

EFFECTS OF ENVIRONMENTAL  
ERGONOMIC FACTORS TOWARDS  
MUSCLES ACTIVITIES FOR LIFTING TASK

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We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science in Industrial Safety and Health.

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRAK

Industri getah merupakan salah satu industri yang dominan, menyumbang kepada pertumbuhan ekonomi Malaysia. Pada masa ini, kebanyakan proses pengeluaran dalam industri getah adalah secara manual atau semi-automatik. Kajian ini menyiasat tentang kesan faktor persekitaran ergonomik terhadap aktiviti otot manusia, yang melibatkan pencahayaan dan suhu sekeliling. Ia diuji semasa pekerja melaksanakan aktiviti mengangkat untuk memuatkan dan memunggah dengan beban tetap 25kg. Korelasi antara aktiviti otot dengan tahap pencahayaan dan suhu yang berbeza kemudiannya dianalisa. Untuk fasa pertama, pengukuran di lapangan kerja telah dijalankan di satu industri getah terpilih yang terletak di Temerloh, Pahang. Tahap suhu dan pencahayaan dicatatkan untuk memperoleh data sebenar semasa pekerja melaksanakan tugas. *Meter Lux* dan *Wet Bulb Globe Temperature* telah digunakan dan prosedur operasi standard peralatan telah diikuti. Sembilan titik sampel telah dikenalpasti berdasarkan zon kerja sebenar. Selang masa untuk bacaan suhu dan pencahayaan adalah sepuluh minit. Data ukuran dan pemerhatian ini digunakan dalam fasa kedua. Selepas itu, kajian di makmal bagi fasa kedua dijalankan di *Ergonomic Simulation Chamber* yang terletak di Universiti Malaysia Pahang. Enam responden dipilih secara rawak untuk menyertai kajian ini. Semua responden diminta mensimulasikan aktiviti kerja yang sama yang seperti dilakukan di bahagian pengeluaran industri getah. Seterusnya, *Surface Electromyography (sEMG)* digunakan untuk mengukur aktiviti otot semasa melakukan kerja mengangkat. Isyarat elektronik diletakkan pada responden kiri dan kanan atas badan termasuk trapezius kanan, bisep brachii kanan, trapezius kiri, dan bisep kiri brachii. Tiga persekitaran ergonomik yang berbeza iaitu suhu 20°C, 24°C dan 32°C dan pencahayaan pada 200, 1500 dan 1000lux telah ditubuhkan. Semua data dikumpul dan dianalisis dengan menggunakan *Microsoft Excel*. Dalam kajian ini, setiap responden menjalankan tugas (memuat dan memunggah bebanan 25kg) dengan sembilan suhu dan pencahayaan yang berbeza. Keputusan menunjukkan bahawa, dengan manuver yang berulang menggunakan beban 25kg pada 19°C dan 32°C, otot badan kanan dan kiri lebih cenderung untuk mengalami keletihan berbanding dengan suhu 24°C pada tahap 200lux, 500lux dan 1000lux. Malah, terdapat hubungan yang ketara antara tahap keletihan badan kanan dan kiri atas dengan suhu 19°C dan 32°C, dan pencahayaan 500lux. Hal ini disebabkan oleh pendedahan yang berpanjangan dan kerja berulang semasa menjalankan aktiviti memuat dan memunggah. Tahap suhu dan pencahayaan yang optimum untuk kerja mengangkat secara berulang adalah pada 24°C dan 500lux. Kajian ini mengesahkan; suhu 24°C adalah suhu yang sesuai untuk pekerja untuk melaksanakan tugas sementara tahap pencahayaan tidak banyak mempengaruhi responden dalam perlaksanaan tugas mereka.

## ABSTRACT

The rubber industry is one of the dominant industries, contributing to the growth of the Malaysian economy. Currently, most of the production processes in the rubber industry are either manually operated or semi-automatic. This study investigates the effect of ergonomic environmental factors, which are including lighting and temperature with human muscle activity. It was tested while workers performing the lifting activity for loading and unloading with a constant load of 25kg. The correlation between muscle activities with different illuminance and temperature level had been analysed. For the first phase, fieldwork measurement had been conducted at one selected rubber industries located in Temerloh, Pahang. Temperature and illuminance level were recorded to obtain the actual data while workers performing the task. Lux meter and Wet Bulb Globe Temperature was used and equipment standard operating procedure had been followed. Nine sampling points had been identified based on actual working zone. Interval for both temperature and illuminance readings is ten minutes. This actual measurement and observations data is used in phase two. Subsequently, a laboratory experiment was conducted in the Ergonomic Simulation Chamber located in Universiti Malaysia Pahang for phase two of this research. Six respondents were randomly selected to participate in the experiment. All the respondents were asked to simulate the same work activities which had been done in the production section of the rubber industry. Next, Surface Electromyography (sEMG) was used to measure muscle activities while doing lifting work. An electronic signal was placed at respondents left and right upper body including the right trapezius, right biceps brachii, left trapezius, and left biceps brachii. Three different ergonomic environments i.e. temperature at 20°C, 24°C and 32°C and lighting at 200, 1500 and 1000lux had been set up. All the collected data were analysed by using Microsoft Excel. In this experimental study, each respondent carried out the task (loading and unloading a 25kg load) with nine different levels of temperature and illuminance. The result shows that with repeated manoeuvres using load 25 kg at 19°C and 32°C, the tendency of the body muscles for right and left to be fatigue is fast compared to the temperature of 24°C with the level at 200lux, 500lux and 1000lux. There was a significant correlation between human right and left upper body fatigue levels with the temperature of 19°C and 32°C, and lighting 500lux. This can be due to the prolonged exposure of repetitive work while performing loading and unloading activities. The optimum temperature and illumination level for repetitive lifting work were at 24°C and 500lux. This study provides confirmatory evidence; temperature 24°C is suitable for workers to perform their task while the illuminance level does not affect much.

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## LIST OF SYMBOLS

°C	Degree Celsius
%	Percentage
cm	Centimetre
Fc	Foot Candle
kg	Kilogram
m	Metre

## LIST OF ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienist
BMI	Body Mass Index
CNS	Central Nervous System
sEMG	Surface Electromyography
HSE	Health and Safety Executive
IEA	International Ergonomics Association
IESNA	Illuminating Engineering Society of North America
WBGT	Wet Bulb Globe Temperature
TLV	Threshold Limit Value
UMP	Universiti Malaysia Pahang



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