UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY ON HOT WATER GENERATOR (HWG) PERFORMANCES AT DRYING PROCESS IN BERNAS FACTORY

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

by

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I hereby, declared this report entitled “A Study on Hot Water Generator (HWG) at Drying Process in BERNAS Factory” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Management) (Hons.). The member of the supervisory committee is as follow:

…….

(DR. ZUHRIAH BINTI EBRAHIM)

ABSTRAK

Hot Water Generator (HWG) dan Cyclonic Husk Furnace (CHF) adalah sistem yang digunakan untuk pengeringan padi. Proses pengeringan adalah proses yang penting dalam pemprosesan beras bagi mengelakkan beras daripada rosak semasa pengilangan beras. Kebanyakan kilang BERNAS di Malaysia menggunakan sistem CHF untuk pengeringan padi. Masalah semasa sistem CHF ialah beras ynag berkualiti rendah hasil daripada proses pengeringan padi dari segi gred, bau, dan warna beras. Ini adalah kerana sistem CHF mengeringkan padi dengan penghantaran udara panas secara langsung ke Inclined Bed Dryer (IBD). Berdasarkan kepada kelemahan CHF, kajian ini adalah bertujuan untuk membuktikan kelebihan sistem HWG lebih daripada sistem CHF untuk proses pengeringan padi. Lebih khusus lagi, aspek-aspek yang diliputi ialah kualiti produktiviti padi dan kesannya kepada kemampanan. Objektif kajian ini ialah:(i) untuk menganalisis kelebihan HWG dan CHF dari segi suhu udara yang dibekalkan, masa pengeringan, dan kualiti beras yang diproses;(ii) untuk mengkaji masalah yang berkaitan dengan sistem HWG dan CHF; dan (iii) untuk mencadangkan penyelesaian untuk masalah HWG. Ishikawa Diagram dan 5 Whys analysis digunakan dalam mengenal pasti punca dan masalah yang berkaitan dengan kedua-dua sistem. 25 eksperimen bagi berlainan tetapan kelajuan dengan bilangan IBD yang beroperasi dijalankan dalam menentukan tetapan kelajuan ID Fan, FD Fan, Screw Feeder 1 dan Screw Feeder 2. Standard tetapan kelajuan untuk ID Fan, FD Fan, Screw Feeder 1 dan Screw Feeder 2 telah dicadangkan untuk sistem HWG itu. Dengan menggunakan tetapan standard, keputusan eksperimen menunjukkan kualiti sekam pembakaran telah bertambah baik.

ABSTRACT

Hot Water Generator (HWG) and Cyclonic Husk Furnace (CHF) are the systems used for paddy drying. The drying process is an important process in rice processing to prevent the rice from getting damaged and broken during rice milling. Most of the BERNAS factories in Malaysia use the CHF system for paddy drying. The current problem with the CHF system is low quality of rice resulted from the paddy drying process in terms of grade, smell, and colour of rice. This is because the CHF system dries wet paddy with direct delivery of hot air to Inclined Bed Dryer (IBD). In view of the weakness of CHF, this study aims to prove the advantages of HWG over CHF for paddy drying process. More specifically, the aspects covered are rice productivity quality and its effect to sustainability. The objectives of this study are: (i) to analyse the HWG and CHF performances in terms of temperature of air supply, drying hours, quality of environment and rice processed; (ii) to study the problems associated with HWG and CHF systems; and (iii) to propose a solution for the HWG problems. Ishikawa diagram and 5 Whys analysis have been used in identifying the root causes and critical problems related to both systems. 25 experiments with different speed setting and number of IBD operating were conducted in determining standard speed setting of ID Fan, FD Fan, Screw Feeder 1 and Screw Feeder 2. A standard speed setting for ID Fan, FD Fan, Screw Feeder 1 and Screw Feeder 2 has been proposed for the HWG system. The experimental results show the quality of husk combustion has been improved by using the standard settings.

DEDICATION

This project is dedicated to beloved who have mean so much to me. First and foremost, to my parents, Md Zakhi bin Abdul Samad and Norhasimah binti Jaafar who love me, taught me a value of hard work. Special dedication to my lecturer, siblings and friends for giving me all their knowledge's and moral support for me to complete this project and report.

