THE TREND OF AIRBORNE PARTICULATES DISTRIBUTION AT RESIDENTIAL AREAS IN RELATION TO COAL POWER PLANT IN MANJUNG, PERAK

BY

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ABSTRACT

Due to the deterioration of air quality in recent years in line with the rapid development, this study is an initiative to provide an overview of the results of the case study and report on the trends of airborne particles distribution at residential areas in relation to distance from coal power plant in Manjung, Perak. Particulate matter from Manjung coal power plant may possibly one of the decreasing health condition factors of the residents' related to respiratory besides motor vehicles, industrial activities and other sources. An 8-hour airborne sampling by using 7-hole Sampler (for total inhalable dust) and Cyclone Sampler (for respirable dust) was conducted to measure and quantify physical characteristics of airborne particulates in the site study area both indoor and outdoor. Four sampling points (housing at Teluk Rubiah, Lumut, Sitiawan and Ayer Tawar) were determined by the radius distance 5km, 10km, 15km, 20km away respectively from the coal power plant and the direction, considering the meteorological factors. For indoor mass concentration of total inhalable dust, the trend shows that 5km and 10km sampling point recorded 0.3788 mg/m^3 and 0.2575 mg/m^3, which exceed the standards for good indoor air quality by EPD (0.180 mg/m^3) compared to 15km (0.0663 mg/m^3) and 20km (0.1515 mg/m^3). As for outdoor mass concentration, the percentage of respirable dust towards total inhalable dust at 10km radius sampling point is the highest among the four sites with 97% (others ranging from 38% to 79%), due the other sources nearby like sea-port, ferry terminal to Pangkor, heavy traffic at tourism point and industrial activities. From the findings, it can be concluded that the level of airborne particulates distribution has association with the coal power plant. Although indoor air quality of the resident's house was influenced by the nearby coal power plant, however the house design and smoking habits also play the role, studies have shown. The outdoor particulate measurement at residential house in Manjung not only determined by the location or distance from the coal power plant, but the results also considering the meteorological factors and other sources around the sampling point.

خلاصة البحث

نظرا لتدهور نوعية الهواء في السنوات الأخيرة والذي كان بالموازاة مع التطور السريع، فإن هذه الدراسة تعتبر مبادرة لتقديم لمحة عامة عن نتائج دراسة حالة، وتقريرا لاتجاهات توزع الجسيمات المحمولة بالهواء في المناطق السكنية، وهذا بالعلاقة بالمسافة من محطة طاقة الفحم في مانجونج التابعة لولاية بيراك. يمكن اعتبار الجسيمات الناتجة من محطة طاقة الفحم بمانجونج إحدى العوامل المؤدية إلى تدهور صحة السكان المتعلقة بالجهاز التنفسي، وهذا بالإضافة إلى السيارات، والنشاطات الصناعية، إلى غير ذلك من المصادر الأخرى. لقد تم أخذ عينة من المواد المتنقلة بالهواء في مدة استغرقت 8 ساعات، وذلك باستعمال أداة التعيين ذات السبع حفر (للغبار القابل للاستنشاق كليا)، وأداة التعيين الإعصاري (للغبار القابل للتنفس كليا)، وهذا لقياس وتكميم الخواص الفيزيائية للجسيمات المحمولة بالهواء بكلا الوسطين الداخلي والخارجي لموقع الدراسة. لقد تم تحديد أربع نقاط لأخذ العينات (المناطق السكلنية لكل من تيلوك روبيا، وملوت، وسيتياوان، وآيير توار) من خلال مسافات أنصاف الأقطار التالية: 5كلم، و10كلم، و15كلم، و20كلم بعدا من محطة طاقة الفحم والاتجاه على التوالي، وهذا بأخذ العوامل الجوية بعين الإعتبار. بالنسبة لتركيز الكتلة الداخلية للغبار القابل للاستنشاق الكلي؛ فإن التوجه يظهر أن عينتي 5كلم و 10كلم قدمتا التسجيلات التالية: 0.3788 ملغ/م^3 و 0.2575ملغ/م^3 التي تجاوزت المعايير الجيدة لنوعية الهواء الداخلي حسب معيار EPD(0.180ملغ/م^3) وهذا مقارنة بـ 15كلم (0.0663 ملغ/م^3)، و20كلم (0.1515 ملغ/م^3). أما بالنسبة لتركيز الكلة الخارجية، فإن نسبة الغبار القابل للتنفس (97%) عند عينة مسافة نصف قطر 10كلم تعتبر الأعلى من بين المواقع الأربع (بينما تراوحت نسب العينات الآخرى ما بين 38٪ إلى 79٪)، وذلك بسبب وجود مصادر أخرى مجاورة مثل الميناء البحري، ومحطة السفن المؤدية الى جزيرة بانكور، وحركة المرور الكثيفة عند موقع السياحة، وأخيراالأنشطة الصناعية. يمكن أن نستنتج من خلال هذه النتائج أن لمستوى توزيع الجسيمات المتنقلة بالهواء علاقة بمحطة طاقة الفحم. وعلى الرغم من أن جودة الهواء في الأماكن الداخلية لتلك السكنات كان متأثرا بمحطة الفحم المجاورة، ومع ذلك فإن تصميم المنازل، وعادة التدخين تلعب دورا في ذلك على حسب ما دلت عليه الدراسات. إن قياس الجسيمات في الوسط الخارجي للمناطق السكنية بمانجونج لم يتم تعيينه بالموقع أو المسافة من محطة طاقة الفحم فقط، بل وكذلك باعتبار العوامل الجوية، والمصادر الأخرى المجاورة للموقع الذي تم أخذ العينات منه.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science (Built Environment).

