASME J. Heat Transfer*, **136**(5), p. 055501.
- Bejan, A., 2017, “Evolution in Thermodynamics,” *Appl. Phys. Rev.*, **4**(1), p. 011305.
- Bejan, A., 2020, *Freedom and Evolution*, Springer Nature, New York, Chapter 11.
- Awad, M. M., 2014, “Entransy Is Now Clear,” *ASME J. Heat Transfer*, **136**(9), p. 095502.
- Awad, M. M., 2014, “Entransy Unmasked,” *Energy Convers. Manage.*, **88**, pp. 1070–1071.
- Awad, M. M., 2015, “Reply to Comments on ‘Second Law Thermodynamic Study of Heat Exchangers: A Review’ (Renewable and Sustainable Energy Reviews 2015; 44: 608–610),” *Renew. Sustain. Energy Rev.*, **51**, pp. 1792–1793.
- Awad, M. M., 2017, “Comments on ‘Entransy Analysis and Optimization of Performance of Nano-Scale Irreversible Otto Cycle Operating With Maxwell-Boltzmann Ideal Gas’,” *Chem. Phys. Lett.*, **671**, pp. 56–57.
- Awad, M. M., 2017, “‘Comments on Introduction of an Energy Efficiency Tool for Small Scale Biomass Gasifiers—A Thermodynamic Approach (S. Vakalis, F. Patuzzi, M. Baratieri, Energy Convers. Manage. 131 (2017) 1–9),” *Energy Convers. Manage.*, **138**, pp. 698–699.
- Awad, M. M., 2017, “Comments on ‘Temperature-Heat Diagram Analysis Method for Heat Recovery Physical Adsorption Refrigeration Cycle—Taking Multi-Stage Cycle as an Example’,” *Int. J. Refrig.*, **82**, pp. 541–542.
- Awad, M. M., 2018, “Comment on the Paper: Goudarzi and Talebi, 2018. Heat Removal Ability for Different Orientations of Single-Phase Natural Circulation Loops Using the Entransy Method. *Ann. Nucl. Energy*. 111, 509–522,” *Ann. Nucl. Energy*, **116C**, pp. 448–449.
- Awad, M. M., 2020, “Comments on ‘Analysis of Heat Transfer and Irreversibility of ORC Evaporator for Selecting Working Fluid and Operating Conditions’,” *Therm. Sci.*, **24**(4), pp. 2661–2663.
- Bejan, A., 2020, “Discipline in Thermodynamics,” *Energies*, **13**(10), p. 2487.

- [15] Lage, J. L., Minkowycz, W. J., Amon, C. H., Awad, M. M., Basak, T., Bayazitoglu, Y., Biserni, C., et al., 2018, "Celebration of Professor Adrian Bejan on His 70th Birthday," *Int. J. Heat Mass Transfer*, **126A**, pp. 1377–1378.
- [16] Bejan, A., 2021, "Nationalism and Forgetfulness in the Spreading of Thermal Sciences," *Int. J. Therm. Sci.*, **163**, p. 106802.
- [17] Ransing, R. S., 2023, "Thermal Irreversibility Demystified," *Int. J. Numer. Methods Heat Fluid Flow*, **33**(2), pp. 682–711.
- [18] Liu, Y., Xu, P., Wang, T., and Liu, C., 2021, "Variabilities and Their Upper and Lower Bounds of the Equivalent Thermal Conductivity and Resistance Defined by the Entropy Dissipation Rate," *Int. J. Heat Mass Transfer*, **170**, p. 120990.