

MANAGEMENT OF WIND LOADS ON BUILDING VENTILATION
FOR HIGH RISE BUILDINGS

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CHARACTERIZATION OF HYDROCARBONS IN ENVIRONMENTAL TOBACCO
SMOKE (ETS)

By

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**PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II**

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DEDICATIONS

In loving memory of my late mother,
Chee Chik bt Darus passed away on 23rd of October 2003,
May Allah shower His compassion on her soul. Amin

&

To my father, Fadzil b. Baharom,
whose belief in me never wavered
and given me the inspiration and courage to pursued .

*"And be not like those who forget God, and
He therefore makes them forget their own selves"*

Qur'an 59:19

*"Allah and His angels send blessings
on the prophet (Prophet Muhammad SAW),
O you who believe, send your blessings on him
and salute him with words of salutation"*

Qur'an 33:56

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LIST OF ABBREVIATION AND SYMBOL

Abreivation

Acn	Acenaphthene
Acnt	Acenaphthylene
Amt	Amount
et,al	and others (latin)
Anth	Anthrcene
ATS	Asap tembakau sekitaran
B&H	Benson&Hedges
Benson	Benson&Hedges
BaA	Benz [a] Anthracene
BaP	Benz [b] Pyrene
BbF	Benzo [b] Fluoranthene
BgP	Benzo [g,h,l] Perylene
BkF	Benzo [k] Fluoranthene
BAT	British American Tobacco
Cmax	Carbon concentration maximum
CPI	Carbon predominance index
Cm	Centimeter
Chr	Chrysene
°C	Degree celcius
dBahA	Dibenz [a,h] Anthracene
DCM	Dichloromethane
ETS	Environmental tobacco smoke
Flt	Fluoranthene
Flr	Fluorene
F 1	Fraction 1
F 2.1	Fraction 2.1
F 2.2	Fraction 2.2
F 3	Fraction 3
GC	Gas chromatography
GC-FID	Gas chromatography-flame ionization detector
GC-MS	Gas chromatography-Mass spectrometer
g	Gram
g/cm ³	Gram per cubic meter
Hi-Vol	High volume
IP	Indeno [1,2,3-cd] Perylene
inj	Injected
ISO	International Organization of standardization
JTI	Japan Tobacco Incorporated
Ks ⁻¹	Kelvin per second
LSC	Liberty Science Centre

LSC	Liquid Solid Chromatography
m/z	mass per charge
MeOH	Methanol
μm	micro meter
μg/m ³	microgram per meter cube
μg/ml	microgram per mililiter
μL	microliter
ml	mililiter
ml/ min	mililiter per minute
Mg/cm	Miligram per centimeter
Mg/L	Miligram per liter
Mm	Milimeter
mg	milligram
Mill.	Million
Min	Minute
M	Molar
M.W	Molecular weight
ng/m ³	nanogram per cubic meter
ng/μl	nanogram per microliter
Naph	Naphthalene
NAS	National Academy of Science
NPC	National Poison Centre
NRC	National Research Council
N/A	Not available
N.D	Not detected
ppm	part per million
%	Percent
Phen	Phenanthrene
PAH	Polisiklik aromatic hidrokarbon
PAHs	Polycyclic aromatic hydrocarbons
Pyr	Pyrene
R ²	Regression linear
Na ₂ SO ₄	Sodium Sulphate
Std	Standard
Surya	Surya Gudang Garam
Σ	Total
TIPAH	Total Identified Polycyclic Aromatic Hydrocarbons
TIRAH	Total Identified Resolved Aliphatic Hydrocarbons
UK	United Kingdom
USA	United State of America
Vol.	Volume

