Ain Shams University

Faculty of Engineering

Design and Production Engineering

Development of Conveyor Belts Design for Reducing Energy Consumption in Mining Applications

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Mechanical Engineering

(Design and Production Engineering)

by

Gerges Samy Fayek Youssef

Bachelor of Science in Mechanical Engineering

(Mechanical Design and Production)

Faculty of Engineering, Ain Shams University, 2009

Supervised By

Prof. Samy J. Ebeid

Associate Prof. Iman M. Taha

Associate Prof. Wagdy E. Abdel-Ghany

Cairo – (2016)

Ain Shams University

Faculty of Engineering

Design and Production Engineering

Development of Conveyor Belts Design for Reducing Energy Consumption in Mining Applications

by

Gerges Samy Fayek Youssef

Bachelor of Science in Mechanical Engineering

(Mechanical Design and Production)

Faculty of Engineering, Ain Shams University, 2009

Supervising committee

Name and Affiliation	Signature
Prof. Samy J. Ebeid, ASU	……..
Associate Prof. Iman M. Taha, ASU	……..
Associate Prof. Wagdy E. Abdel-Ghany, ASU	……..

Date: 1 June 2016

Ain Shams University

Faculty of Engineering

Design and Production Engineering

Development of Conveyor Belts Design for Reducing Energy Consumption in Mining Applications

by

Gerges Samy Fayek Youssef

Bachelor of Science in Mechanical Engineering

(Mechanical Design and Production)

Faculty of Engineering, Ain Shams University, 2009

Examining committee

Name and affiliation	Signature
Prof. El Sayed Y. S. El Kady, Benha University	……..
Prof. Hesham A. Sonbol, Ain Shams University	……..
Prof. Samy J. Ebeid, Ain Shams University	……..

Date: 1 June 2016

"Persistence is to the character of man as carbon is to steel"
Napoleon Hill

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Mechanical Engineering, Faculty of Engineering, Ain shams University. The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Signature

Gerges S. Youssef

Date: 1 June 2016

Acknowledgement

It is my pleasure to acknowledge all who helped me to complete this thesis.

I have to express my sincere gratitude to my parents, my lifetime partner, Sarah and the whole family. Without their ultimate love and support, I would have never accomplished this.

I am also grateful to Dr. Iman Mohamed Taha for her continuous attention and professional guidance all the way from the very first beginning.

I would like to thank Prof. Dr. Samy Jimmy Ebeid, Dr. Wagdy El Desouky Abdel-Ghany, and Dr. Lamia Shihata for their precious comments, encouragement and guidance through hard times.

The last but not the least, I would really want to acknowledge MGA Technology and MGA Industrial Inc. for their support and for providing me with the necessary software packages required for modeling and simulation.

Gerges S. Youssef

Researcher Data

Name	Gerges Samy Fayek Youssef
Date of birth	01.10.1986
Place of birth	Cairo, Egypt
Last academic degree	B.Sc. of Mechanical Engineering
Field of specialization	Design and Production
University issued the degree	Ain Shams University
Date of issued degree	07.2009
Current job	Senior Mechanical Engineer

Thesis Summary

Belt conveyors are one of the most common systems in the field of bulk materials handling. Such systems are typically used to convey bulk materials such as coal, cement, ores and grains throughout processing facilities or to storage or shipping facilities. Belt conveyor systems may extend for tens of kilometers of length with an approximate maximum standard belt width of 275 centimeters (108 inches). Driving such systems consumes energy at high rates and accordingly results in emitting huge amounts of pollutants in the environment.

The study aims at analyzing the most significant factors affecting power consumptions in such systems and attempting to find solutions that can lower power consumption in the design phase. As a first step, the most influential factors on power demand of belt conveyors were studied and summarized based on literature review. These factors can be classified to system design parameters (as idler roll material, trough angle, idler spacing, idler roll diameter and idler roll bearing type), operational conditions (as belt speed) and environmental conditions (as ambient temperature). Calculations of the power demand of a belt conveyor system are prepared under different working conditions, based on common inputs applied in the mining industry. The calculated values were closely examined in a factorial design to investigate the significance of these factors and their interaction effects on power demand.

Based on this factorial design study, the influential factors could be narrowed down to idler spacing, idler roll material and diameter, idler spacing, belt speed and ambient temperature. Accordingly, Finite Element Method (FEM) was used to study the effect of some of these factors on the Indentation Rolling Resistance (IRR), one of the major resistances contributing to increased power demand in horizontal belt conveyor systems. In order to construct the FE model, material data were defined through a set of experimental characterization methods, involving mechanical testing of tensile properties, density measurements and Dynamic Mechanical Analysis (DMA).

A pilot study FE model was prepared to assure that results are accurate in comparison to experimental results for a similar application. The pilot study FE model was used to compare indentation rolling resistance of a flat belt conveyor system against experimental results reported in literature. The applied model proved good agreement