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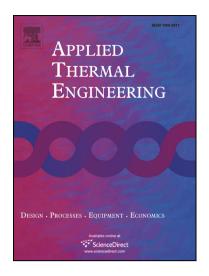
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## ACCEPTED MANUSCRIPT

A new stage-wise superstructure for heat exchanger network synthesis considering

substages, sub-splits and cross flows

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**Abstract** Several optimization models for process synthesis and optimization are derived from

superstructures. Those used for Heat Exchanger Networks (HEN) must comprise consistent

design options so that efficient structures may be found. The complexity arisen from

nonlinearities and non-convexities in the mathematical models for HEN synthesis, though,

hampers the use of superstructures with elaborated streams splits and mixing alternatives as well

as multiple options for devices allocation. In this work, a new superstructure based on a

previous stage-wise one is presented encompassing, for each process stream, the use of splits,

sub-splits, cross flows (i.e., partial stream mixing), serial heat exchanger allocation in single

stream split branches and heaters/coolers allocation in intermediate stages of the structure (i.e.,

before process streams heat exchangers). The meta-heuristic approach used to solve the

optimization model was able to achieve solutions better than those previously reported in the

literature for five case studies, demonstrating efficiency in solving such complex model.

Keywords: optimization; heat exchanger networks; meta-heuristics; mathematical modeling;

process synthesis

1 Introduction

Mathematical programming (MP) has been a successful basis for several HEN synthesis works,

providing a fair degree of automaticity to a complex design and optimization task. Among the

frameworks presented in the literature to conduct HEN synthesis, two MINLP formulations can

be highlighted as noteworthy contributions to the field. Those are the generalized match-

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