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Supervisor

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science (Built Environment).

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Internal Examiner

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science (Built Environment).

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Dean, Kulliyyah of
Architecture &
Environmental Design

DECLARATION

I hereby declare that this thesis the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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Signature Date

Thanks to Allah the Almighty for His bounties and blessings throughout my whole life, and this journey of studies. Special dedication to my parents, wife, family, supervisors, lecturers, friends and others who are always be supportive and understanding.

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LIST OF ABBREVIATIONS

AED	Aerodynamic Diameter
AELA	Australian Earth Laws Alliance
API	Air Pollution Index
CAQMS	Continuous Air Quality Monitoring Station
CEMs	Climate Envelope Models
COPD	Chronic Obstructive Pulmonary Disease
CWP	Coal Workers' Pneumoconiosis
DOE	Department of Environment
DOSH	Department of Occupational Safety and Health
DOSM	Department of Statistics Malaysia
E&EPRE	Energy and Endurance Pre-Workout
ECD	Equivalent Circular Diameter
EE	Energy Efficiency
EH&E	Environmental Health and Engineering
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
EQ	Indoor Environmental Quality
EDX	Energy-Dispersive X-ray
FESEM	Field Emission Scanning Electron Microscopy
GBI	Green Building Index
HVAC	Heating, Ventilation and Air Conditioning
HVS	High Volume Sampler
IAQ	Indoor Air Quality
IEA	International Energy Agency

IIUM	International Islamic University Malaysia
IN	Innovation
MMD	Malaysia Meteorological Department
MOSTI	Ministry of Science, Technology and Innovation
MR	Material and Resources
NAAQS	National Ambient Air Quality Standards
NAP	National Academies Press
NCAR	National Center for Atmospheric Research
PCC	Pulverised Coal Combustion
PMF	Progressive Massive Fibrosis
PSI	Pollutant Standard Index
SBS	Sick Building Syndrome
SEM	Scanning Electron Microscope
SM	Sustainable Site Planning & Management
TEM	Transmission Electron Microscope
USDA	United States Department of Agriculture
USDHEW	United States Department of Health, Education and Welfare
WE	Water Efficiency
WHO	World Health Organisation
YPTE	Young People's Trust for the Environment