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CHF	-	Cyclonic Husk Furnace
HWG	-	Hot Water Generator
BERNAS	-	Padiberas Nasional Berhad
IBD	-	Inclined Bed Dryer
KBB	-	Kilang Beras Bernas
GRR	-	Graded Rice Recovery
ID	-	Induce Damper fan
FD	-	Frost Damper fan
LM	-	Lean Manufacturing

CHAPTER 1

INTRODUCTION

This chapter discusses the background of the study, problem statement, aim and objectives, scope of study, and background of BERNAS. At the end of this chapter, the expected outcomes of this study are also presented.

1.1 Background of the Study

Rice is a staple food of the Malaysian community, which comprises Malay, Chinese and Indian; it is also consumed by people living in most Asian countries. However, the preparation of rice is dependent on the respective cultures (Ramli et al., 2012). The quality of rice is paramount to consumers because it is an essential food item in their daily life. According to Anang et al. (2011), the quality of rice is very important to people as they enjoy eating good rice. The quality of rice is characterised by aroma, taste, colour (white is better), size, percentage of broken rice (less is preferred) and shape of the rice kernel.

Paddy drying is one of the important processes that determine the quality of rice produced. Drying process is carried out by blowing heated air over grains, causing them to lose moisture rapidly (Prakash and Pan, 2011). There are two different drying systems used in the drying of grains at BERNAS Company, namely Cyclonic Husk Furnace (CHF) and Hot Water Generator (HWG).

The focus of this study is to analyse the performance of the HWG and CHF systems in drying paddy grains. The CHF system has been used for many years since the drying technology was introduced in the BERNAS Company. The HWG system has only started to be used in the company three years ago. This study is to define the best system for the drying process to produce rice of better quality than now.

First, an analysis of problems and characteristics of the HWG and CHF systems is needed. The elements that need to be focused on are the criteria of problems, which can be obtained from journals as well as books pertaining to the working of the HWG and CHF systems. The information about the criteria must be studied in order to make a comparison between these two systems. The problems of these two systems must be understood to determine the best system that should be used, HWG or CHF.

1.2 Problem Statement

Hot Water Generator (HWG) technology was introduced about 20 years ago, but it has not been widely used as a drying process in the factories of Padiberas Nasional Berhad (BERNAS). BERNAS still uses Cyclonic Husk Furnace (CHF) as one of the major drying systems for drying wet paddy. BERNAS has 30 factories located in many parts of Malaysia. Starting from year 2011, eight factories began to operate using hot water system while 18 factories have been using the CHF system since year 2007 and the remaining factories do not have drying facilities. (BERNAS, 1996).

The CHF system is the source of hot air supply to the dryers. CHF sends hot air directly to the Inclined Bed Dryer (IBD), and that produces drying effect in the IBD. The current problem in using CHF is that paddy grains dried by the CHF system are of low quality in terms of grade, smell, and colour of rice. The CHF system also requires very high frequency of maintenance, which includes components such as blower fan, ducting hot water, sieve IBD and body furnace as well as IBD, due to the effect of the direct hot air.

In addition, the hot air generated by the CHF system is not environmentally friendly. Thus, these problems must be resolved to save the time of drying and improve the quality of rice processed. The important qualities that need to be analyzed are temperature of energy supply, drying hours, and quality of rice processed. Therefore, in this study the appropriate lean tools and techniques are proposed for solving the critical problem of HWG systems.

1.3 Aim and Objectives

The aim of this project is to prove the advantages of HWG compared with CHF for the paddy drying process, which will improve the rice quality. In doing so, three objectives have been set:

i) To analyse the HWG and CHF performances in terms of temperature of energy supply, drying hours, and quality of rice processed.
ii) To study the problems associated with the HWG and CHF system.
iii) To propose solution for the problem of HWG system.

1.4 Scope of Study

This study will be carried out at five BERNAS factories which are (i) KBB Guar Cempedak; (ii) KBB Sungai Limau; (iii) KBB Kangkong; (iv) KBB Sungai Manik or KBB Rompin; and (v) KBB Telok Kechai. The study will focus on the performances and problems of the HWG and CHF systems related to the paddy drying process. The implementation of appropriate lean tools and techniques that proposed for solving critical problem of HWG systems cannot be done due to the time constraint.

