Optimal design of a heat exchanger network composed of parallel tubes

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Summary - Networks of tubes for heat and mass transport abound both in nature and in engineered systems. The design of optimized flow networks is a commonplace occurrence in nature (vascularised tissues, mammalian respiratory system, leaves, etc.) [1, 2]. We also find them in many man-made systems (e.g. electronic devices, solar panels, hot water delivery systems, etc.) In engineered systems the successful implementation of these networks depends on the degree of optimization that they achieve with the purpose of maximizing performance. There has been a particular interest in optimizing tree-shaped structures [1]. Optimized design of many kinds of structures has been presented in the framework of the constructal principle [1]. Examples include flow networks [3, 4], heat exchangers [5], heat conduction networks [6] and others [1]. t
In this paper we study the optimal design of heat exchanging flow networks composed of parallel tubes as that depicted in Fig. 1. The impact of the network size-limiting constrains (surface area, tubes diameter), fluid flow regime, as well as the fluid pumping power requirements is addressed in this paper for the cases when Biot number is smaller than 0.1.

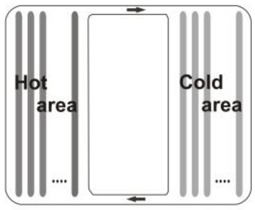

Figure 1. Heat exchanger network composed of parallel tubes

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