DEVELOPMENT OF LOW POWER AIR-CONDITIONING USING WATER CHILLED SYSTEM

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“I admit to have read this report and it has followed the scope and quality in Partial Fulfillment of Requirement for the Degree of Bachelor of Mechanical Engineering (Thermal Fluid)”

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AGREEMENT

"I agree that this report is my own work except for some summaries and information which I have already stated"

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Date	: APRIL 2009

Untuk Ibu Dan Ayah Tersayang….
Hanya Engkau Sahaja Ilham hidup Ku….
Akan Ku Buktikan Kepadamu….
Yang Aku juga boleh Berjaya seperti Orang lain….

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ABSTRACT

Nowadays, most of the building was using the air conditioning refrigeration systems for a cooling down the temperature inside of the room. However, the air conditioning refrigeration systems is using more electric consumption. To reduce electric consumption, researcher in Thermal energy storage was already done for reduce energy costs by allowing energy intensive. A survey of approximately 25 manufacturers was already using thermal energy storage also know as “Ice ball Thermal energy storage”. The oldest form of energy storage involves harvesting ice from lakes and a river, which was stored in well insulated warehouses and sold or used throughout the year for almost everything. In Generally, Cool storage technology can be used to significantly reduce energy costs by allowing energy intensive, electrically driven cooling equipment to be predominantly operated during off-peak hours when electricity rates are lower. For this studying, investigates about the applications, methodology, components of the ice ball thermal energy, advantages and disadvantages of this system would be discuss and explained.

ABSTRAK

Pada masa kini, kebanyakan bangunan adalah menggunakan sistem penyejukan penyamanan udara untuk menyejukkan suhu di dalam. Bagaimanapun, Sistem penyejukan penyaman udara menggunakan lebih tenaga elektrik. Untuk mengurangkan penggunaan tenega elektrik, penyelidik dalam penyimpanan tenaga haba telah pun dibuat untuk mengurangkan kos tenaga dengan membenarkan tenaga intensif. Satu kajian kira-kira 25 orang pengeluar adalah telah menggunakan terma simpanan tenaga juga diketahui sebagai "*Ice ball Thermal energy storage*". Penyimpanan tenaga sejuk adalah bentuk paling lama simpanan tenaga melibatkan menuai ais daripada tasik-tasik dan sebatang sungai, yang telah disimpan dalam gudang-gudang betul-betul ditebat dan berjual atau terpakai sepanjang tahun. Secara umumnya, teknologi penyimpanan tenaga sejuk boleh digunakan untuk mengurangkan kos tenaga dengan membenarkan tenaga intensif, kelengkapan penyejukan elektrik dipandu menjadi lebih banyak beroperasi semasa waktu tidak sibuk apabila kadar elektrik adalah rendah. Untuk pembelajaran ini, kajian mengenai aplikasi-aplikasi, kaedah, komponen-komponen menyejukkan tenaga haba bola, kelebihan-kelebihan dan keburukan-keburukan sistem ini akan dibincangkan dan dihuraikan.

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ρ	Density
C_p	Constant Pressure
K	Thermal Conductivity
α	Thermal Diffusivity
ω	Specific Humidity
m_a	mass
$\dot{m}$	Specific mass flow rate
ϕ	Relative humidity
V	Volume
T	Absolute Temperature
υ_{υ}	Specific volume
P	Pressure
μ	Dynamic viscosity, head coefficient, Degree of saturation
h	Enthalpy
f_g	Heat-transfer coefficient of the air film around the wetted surface
A	Area
k_d	Mass transfer coefficient of water vapor
h_{fg} '	Enthalpy of vaporization
Q_L	Latent heat transfer
Q_S	Sensible heat transfer
Q	Heat transfer rate
W	Work
COP	Coefficient of Performance
h	Enthalpy

CHAPTER I

INTRODUCTION

1.1 Background of Study

Nowadays, refrigerator system is most popular used at many home in this world compare than Thermal Energy storage System (TES). As we know, air conditioning was used for cooling down the temperature in the room, and the same time could heat the room depend on the situation. However, power usage per unit kW per hour (kW/h) is big and than need more energy to generate it.

However, system Thermal Energy Storage (TES) was already produced to overcome these problems. In general, Energy storage is employed in solar thermal energy systems to shift excess energy produced during times of high solar availability to times of low solar availability. Two situations exist in solar energy system design where energy storage may be needed; for the situation in which some of the solar thermal energy produced during the day is stored for use later during the night, and to provide energy during events such as cloudy days.

Ice Balls thermal storage is an initiative to overcome these high power usage problems. Actually, Ice Balls thermal storage is created to change air conditioning using refrigerant (R132) and change it to cool water using chilled water. Ice thermal storage is an electric load shifting technology used to reduce cooling energy costs. Working is like a battery, an ice storage system stores cooling energy at night when electric costs are low and uses that stored energy to cool a building the next day when electric costs are high. Depending on the situation, type of installation and off-

peak electric rates available, ice storage can cut electric cooling costs dramatically. In addition, ice storage shifts cooling loads from low efficiency peaking generators during the day to high efficiency base load generators at night, thereby reducing fossil fuel use and air pollution.

1.2 Objective

Consist of several objectives regarding to the title of this project. The objective is:

1. To develop “saving power energy using Ice ball Thermal storage system”
2. To Determine the Coefficient of Performance (COP) of Ice ball Thermal storage system.