LIST OF SYMBOLS

Al	Aluminium
Ba	Barium
C	Carbon
CFC	Chlorofluorocarbon
CH_4	Methane
CO	Carbon Monoxide
Cr	Chromium
Cu	Cuprum
Fe	Iron
FP	Fine Particulate
GHGs	Greenhouse Gases
ɥ	Micro
HC	Hydro Carbon
m^3	Cubic Meter
mg	Milligram
Mg	Magnesium
Mn	Mangan
MW	Megawatt
NO_2	Nitrogen Dioxide
O	Oxide
Ø	Diameter
O_3	Ozone
Pb	Lead
$PM_{2.5}$	Particulate Matter

POA	Primary Organic Aerosol
S	Sulphur
Sb	Antimony
Si	Silicon
SO_2	Sulphur Dioxide
TSP	Total Suspended Particulate
UFP	Ultra Fine Particulate
VOCs	Volatile Organic Compounds
Zn	Zinc

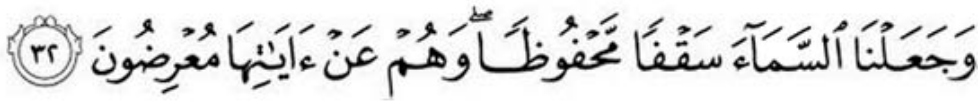
Chapter One

INTRODUCTION

Airborne particulates usually act as toxicants, and are more complex than pollutant gases and vapours because of the additional variables of particle size and mixed chemical composition. The size and chemical composition of these particles affect the impacts on human health. The effects will become worse when it comes to human health in public buildings. Nowadays, public building is not healthy anymore. In certain places, coal power plant is still used to generate energy, thus resulting in air pollution which lead to environmental concern. International Energy Agency (IEA) is concerned about the environmental impact of burning fossil fuels, and coal in particular that contributes to acid rain, air pollution, haze and leads to global warming. The case studies conducted on several site locations which are the residential area at 5,10,15 and 20 km radius from the Manjung coal-fired power plants. The results of this research will include the comparison of mass concentration, both indoors and outdoors of the building, the relationship of air quality indoor and outdoor, the effects of airborne particulates towards public health and the physical characterization of airborne particulates that may come from different sources in which the sample of inhalable dust and respirable dust will be collected so that it may cover also the effects towards human health focusing on residents of Manjung, Perak. The relationship of airborne particulates with temperature and relative humidity will also be highlighted as the combination of those agents of decay will be as harming and damaging towards public health.

1.1 PROBLEM STATEMENT

In general, air pollution is the result of chemicals, particulate matter, and biological materials located in the air that provide harm and discomfort to human being and living things including animals and plantation. The atmosphere supports life, as it is made from gaseous system. Air pollution which leads to global warming phenomenon slowly damages the atmospheric layer, and this is called ozone depletion which will affect life and activities on the planet.



"And We made the sky a protected ceiling (canopy). but they are turning away from its signs." (Qur'an, 21:32)

Islamic scholars addressed the ceiling mentioned above is most probably the ozone layer where it protects living things, including human beings underneath. As a matter of fact, ozone depletion caused many side effects such as increased Ultra-violet light from the Sun, which may cause skin cancer; and other biological effects where it attacks human and non-human health. The chlorofluorocarbon (CFC) is an organic compound that contains carbon, chlorine, and fluorine, produced as a volatile derivative of methane and ethane, which is often used as refrigerants, propellants (in aerosol applications), and solvents which also contributes to ozone depletion.

The main sources of air pollution in Malaysia are motor vehicles, power stations, industrial fuel burning and processes, domestic fuel burning, burning of municipal and industrial waste. The main pollutants include Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Particulates (minutes particulates suspended in the air), and Sulphur Dioxide (SO_2). In fact, coal-fired power plant occupies about