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ABSTRACT

This study is conducted to investigate the distribution of aliphatic hydrocarbons and PAHs in Environmental Tobacco Smoke (ETS). In analyzing the Environmental Tobacco Smoke (ETS), volunteers were asked to smoke a total of 300 cigarettes from 6 famous brands (Mild Seven, Marlboro, L&M, Dunhill, Benson&Hedges and Surya Gudang Garam) selected based on a questionnaire survey carried out in this study. Smoking was done in a closed room and smokes from the surrounding atmosphere (ETS), were then collected using the High Volume Air Sampler fitted with a glass fiber filter. Smoke samples from the glass fiber filter were extracted using Ultrasonic Agitation and fractionated into aliphatic and aromatic using silica alumina column chromatography. Identification and quantification was done using Gas Chromatography with Flame Ionization Detector (GC-FID), conformation of the aliphatic hydrocarbons and PAHs was done using Gas Chromatography-Mass Spectrometer (GC-MS). Results indicated that hydrocarbons characterized from the ETS were *n*-alkanes in the range of C₁₂ to C₃₆ with an odd to even number carbons predominance (CPI) ranging from 2.48 to 5.22. Percentage of plant wax *n*-alkanes in the range of 41% to 65% moderately correlated with CPI values indicates *n*-alkanes contribution from epicuticular waxes generated by the burning of tobacco (smoking). Formation of PAHs in all ETS samples ranging from 6.54 ng/m³ to 56.11 ng/m³. Results also indicate the presence of medium to high molecular weight of PAHs with dominant of Benzo[g,h,i]perylene compound. These results suggest a high temperature and oxygen deficient zone during the smoking processes. Although the concentration were low, the carcinogenic and mutagenic PAHs still present in their ETS samples making the passive smokers vulnerable to diseases resulted from PAHs.

PENCIRIAN HIDROKARBON DI DALAM ASAP TEMBAKAU SEKITARAN (ATS)

ABSTRAK

Kajian ini dijalankan untuk mengkaji penyebaran hidrokarbon alifatik dan PAH di dalam Asap Tembakau Sekitaran (ATS). Bagi menganalisa Asap Tembakau Sekitaran (ETS), sukarelawan telah dipanggil untuk menghisap sejumlah 300 batang rokok daripada 6 jenama yang terkenal dipasaran (Mild Seven, Marlboro, L&M, Dunhill, Benson&Hedges dan Surya Gudang Garam) yang dipilih berdasarkan soalselidik yang dilakukan dalam kajian ini. Proses menghisap rokok dilakukan di dalam bilik tertutup dan asap daripada persekitaran (ATS), dikumpulkan menggunakan Pengumpul Udara Isipadu Tinggi yang dimuat dengan penuras gentian kaca. Sampel asap daripada kertas turas gentian kaca diekstrak menggunakan kaedah ultrasonifikasi dan dipisahkan kepada kumpulan alifatik dan aromatik menggunakan kromatografi turus silica alumina. Identifikasi dan kuantifikasi dilakukan dengan menggunakan Kromatografi Gas dengan Pengesan Pengionan Nyalaan (GC-FID), pengesanan hidrokarbon alifatik dan PAH telah dilakukan dengan menggunakan Kromatografi Gas- Spektrometer Jisim. Keputusan menunjukkan bahawa pengelasan hidrokarbon daripada ATS adalah berasal dari *n*-alkana dalam julat C12 hingga C36 dengan dominasi karbon ganjil daripada karbon genap. Nilai CPI pula dalam julat 2.48 hingga 5.22. Peratusan *n*-alkana lilin tumbuhan adalah dalam skala 41% hingga 65% dan berkolerasi secara sederhana dengan nilai CPI. Ini menunjukkan kehadiran *n*-alkana adalah berasal daripada lilin epikutular yang terhasil daripada pembakaran tembakau (penghisapan rokok). Pembentukan PAH dalam sampel ATS adalah dalam julat 6.54 ng/m³ hingga 56.11 ng/m³. Keputusan juga menunjukkan kehadiran PAH dengan

berat molekul sederhana ke berat dengan dominasi Benzo[g,h,i]perylene. Keputusan ini mencadangkan bahawa kewujudan suhu tinggi dan zon kurang oksigen ketika menghisap rokok. Walaupun nilai kepekatan adalah rendah, PAH yang karsinogenik dan mutagenik masih terdapat dalam setiap sampel ATS. Ini menjadikan perokok pasif masih terdedah kepada bahaya yang datang daripada PAH.