1.3 Scope

Scope of this title is:

1. To produce Split unit for ice ball thermal energy storage system.
2. To compare rate cooling can be remove within building with air conditioning split unit system.
3. Literature review based on the Journals, article, and other references.
4. To describe about operation of the ice ball thermal energy storage system.
5. To make comparison between refrigeration systems with thermal energy storage system.
6. To describe about components is needed in thermal energy storage.
7. To describe advantages and disadvantages of this system compare to the air conditioning refrigeration system.

1.4 Problem Statement

Power electric energy is most important thing and very useful for daily activity. However, electric power must be control for make sure no wasting in power energy. For control the electric power, a researcher was already done produce some product like are solar energy and thermal energy storage system for avoid wasting in power electric energy.

Nowadays, for saving the power electric energy, solar energy is used. Where solar energy can absorbs energy from sun energy. So, when the night time the energy from the solar will be used, for instance is for generate the light of the lamp. Talking about the sun energy, building or room would be hot when exposed to sun energy. For this case, refrigeration system or air conditioning system is used for cooling down the temperature of the building or room. But, how long these system will be used.

From the research of power electric energy usage, electric energy rate is highest begin 8am until 5pm just for air conditioning system. So, for solve this case or electric usage problem, ice ball thermal energy storage system is used for replace the air conditioning system.

1.5 Analysis the Problem

Refrigeration system is used for cooling down the temperature inside of the room or building. However, this system consists of several problems and the main problem is rate of electric energy usage is highest or electric consumption is big.

1.6 Important of the Project

Main source of energy was already exist in the world can not be neglect but could be change with new source of energy. Ice ball thermal energy storage system is one system where can be improve the performance of air conditioning refrigeration

system. Same like the refrigeration system, fresh air and cool air could be produce using this system, and just the component in both systems is different. From this research, we would know advantages and disadvantages using the refrigeration system and the same time will know the advantages disadvantages using ice ball thermal energy storage system. Furthermore, we also would know components is needed is this system.

CHAPTER II

LITURATURE REVIEW

2.1 A Short History of Energy Storage

The oldest form of energy storage involves harvesting ice from lakes and rivers, which were stored in well insulated warehouses and sold or used throughout the year for almost everything, we use mechanical refrigeration for today, including preserving food, cooling drinks, and air conditioning.

Chemically-charged batteries became quite common in the mid-nineteenth century to provide power for telegraphs, signal lighting, and other electrical apparatus. By the 1890s central stations were providing both heating and lighting, and many did both. Electric systems were almost all direct current (DC), so incorporating batteries was relatively easy. In 1896, Toledo inventor Homer T. Yaryan installed a thermal storage tank at one of his low temperature hot water district heating plants in that city to permit capturing excess heat when electric demand was high. Other plants used steam storage tanks, which were not as successful for some reason.

Other forms of energy storage were used to power street cars in the 1890s, including compressed air and high temperature hot water that was flashed into steam to run a steam engine. Electric cars and trucks were quite common prior to World War I until gasoline-powered internal combustion engines ran them off the road.

Energy storage has always been closely associated with solar installations, including both solar heating and photovoltaic (PV) applications. Today you can find compressed air storage, batteries, chilled and hot water storage, ice storage, and the occasional fly well in use, all designed to meet one or more of the purposes listed above. Many utilities provide incentives for energy storage applications, while time-of-day rates and stiff demand charges also entice customers to consider these opportunities

2.2 Explanation about Literature Review

Research about cooling system was already done by a researcher in several methods for cooling purpose. However, many types of cooling system were using high electric energy for instance is refrigerant system. In most journals about cooling system, researcher had been writing down the several types of systems regarding to the cooling system. There are refrigeration systems and the thermal energy systems like ice ball thermal energy storage. In journal about the ice ball thermal energy storage, researcher had been discuss about many kind of problems encountered regarding to the accomplished the new system. However, researcher was created one system where could overcome the main problem, there is a high demand electric energy.

Nowadays, ice ball thermal energy storage system is most popular used in a building for cooling purpose compare than the refrigeration system. This is because, with using this system, rate of electric energy per day could be decrease.

Therefore, in this research which is regarding to the ice ball thermal energy storage system, the author would be produce one split unit ice ball system for make comparison between ice balls system in a building with ice ball system in a split unit. For execute and for easily this task, the author would explain about the ice ball thermal energy storage system in a building first.

2.3 Ice Ball Thermal Energy in a Building.

2.3.1 Water Based Technology

Thermal energy storage is made practical by the large heat of fusion of water. One metric ton of water, just one cubic meter, can store 334 MJ (317 k BTUs, 93kWh or 26.4 ton-hours). In fact, ice was originally transported from mountains to cities for use as a coolant, and the original definition of a "ton" of cooling capacity (heat flow) was the heat to melt one ton of ice every 24 hours. This is the heat flow one would expect in a 3,000 square foot house. Either way, an agreeably small storage facility can hold enough ice to cool a large building for a day or a week, whether that ice is produced by anhydrous ammonia chillers or hauled in by horse-drawn carts.

2.3.2 Economics

Ice ball thermal energy storage can be used for reduce electric power per day. A kilowatt-hour of electricity consumed at night can be produced at much lower marginal cost. Utilities have begun to pass these lower costs to consumers, in the form of Time of Use (TOU) rates, or Real Time Pricing (RTP) Rates. Thermal energy is cheaper than any other energy source. Unfortunately, since using the refrigeration system as air conditioning, rate of electric energy demand is higher and is responsible for creating extraordinarily high prices in the electricity business.