COMPARISON FOR WATER PUMP PRIME MOVER FOR IRRIGATION OF PADDY FIELD SYSTEM ON JABATAN PENGAIRAN DAN SALIRAN MALAYSIA (JPS)

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"I admit that I have read this report and I found that it is suffice from the aspect of scope and quality to pass the
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This work is dedicated to my beloved emak ayah, sister and brother, you all are my inspiration, to "my girl" thanks for the supports and a true love. For my friend always remember "we are the best"

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ABSTRACT

There are three types of prime movers namely, electric motor, diesel engine with gear box transmission and diesel engine with hydraulic drive, this study is to justify the most economic prime mover in term of its operational cost. The operational cost it divided into two components which are cost hectare per meter and maintenance cost. To determine the value of hectare per meter, design of pump house with the pipeline was first considered .Cost of hectare per meter is then determined by calculating the power consumed to irrigate water to the paddy field. These included the electricity and diesel oil calculation for each prime mover. The maintenance cost is involved the price of spare part for the prime mover i.e strainer, engine oil, air filter and etc. The lowest operation cost among the three prime movers is electric prime mover at the amount of RM 66.34, this follow by the diesel engine with gear box transmission at RM 112.91 and the most expansive prime mover is diesel engine with hydraulic transmission at RM129.17

ABSTRAK

Kajian ini dibuat bagi mencari prime mover yang ekonomik dari segi kos operasinya. Antara jenis prime mover yang digunakan adalah jenis motor elektrik, enjin diesel dengan transimisi kotak gear dan enjin diesel dengan transimisi pacuan hidraulik. Didalam kos operasi ini terbahagi kepada dua banagian iaitu kos hektar per meter dan kos penyelengaraan.

Untuk mendapatkan nilai kos hektar per meter pelbagai pengiraan harus dibuat.dan rekabentuk bagi rumah pam juga dibuat. Kos hektar per meter adalah pengunaan kuasa yang diperlukan untuk mengairi sesebuah sawah padi.samada kuasa elektrik atau penggunaan minyak diesel bagi setiap prime mover. Kos penyelengaraan pula merangkumi harga alat ganti bagi setiap prime mover.

keputusan bagi analisis ini dibuat dengan mengambil kira kos operasi yang paling murah diantara ketiga- tiga prime mover. Prime mover yang paling murah kos operasinya ialah jenis motor elektrik sebanyak RM 66.34 diikuti dengan prime mover jenis enjin disel dengan transimisi kotak gear sebanyak RM 112.91. dan prime mover yang paling mahal kos operasinya ialah prime mover jenis enjin disel dengan pacuan hidraulik iaitu sebanyak RM 129.17

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LIST OF SYMBOLS

SYMBOL	DEFINITION
H_T	Total Head
H_f	Friction Head
A	area
D	Diameter
L	Length of pipe
Q	Volume flow
n	Joint time
P_i	Input power
P_o	Output power

GREEK SYMBOL	DEFINITION
θ	Total angle
η	efficiency

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Irrigation system of paddy field

A good Paddy irrigation system is very important to get the good paddy. One of the main functions of the JPS Malaysia is to promote paddy cultivation in this country by means of efficient irrigation system.

Pump is used to pumping water from river, canals, and drains by using irrigations pumps. To irrigate the paddy cultivation, a pump system is design. Which constitute a pump, prime mover and the piping system

There are a three type of water pump available in JPS Malaysia i.e. axial flow pump, mixed flow pump and radial flow pump. All the irrigation pump used in JPS Malaysia are rotor dynamic pump which constitute a set of rotating vanes called impellers, enclosed in a casing and used to continuously impart energy to the water eventually lift the water from a lower level to a higher level.

A pump can only work when driven by a prime mover, such as electric motor, diesel engine with gear box transmission and diesel engine with hydraulic drive.

