بسم اللّه الرحمن الرحيم

شبكة المعلومات الجامعية
التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

Cairo University

NUMERICAL INVESTIGATION OF VENTILATION METHODS FOR NiCd BATTERIES OF AN INDOOR SUBSTATION

By

Karim Tarek Abd El-Hamid Mohamed Abd El-Aziz

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
MECHANICAL POWER ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

NUMERICAL INVESTIGATION OF VENTILATION METHODS FOR NiCd BATTERIES OF AN INDOOR SUBSTATION

By

Karim Tarek Abd El-Hamid Mohamed Abd El-Aziz

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
MECHANICAL POWER ENGINEERING

Under the Supervision of

Prof. Dr. Mahmoud A. Fouad	**Dr. Taher M. Halawa**
……………………………….	……………………………….
Professor of Mechanical Power Engineering Faculty of Engineering, Cairo University	Assistant Professor Mechanical Power Engineering Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

NUMERICAL INVESTIGATION OF VENTILATION METHODS FOR NiCd BATTERIES OF AN INDOOR SUBSTATION

By

Karim Tarek Abd El-Hamid Mohamed Abd El-Aziz

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
MECHANICAL POWER ENGINEERING

Approved by the Examining Committee

Prof. Dr. Mahmoud Ahmed Fouad, Thesis Main Advisor
Professor, Mechanical Power Engineering Department
Faculty of Engineering, Cairo University

Prof. Dr. Mostafa Abd-elhamid Rizk, Internal Examiner
Professor, Mechanical Power Engineering Department
Faculty of Engineering, Cairo University

Prof. Dr. Mahmoud Abd-elftah Elkady, External Examiner
Professor of Mechanical Power Engineering Department
Faculty of Engineering, Al-Azhar University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer's Name: Karim Tarek Abd El- Hamid Mohamed Abd EL-Aziz
Date of Birth: 16/04/1992
Nationality: Egyptian
E-mail: engkarim.m.d@gmail.com
Phone: 0111-948-3000
Address: 24 Madina El Monora st. from Tahrir St. Giza, Egypt

Registration Date: 01/10/2016.
Awarding Date: …./…./2021
Degree: Master of Science
Department: Mechanical Power Engineering

Supervisors:

Prof. Dr. Mahmoud A. Fouad
Dr. Taher M. Halawa

Examiners:

Prof. Dr. Mahmoud Ahmed Fouad (Thesis main advisor)
Prof. Dr. Mostafa Abd-elhamed Rizk (Internal examiner)
Prof. Dr. Mahmoud Abd-elftah Elkady (External examiner)
Professor of Mechanical Power Engineering Department,
Faculty of Engineering, Al-Azhar University

Title of Thesis:

NUMERICAL INVESTIGATION OF VENTILATION METHODS FOR NiCd BATTERRIES OF AN INDOOR SUBSTATION

Key Words: **Ventilation / Indoor air quality / Hydrogen Emissions / NiCd Batteries Energy Storage**

Summary:

Performance of ventilation inside NiCd battery room was investigated numerically utilizing Ansys Fluent 19.0. The model was built and mesh by ANSYS design modeler yielding around 3.4 million elements after making good use of symmetry B.C. Validation was done against experimental published data and comparison between various turbulence models was performed. A parametric study is done to explore the impact of three various factors on the efficiency of the ventilation system. First, the relation between (ACH) utilized and the average hydrogen concentration. Second, the impact of changing inlets and outlet grilles location under fixed 20 (ACH) on hydrogen concentration. Third, the impact of storing batteries in double vertical racks on the ventilation performance, which offered the best ventilation performance utilizing wall type inlet grille at the lower wall section and outlet grille at the roof, while the batteries racks are surrounded by curtains to act as spot ventilation which offered the opportunity for choosing lower value of ACH (10) in order to reduce the equipment and energy cost which maintained an acceptable value of hydrogen concentration 0.66%.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Karim Tarek Abd El-Hamid Mohamed Abd El-Aziz Date: / / 2021

Signature:

Acknowledgments

First, I would like to prostrate and praise THE ALMIGHTY ALLAH whose blessing, guide, and mercy have been behind whatever success may have been achieved in this work. I am eternally grateful that his blessings have come in the form of family and friends who have supported me in all my endeavors.

This Thesis would not be successfully completed without the generous support of many people. Firstly, I would like to express my deepest gratitude to my dearest supervisors, **Prof. Dr. Mahmoud A. Fouad and Dr. Taher M. Halawa** for their inspiration, guidance, and valuable advice throughout the preparation of this thesis. Without their kind support and tolerance, I can hardly complete this thesis.

Secondly, I would like to give my sincere thanks to my colleagues at work who helped me a lot.

And finally, I would like to thank my dear **Father Mr. Tarek Abd El-Hamid,** and my dear **Mother** for their encouragement, continuous support, and care during the whole period. Also, I would like to thank my friends and colleagues for helping me in finding data and their valuable suggestions.

Table of Contents

List of Tables

List of Figures