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Chapter

Introductory Chapter: Recent Advances in Heat Pipes

Wael I.A. Aly

1. Introduction

Heat pipe is a two-phase flow passive and reliable heat transfer device widely used in thermal systems [1]. It is known that the thermal conductance of heat pipes is higher than any solid conductor due to the accompanying latent heat during the closed two-phase cycle. Moreover, heat pipes have many advantages compared to other heat exchangers: higher amounts of heat transferred over long distance, faster thermal response time, easier design and manufacturing, lower temperature difference, broad temperature range for applications, and easier control which allow transporting high rates of heat at various temperature levels. Also, as a passive device, no external power is required for its operation, and heat pipe is highly reliable and almost requires no maintenance. Because of the mentioned advantages, heat pipes are ideal for many applications. Heat pipe is considered as an effective thermal solution, particularly in high heat flux applications and in situations where there is a combination of nonuniform heat loading, limited airflow over the heat-generating components, and space or weight constraints.

After the introduction of heat pipes with the paper *Structures of Very High Thermal Conductance* by the authors Grover et al. [2] in 1964, the interest in the applications of heat pipes has increased remarkably. Currently, a huge amount of documents (research articles, review articles, and books) concerning heat pipes

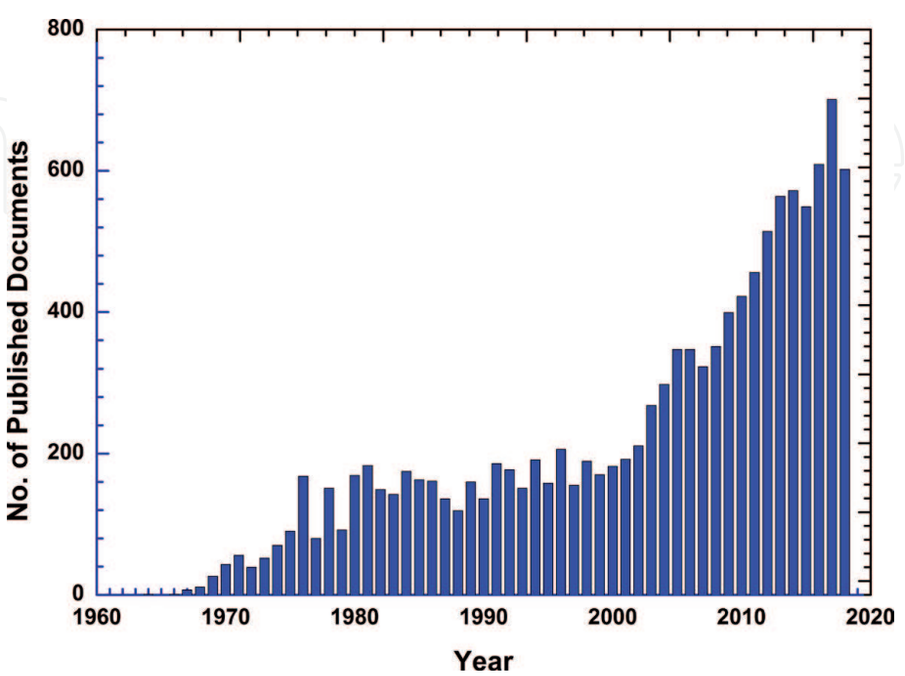

Figure 1.
Number of published documents on heat pipes each year.

and two-phase closed thermosyphon are published. The literature is very rich now with documents about heat pipes, and the heat pipe has become recognized as an important development in heat transfer technology. Many researchers assessed the potential applications of various types of heat pipes. **Figure 1** shows how the research on heat pipes evolved from its introduction in 1964 up to the present time. Around 12,372 documents have been published since 1964. The data were extracted from the Scopus database by searching "heat pipe" or "heat pipes" in the article title, abstract, and keywords (date of extract: 25 May 2019). As shown in **Figure 1**, after the year 2000, the number of documents per year increased remarkably, so that by 2017, it reached more than 700 papers.

2. Advances on heat pipes

The recent advances of heat pipes may include recent advances in working fluids (nanofluids, new refrigerants, etc.), wick structures (microgrooves, sintered, etc.), special types of heat pipes (VCHP, pulsating HP, rotating HP, electrokinetic force), and new applications (energy conservation and storage, reactors, spacecraft, renewable energy, food industries, cooling of electronic components, etc.) [3–5].

Author details

Wael I.A. Aly
Department of Refrigeration and Air Conditioning Technology, Faculty of Industrial Education, Helwan University, Egypt

*Address all correspondence to: aly_wael@helwan.edu.eg; aly_wael@yahoo.com

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