1.2 Problem Statement

Today there are only three type of prime mover used in JPS Malaysia. These are electric motor type; diesel engine with hydraulic driven and diesel engine with gear box transmission prime mover is used to generate the power to the pump in order to suck water from river and irrigates it to the paddy field. For this reasons prime mover is one of most important components in the pumping system.

In conjunction to this there is no information showing which prime mover is the most economic one especially in term of the operation of cost for irrigates water to a specific paddy field. The operational cost will involved the cost per hectare meter

The operation cost involve the analysis of the power used because the power input into the system either in the form of electricity or diesel and hydraulic oil will cost the system at a significantly amount in a long run . It may also involve maintenance cost as well

1.3 Objective

Base on the stated problems, the aim of this project is to archive three objective as follow:-

1. To study an irrigation system for a specific paddy field

2. To make a comparison of operation cost between three type of prime mover available in JPS Malaysia

3. To suggest the most economic prime mover for the specific irrigation system.

1.4 Scope of study

This project will involve the pump system design for paddy cultivation. The main cost involve in the system are operational cost. The pump will be drive by using the electric motor, diesel engine with gear box transmission and hydraulic drive prime mover.

Operational cost contains the cost per hectare meter for the electric prime mover, diesel engine with gear box transmission and diesel engine with hydraulic drive Maintenance cost for the prime mover will be containing in this calculation. prime mover used to drive a water pump in order three type of pump involved are axial pump, radial pump and mixed pump. The area of paddy field to be irrigated in this analysis is 1500 hectares. The most economical prime mover in term of operation its cost was justified.

1.5 Pump

Today, only three type of water pump in JPS Malaysia. Pump may be classified in many ways either the pump recognize by the prime mover or by the water flows through the pump impeller

1.5.1 The type of pump recognize by the prime mover

a) End suction-centrifugal: the most common type of pump. Typically the pump is "close-couple" to an electric motor,that is the pump is mounted right on the end of the motor's drive shaft and the pump case is bolted straight into the motor so that it looks like a single unit. The water typically enters the pump through a 'suction inlet' centered on one side of the pump. And exits at the top. Almost all portable pumps are end-suction centrifugals. If the pumps isn't one of the next two types,then chances are it is an end-suction centrifugal. This type of pump needs to be installed on a pad above the high water level if pumping from a lake or river.(Kursus pam Air,1997,JPS Malaysia)

b) Submersible pumps : are installed completely underwater, including the motor.

The pump consists of an electric motor or and pump combined in a single unit. Typically the pump will be shaped like a long cylinder so that it can fit down inside of a well casing. Although most submersibles are designed to be installed in a well, many can also be laid on their side on the bottom of a lake or stream. Another common installation method for lakes and rivers is to mount the submersible pump underwater to the side of a [illegible]'t need to be primed

since they are already under water. They also tend to be more efficient because they only push the water, they don't need to suck water into them. Most submersible pumps must be installed in a special sleeve if they are not installed in a well, and sometimes they need a sleeve even when installed in a well. The sleeve forces water coming into the pump to flow over the surface of the pump motor to keep the motor cool. Without the sleeve the pump will burn up. Because the power cord runs down to the pump through the water it is very important that it be protected from accidental damage. You wouldn't want a boat tangled up in the cord or a snapping turtle to bite through it (Kursus Pam Air, 1997, JPS Malaysia)

However the hydraulic prime mover uses the submersible pump like the electric prime mover.

1.5.2 Type of pump which water flows through the pump impeller

in the table below shown the type of water pump and specification

On the table below shown the type of pump and the function

Table 1.1: type of pump and its function

PUMP TYPE	SPECIFICATION
AXIAL FLOW PUMP	For high head value and low discharge
MIXED FLOW PUMP	For medium head value and discharge
RADIAL FLOW PUMP	For high head value and low discharge

1.5.3 Component of pump

Stripped of all smaller refinements a typical irrigation pump has two main parts:-

a) rotating components and it contains a impeller and shaft

b) stationery component and its contains a casing ,bearing and stuff box

The table below gives a summary of the function of each component and some common terms used by the pump manufactures to describe them:-

