UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

A STUDY ON AGV BATTERY PERFORMANCE AFFECTING FACTORS IN MANUFACTURING ENVIRONMENT

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Master of Manufacturing Engineering
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A STUDY ON AGV BATTERY PERFORMANCE AFFECTING FACTORS IN MANUFACTURING ENVIRONMENT

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A thesis submitted
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DECLARATION

I declare that this thesis entitle "A Study on AGV Battery Performance Affecting Factors in Manufacturing Environment" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : Madihah binti Haji Maharof

Date : 6 Sept 2013

APPROVAL

This thesis is submitted to the Centre for Graduate Studies of UTeM as a partial fulfilment of the requirements for the Master of Manufacturing Engineering (Manufacturing Systems Engineering). The member of the supervisory committee is as follow:

Signature : .....

Supervisor Name : Dr. Fairul Azni bin Jafar

Date : 6 Sept 2013

DEDICATION

This thesis report is lovingly dedicated to my respective family who have been constant source of inspiration to me. They have given me the drive and discipline to tackle any task with enthusiasm and determination. Without their love and support this project would not have been made possible.

ABSTRACT

Material Handling System (MHS) is the backbone of a Flexible Manufacturing System (FMS). AGV is most often used in MHS industrial applications to move materials around manufacturing facility. AGV is unmanned vehicles that usually run on predefined guide paths in large material warehouses to transport goods among different workstations. This project focuses on the factors AGV battery performance affecting in manufacturing environment. When dealing with AGV in factories, many important factors need to be considered in order to ensure that the AGV will works efficiently and the life of the AGV battery itself is one of the crucial parts to maintain and control. Usually, when AGV is running and working smoothly in production lines, the battery condition need to be always monitored and it is necessary to take into account that the use of battery may impact the performance of the overall system. In this study and analysis, the factors of load and no load are considered. During data collection, AGV is running with both of factors in two conditions which are with stoppage and without stoppage, assuming that stoppage condition happen due to the existence of obstacles such as human, forklift, and etc. When AGV is running on the path within 15 minutes, without load and without stoppage gives more effect to the battery deterioration. It used 39.17% of battery to move the AGV compared to when AGV is working with load and without stoppage which used only 23.34% of battery. Furthermore, when AGV is running without load and with stoppage also used 35.17% of battery to move on the path compared to load factor with stoppage only used 10.45% of battery. Through this analysis, it is believe that battery deterioration

increases when AGV is working without load in manufacturing environment. A part from that, AGVs perform their task effectively by means less monitor and less frequent to charge the battery when AGV is running with load. Through this analysis too, performance of battery is 76.66% when AGV is running with load and without stoppage and 89.55% when AGV is running with load and stoppage. Significant parameters of this analysis that give effect to the battery deterioration are voltage, followed by current and temperature.

ABSTRAK

Sistem Pengendalian bahan (MHS) merupakan tulang belakang kepada Sistem Pembuatan Fleksibel (FMS). AGV merupakan kenderaan yang sering digunakan dalam MHS aplikasi industri untuk menggerakkan bahan-bahan di sekitar kemudahan pembuatan. AGV adalah kenderaan tanpa pemandu yang biasanya berjalan di laluan yang telah ditetapkan panduan dalam gudang bahan besar untuk mengangkut barang-barang antara stesen kerja yang berbeza. Projek ini memberi tumpuan kepada faktor-faktor AGV menjejaskan prestasi bateri dalam persekitaran pembuatan. Apabila berurusan dengan AGV di kilang-kilang , banyak faktor-faktor penting yang perlu dipertimbangkan untuk memastikan bahawa AGV akan berfungsi dengan cekap dan hayat bateri AGV itu sendiri adalah salah satu bahagian yang penting untuk mengekalkan dan mengawal . Biasanya, apabila AGV sedang berjalan dan bekerja dengan lancar dalam barisan pengeluaran, keadaan bateri perlu sentiasa dipantau dan adalah perlu untuk mengambil kira bahawa penggunaan bateri boleh memberi kesan kepada prestasi sistem secara keseluruhan. Dalam kajian dan analisis ini, faktor-faktor beban dan tanpa beban akan dipertimbangkan. Dalam pengumpulan data, AGV sedang berjalan dengan kedua-dua faktor dalam dua keadaan yang dengan kecederaan dan tanpa kecederaan, dengan anggapan bahawa keadaan kecederaan berlaku disebabkan oleh kewujudan halangan-halangan seperti manusia, forklift, dan lain-lain Apabila AGV sedang berjalan di atas jalan dalam 15 minit, tanpa beban dan tanpa pemberhentian memberi kesan yang lebih kepada kemerosotan bateri. Ia digunakan 39.17 % daripada bateri untuk bergerak AGV berbanding apabila AGV bekerja