1.5 Background of BERNAS Company

1.5.1 History of BERNAS

Padiberas Nasional Berhad (BERNAS) is a company listed on the Main Market of Bursa Malaysia. As the nation's partner in the domestic paddy and rice industry, BERNAS and its group of companies are involved in the procurement and processing of paddy; they are also involved in the importation, warehousing, distribution and marketing of rice in Malaysia. BERNAS currently controls about 24% of the paddy market and 45% of the local rice demand (BERNAS, 1996).

BERNAS was privatised in January 1996 and assumed the role of Lembaga Padi dan Beras Negara (LPN) as guardian of the local rice industry. BERNAS plays a major role in overseeing the development of the rice industry, while taking social and commercial responsibilities previously undertaken by the LPN. This includes representing the government in the management and disbursement of subsidies to farmers, managing Bumiputra Rice Milling scheme, buying rice from farmers at a guaranteed minimum price and acting as a buyer of last resort of rice from farmers.

BERNAS continues to grow through the integration of supply chain with the operators at the international level for the wholesale sector, farming, processing and distribution. To increase its presence along the entire industry supply chain, the BERNAS Group is now involved in seed and farming activities, international rice joint ventures, as well as rice complementary businesses.

As a corporate body, BERNAS is responsible for ensuring the continued supply of rice at affordable prices to the people of Malaysia, and to optimise the supply chain, infrastructure and distribution network. The group of companies under the umbrella of BERNAS also pay attention to environmental management through an emphasis on the effective removal of rice husk as well as diversification of products to maximise the potential of its by-products.

1.5.2 Process Flow of Rice Production

Rice needs to go through many processes before it can be marketed to customers. Rice requires various processes in order to have a good quality and good appearance. Figure 1.1 shows the process flow from harvest to packaging stage. Paddy which has been harvested is loaded onto a lorry and transported to Kilang Beras Bernas (KBB). The wet paddy is weighed and graded in the factory. Wet paddy has 20 to 25% moisture content (BERNAS, 1996). The wet paddy is sent to the rough cleaner to undergo cleaning process, which helps to separate paddy from paddy straws and other impurities.

After that, the wet paddy is sent to Inclined Bed Dryer (IBD) to undergo drying process. The paddy must be dried until the moisture content is reduced from the original 20 to 25% down to 14% (Cheenkachorn, 2007). If the paddy is overdried to less than 14% moisture content, the paddy will break easily. After the completion of the drying process, the dried paddy has to go through one more cleaning process before it is stored in the silo.

From the silo, the paddy is sent for another cleaning process to remove foreign materials such as sand particles, stones, straws, seeds and others from paddy; this is the first step in the milling process. Cleaning not only produces clean rice but also protects the milling machinery and increases milling capacity. Then, the paddy is sent to Rubber Huller Separator to remove the husk from the paddy, with minimum damage to the grains (brown rice). At Paddy Separator, any remaining paddy is separated from paddy grains (separate paddy and brown rice). Then, the rice is separated from stones in a Destoner machine. The process of removing the outer and sometimes inner bran layer is commonly referred to as “whitening” or polishing. However, polishing refers to the process of removing small bran particles that stick to the rice surface after whitening and gives the rice grains a shiny appearance.