Table 1.2: The Function of Each Component

COMPONENTS	MAIN FUNCTION
Impeller	Impart energy into water
Shaft	Transmit torque from prime mover to impeller, support weight and thrust force
Casing	As guide for following water, convert velocity energy of water into pressure energy
Stuffing box	Prevent pump against leakage where shaft passed out through pump casing
Bearing	Keep shaft in alignment

1.6 Prime Mover

A pump can only work when driven by a prime mover such as electric motor, diesel engine with gear box transmission and diesel engine with hydraulic drive. In JPS Malaysia diesel engine with gear box transmission is a older prime mover. The electric motor and diesel engine with hydraulic prime mover is a new application.

Table 1.3: Type of prime mover and the function

TYPE OF PRIME MOVER	FUNCTION
DIESEL ENGINE WITH GEAR BOX TRANSMISSION	Usually low and medium speed heavy duty engine. most commonly used in JPS
A.C ELECTRIC MOTOR	Usually used in places where electricity supply is available
DIESEL ENGINE WITH HYDRAULIC DRIVE	Diesel engine with Hydraulic pump, hydraulic motor, water pump and other hydraulic accessories. Only used at certain unusual site conditions.

1.7 Pipe Line

Pipe line is an important thing in the pump system design. It used to irrigate the water from the inlet pump to the discharge. However pipe line may cause the friction losses. Generally the pipe line contains two types of pipe lines it is a suction line which includes intake strainer, suction pipes or hose and foot valve and the second one is delivery lines it include sluice valve, siphon breaker, delivery pipes or hoses. So pipe line calculation important for this analysis (http://aquanic.org /pubicat/ usda_rac /efs/srac/373fs.pdf
J.David Bankston Piping Systems)

1.8 Friction Head or Losses Head

The friction head is the pressure loss (in feet of water) caused by friction resistance when waterfowls through pipe, fittings, valves, etc. This loss is directly dependent on the length of the pipe and the number of fittings. Pipe twice as long as another pipe of the same diameter with the same water flow would have twice the friction loss and require twice the power to overcome the loss. The friction losses vary approximately as the velocity squared. Thus, like the velocity head they are very dependent on pipe diameter – the smaller the pipe the more losses (pressure drop) and the more pumping power required to move the same amount of water. Friction losses for pipe are quite often given as the loss in feet of water at a given flow rate for a 100 foot length of pipe (http://aquanic.org /pubicat/ usda_rac /efs/srac/373fs.pdf J.David Bankston Piping Systems)

CHAPTER 2

METHODOLOGY

In order to justify the most economical prime mover, the operational of operation cost contains cost per hectare meter and the maintenance cost. In cost per hectare the calculation involve the value for output power, input power, total head, Specific Fuel Consumption, for the maintenance cost it is involve the lubrication oil, filter rate for diesel engine, coil, bearing for electric motor and suction strainer and in line filter for the hydraulic prime mover.

in order to calculated the operational cost, total head is first determined. Then followed by output power, input power, SFC, overall efficiency, time, and cost per hectare per meter figure 2.6 show the layout of this calculations

2.1.1 Total Head

Total head is the total energy required to lift unit weight of water from upstream to downstream. Its formula contains of static head and losses head, total head= static head + losses head. Value of total head will be applied in output power calculation.(International Course On Irrigation System Management Pump Technology, October 2003 Muhammad Suhaimi B.Mohd Ali, JPS Malaysia)

TOTAL HEAD = STATIC HEAD + LOSSES HEAD (m)

2.1.2 Static head

Static head the elevation difference between the free surface water level at downstream and at upstream. Static head can also be defined as the increase in potential energy when unit weight of water is pumped from upstream to downstream. In this layout the value of static head is 7.5 m because author assume that this analysis will be run in the same layout with different pump and prime mover (International Course On Irrigation System ManagementPump Technology, October 2003 Muhammad Suhaimi B.Mohd Ali, JPS Malaysia