Cairo University

# OPTIMIZATION OF SMALL SCALE LIQUEFACTION PROCESSES USING GENETIC ALGORITHM

By

Mohamed Ibrahim Abdelhamid Awad

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Chemical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

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Approved by the
Examining Committee

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FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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**Title of Thesis:**

Optimization of Small Scale Liquefaction Processes Using Genetic Algorithm

**Key Words:**
Liquefaction; Natural gas; Optimization; Genetic algorithm; Nitrogen expander cycles

**Summary:**

A new optimization scheme based on communication between the Genetic Algorithm toolbox of Matlab and HYSYS process simulation software is suggested. The power of this newly developed scheme is illustrated by considering the optimization of alternative existing nitrogen based stranded gas liquefaction technologies. The studied genetic operators included population size, selection method, and cross over probability. It is found that the application of this scheme using the range of genetic operators studied led to the establishment of optimum values of the different operating variables in alternative cycles. This enabled the minimization of power consumption compared to the results obtained using the traditional HYSYS Optimizer tool. The results also confirmed the ranking with respect to minimization of power consumption indicating the superiority of the dual nitrogen expansion cycle over the single nitrogen expansion cycle. When the proposed optimization scheme was tested for the optimization of the $CO_2$ pre-cooled single nitrogen expansion cycle, the power consumption significantly decreased compared to the HYSYS-optimized case which demonstrates the strength of the integrated HYSYS-MATLAB framework in the optimization of the nitrogen expansion liquefaction cycles.

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# Dedication

*To my life companion my wife, Yara*

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