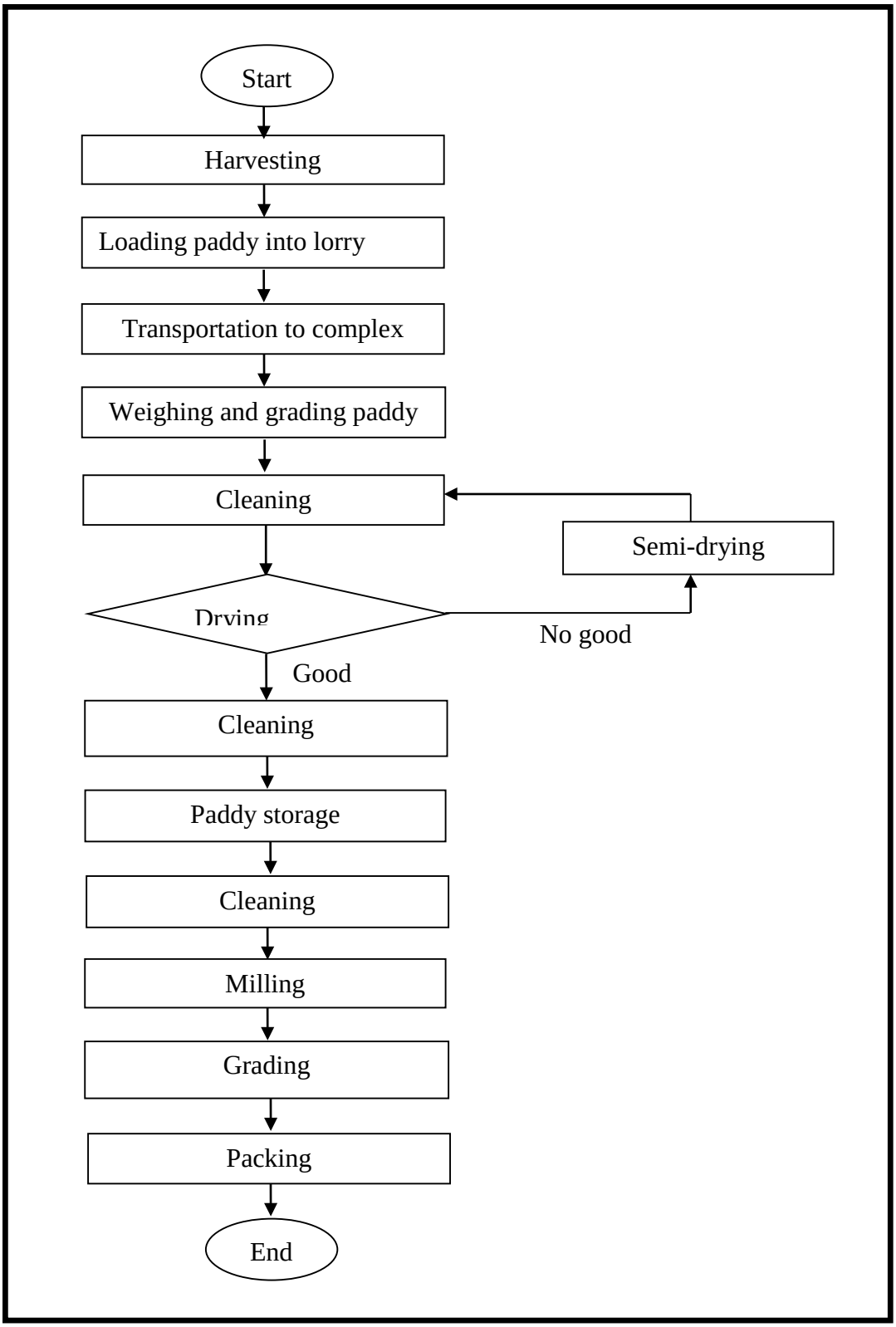

Figure 1.1: Paddy process flow chart

The rice is still mixed with broken rice of different sizes, bran and dust. Separation of these particles after whitening is termed “grading”. The degree of grading is determined by the rice market or consumer preference. The function of Rotary Flat Sieve is to separate temukut, head rice from broken rice. The head rice is separated from broken rice in the Cylindrical Grader machine. The broken rice is further separated into the coarse and fine categories. The grade of rice is determined by the percentage of head rice and broken rice in a particular portion; the grading is done at volumetric measure. The graded rice is sent to be packaged in the weights of 10 kg, 50 kg, 100 kg, and 1 ton, which are then sold in the market.

1.6 Expected Outcomes

The expected outcomes of this study are (i) to save time in drying the wet paddy, (ii) improve the quality of rice processed by using HWG system, and (iii) preserve the quality of rice processed by using HWG system.

1.7 Organization of the Study

The content of this study is organised as follows; Chapter 1 serves as an introduction to the study. Chapter 2 summarises the literature review related to the paddy drying system, which includes previous studies on the issues and problems of drying systems. Chapter 3 describes the data used in this study and explains the methodology. Chapter 4 discusses the results from the analysis and Chapter 5 summarises the findings of this study.