dengan beban dan tanpa kecederaan yang digunakan hanya 23.34 % daripada bateri. Tambahan pula, apabila AGV sedang berjalan tanpa beban dan dengan kecederaan juga digunakan 35.17 % daripada bateri untuk bergerak di jalan berbanding dengan faktor muatan dengan kecederaan hanya digunakan 10.45% bateri. Melalui analisis ini, ia percaya bahawa kenaikan kemerosotan bateri apabila AGV bekerja tanpa beban dalam persekitaran pembuatan. Sebahagian daripada itu, AGVs melaksanakan tugas mereka dengan berkesan oleh bermakna kurang memantau dan kurang kerap untuk mengenakan bateri apabila AGV sedang berjalan dengan beban. Melalui analisis ini juga, prestasi bateri adalah 76.66 % apabila AGV sedang berjalan dengan beban dan tanpa pemberhentian dan 89.55 % apabila AGV sedang berjalan dengan beban dan kecederaan. Parameter penting analisis ini yang memberi kesan kepada kemerosotan bateri adalah voltan, diikuti oleh arus dan suhu.

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ms	Millisecond
Vin	Voltage input
Vmax	Voltage maximum
Vss	Voltage source

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LIST OF ABBREVIATIONS

AGV	Automated Guided Vehicle
AS/RS	Automated System and Retrieval System
BMS	Battery Management System
DOD	Depth of Discharge
FMS	Flexible Manufacturing System
GUI	Graphical User Interface
JIT	Just In Time
MHS	Material Handling System
NV	Non-Volatile
OCV	Open Circuit Voltage
PC	Personal Computer
RAAC	Remaining Active Absolute Capacity
RSAC	Remaining Stand-By Absolute Capacity
RARC	Remaining Active Relative Capacity
RSRC	Remaining Stand-By Relative Capacity
SOC	State of Charge
TEMP	Temperature
VOLT	Voltage
WIP	Work-In-Process

CHAPTER 1

INTRODUCTION

This chapter introduces the problem statements, objectives, scopes and the organization of a work entitled "A Study on AGV Battery Performance Affecting Factors in Manufacturing Environment".

1.1 Background

Material Handling System (MHS) is the backbone of a Flexible Manufacturing System (FMS). It connects various production functions and regulates part movement. From different types of material handlers available for FMS, Automated Guided Vehicle (AGV), which comprises several microprocessors controlled driverless vehicles, is the most adaptable and capable one. Automated Guided Vehicle (AGV) is unmanned vehicles that usually run on predefined guide paths in large material warehouses to transport goods among different workstations.

In early 1950's AGVs has been introduced, the numbers use of AGV has increased along with the application areas and types (Hamid *et al.,* 2009). Usually in a warehouse, the operators are one of the main purposes to maintain productivity in the production lines. By using AGV in production lines it will be safe and easy to operate. AGV is very flexible of controlling in a communication way. The AGV is now found in all types of industries, with the only restrictions on their use mainly resulting from the dimensions of the goods to be transported considerations (Ali, 2003). Many applications of AGV are technically possible, but the purchase and implementation of such systems are usually based on economic considerations (Chiew *et al.,* 2009).

AGV system is mainly integrated with a central controller, paths, an electronic communication mechanism and routing strategies. Nowadays, AGV systems are widely

used in automated MHS, FMS and even in container terminals to transport containers. The vehicles can automatically perform loading, routing selection, and unloading process. Though flexible, it is highly complex and expensive. To realize the full potential, it is essential to design, plan, schedule, and control the system efficiently.

When dealing with the AGV in factories or in industries many important factors need to be considered in order to ensure that the AGV will work efficiently and the life of AGV battery itself is one of the crucial parts to maintain and control. When AGV is running and working smoothly on production lines or warehouse systems, usually the battery condition needs to be always monitored and it is necessary to take into account that the use of batteries may impact the performance of the overall system.

1.2 Problem Statement

Based on the previous work of the AGV battery performance, it is very hard to find the details manufacturing environment factors that give effect to the deterioration of the AGV battery. Usually, the battery of AGV always needs to be recharged or changed after a certain time being used, and the time required to execute these operations might interfere the AGV availability. In order to avoid and reduced this problem, this project is analysed the AGV battery performance with regards to some potential affective factors in manufacturing environment that will effect the battery system. This is to ensure that the shelf life of the battery will perform their task effectively by means less frequent to charge the battery and less monitor. All kind of factors and the data will be captured by using Maxim DS2788. Hence, all the measurements is analysed in order to find the most significant parameter that give effect to the battery performance.