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AN INVESTIGATION OF ENERGY UTILIZATION AND ENERGY SAVING
IN TEXTILE INDUSTRY

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 Saving in Textile Industry

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บทคัดย่อ

วิทยานิพนธ์นี้ได้ศึกษาการใช้พลังงานและหาแนวทางที่เหมาะสม เพื่อการประหยัดพลังงาน ในโรงงานตัวอย่าง

การวิจัย เริ่มต้นด้วยการศึกษาข้อมูลในอดีตที่เกี่ยวข้องกับพลังงานที่ใช้และผลผลิตที่ได้ เพื่อดูแนวโน้มของการใช้พลังงาน อันดับต่อมาได้ศึกษาสภาพการบริหารพลังงานที่เป็นอยู่และได้เสนอให้จัดตั้งคณะกรรมการ เพื่อการประหยัดพลังงาน โดยมี "ผู้จัดการพลังงาน" ที่ทำงานเต็มเวลา เป็นผู้รับผิดชอบโดยตรงในการประสานงานและดำเนินโครงการ นอกจากนี้ ได้วิเคราะห์ระบบพลังงานของโรงงานโดยแบ่งการศึกษาออกเป็น 2 ภาค คือ ภาคไฟฟ้า เน้นเรื่อง เส้นกราฟของโหลด, ระบบแสงสว่าง, และระบบปรับอากาศ และภาคความร้อน เน้นเรื่องประสิทธิภาพของการสันดาปและการใช้ไอน้ำ

จากการศึกษาได้พบแนวทางที่สามารถประหยัดพลังงานในระบบต่าง ๆ พลังงานที่ประหยัดได้มีค่าประมาณ 10 เปอร์เซ็นต์ของพลังงานทั้งหมดที่ใช้อยู่ในปัจจุบัน การวิเคราะห์ทางเศรษฐศาสตร์ได้แสดงให้เห็นว่าแนวทางประหยัดพลังงานเหล่านี้มีระยะ เวลาคืนทุนที่สั้น

การประหยัดพลังงานสำหรับโรงงานนี้ยังมีช่องทางที่สามารถทำได้อีก จุดที่น่าสนใจ ได้แก่ การลดของเสียในกระบวนการผลิต, การเลือกใช้ระบบอุปกรณ์ที่ล้ำสมัยและใช้พลังงานมาก, การเลือกสภาวะ (อุณหภูมิ, ความดัน, เวลา, ฯลฯ) ที่เหมาะสมที่สุดสำหรับแต่ละขั้นตอนของกรรมวิธีการผลิต, และการลงทุนใช้เทคโนโลยีใหม่ในกระบวนการผลิต

Thesis Title An Investigation of Energy Utilization and Energy
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ABSTRACT

This thesis investigated the energy utilization in a selected plant and identified the energy conservation opportunities (ECOs) existing throughout the factory system.

In the first phase of this study, historical data concerning energy and production capacity were collected and analyzed to determine the trend of energy consumption. The current status of energy management was then investigated and it was found that an energy conservation committee, with a full-time "energy manager" responsible for energy matter of the plant, is necessary to handle the energy program. Finally, the energy system was categorized for detailed study, into two (2) major sections. The electrical section emphasized the load curve, the lighting system, and the air-conditioning system. The thermal section emphasized the combustion efficiency and steam utilization.

According to the study, the ECOs were identified for each energy consuming system. The amount of energy savings that can be anticipated by the opportunities that were found could result in a reduction of

almost ten (10) percent of the total energy required by the entire plant. The economic analysis indicated that investment for these energy saving measures can be recovered within a short period of time.

Additional energy savings is possible for this plant. The challenging ECOs worth studying include reduction of waste material and defective products, elimination of the inefficient obsolete equipment that consumes a great amount of energy, optimization of processing conditions, and investment on modern technology for the manufacturing process.



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LIST OF ABBREVIATIONS



A	Area, m ²
A	Quantity of air required by actual combustion, Nm ³ per kg of fuel oil.
A/C	Air conditioning
avg	Average
bb1	Barrels (1 tonne of fuel oil is approximately 6.6 barrels)
bpd	Barrel per day
Btuh	British Thermal Unit per hour or Btu/hr
C _b	Specific heat of blowdown, kcal/kg °C
C _c	Specific heat of polymer chip, kcal/kg °C
C _d	Specific heat of dryer, kcal/kg °C
CF	Cash flow, baht
C _f	Specific heat of fuel oil, kcal/kg °C
C _g	Average specific heat of dry flue-gas, kcal/Nm ³ °C
C _l	Specific heat of solid lactam, kcal/kg °C
C _m	Specific heat of monomer, kcal/kg °C
(CO ₂) _{max}	Volume fraction of carbon dioxide found from laboratory analysis
C _{pfw}	Specific heat of feedwater, kcal/kg °C
C _w	Specific heat of water, kcal/kg °C
C _{ww}	Specific heat of waste water, kcal/kg °C
d	Day
G	Quantity of actual dry flue-gas, Nm ³ /kg
G _o	Quantity of theoretical dry flue-gas, Nm ³ /kg
H _l	Low heating value of fuel oil, kcal/kg

hr	Hour
HP	Horse power
h_1	Enthalpy of water at reference temperature, kcal/kg
h_2	Enthalpy of steam produced, kcal/kg
i	Effective interest rate, %
k	Thermal conductivity, Btu/(hour) (sq ft) (one inch) (deg F)
L_1	Heat of fusion of solid lactam, kcal/kg
m	Excess air coefficient or air ratio
m_c	Weight of polymer chip, kg
m_d	Weight of dryer, kg
m_f	Weight of fuel oil, kg
mo	Month
\dot{m}_1	Molten lactam flow rate, kg/hr
\dot{m}_m	Mass flow rate of monomer, kg/hr
\dot{m}_s	Steam flow rate, kg/hr
\dot{m}_w	Water flow rate, kg/hr
\dot{m}_{ww}	Mass flow rate of waste water, kg/hr
n	Payback period, month
NBS	The National Bureau of Standards
O.T.	Overtime
P	Initial investment, baht
Q	Heat loss from equipment, kcal/hr
Q	Heat gain to the air-conditioned space, Btuh
Q_b	Heat loss due to blowdown, kcal/hr
Q_{fe}	Chemical heat in the fuel "as fired," kcal/hr
Q_{fp}	Heat credit supplied by preheated fuel oil, kcal/hr
Q_g	Heat loss due to dry flue-gas, kcal/hr
Q_s	Heat of steam produced, kcal/hr

q_s	Specific enthalpy of vapor, kcal/kg
Q_w	Heat credit supplied by feedwater, kcal/hr
R	Resistance to flow of heat, (hour) (sq ft) (deg F)/Btu
SV	Salvage value, baht
t	Useful life of equipment, year
T_1	Room temperature, °C
t_b	Temperature of blowdown, °C
T_d	Drying temperature, °C
t_f	Temperature of fuel oil before combustion, °C
t_{fw}	Temperature of feedwater, °C
t_g	Temperature of dry flue-gas, °C
t_i	Reference temperature, °C
T_1, T_{l_1}	Melting point of solid lactam, °C
U	Overall heat transmission coefficient, Btu/(hour) (sq ft) x (deg F)
W	Electric energy input, kWh
W_b	Quantity of blowdown, kg/hr
W_f	Measured fuel oil flow rate, kg/hr
W_s	Net quantity of steam produced, kg/hr
W_w	Feedwater flow rate, kg/hr