UNIVERSITI PUTRA MALAYSIA

MEASUREMENTS AND ANALYSIS OF SELECTED AIR POLLUTANTS IN KUALA LUMPUR, KAJANG AND UNIVERSITI PERTANIAN MALAYSIA - WITH EMPHASIS ON SUSPENDED PARTICULATE MATTER

AZMAN ZAINAL ABIDIN

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by

Azman Zainal Abidin

A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in the Faculty of Science and Environmental Studies, Universiti Pertanian Malaysia

May 1987

Dedicated to

GHAZINAH

SHAZRINAH

SHAZRIL

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May, 1987

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Faculty : Science and Environmental Studies

Continuous monitoring of air pollutants in Malaysia was, until recently, virtually non-existent. The installation of three micro-computer system for air monitoring (MCSAM) units , each in Kuala Lumpur, Kajang and Universiti Pertanian Malaysia (UPM), had made it possible to monitor selected air pollutants continuously.

From the data acquired from these monitoring systems, several observations were noted. Suspended particulate matter (SPM), oxides of nitrogen (NOx), carbon monoxide (CO) and, to a small extent, sulphur dioxide (SO2), showed two distinct peaks in their diurnal patterns. These peaks were evident in the morning hours

and late evenings. Diurnal patterns of nitric oxide (NO), nitrogen dioxide (NO2) and ozone (O3) were "normal", with nitric oxide reaching its peak first, followed by nitrogen dioxide, and finally by ozone several hours later.

While these diurnal patterns differed slightly by the locations, they exhibited remarkable similarity by the seasons (namely, the northeast monsoon, the southwest monsoon, and the two transitional seasons).

Although there appeared to be no clear seasonal variations for oxides of nitrogen and ozone, carbon monoxide, on the other hand, remained fairly unchanged throughout the months. Suspended particulate matter, however, showed a distinct peak sometime in the middle of the year. The prolonged dry spell, the formation of strong ground based inversions, and the accompanying local meteorology, were believed to have accounted for the high particulate levels.

From the frequency distribution analysis, weekday levels of carbon monoxide and oxides of nitrogen were observed to be consistently higher than the corresponding weekend/holiday levels. For suspended particulate matter, however, there were no noticeable differences between weekday and weekend/holiday levels, due, in part, to the longer residence time of the particulates in the air.

Additional analysis on suspended particulate matter was also carried out, using different instruments. From readings obtained by the high volume cascade impactor, it was observed that fine

fractions formed a very dominant portion of the suspended particulate matter (74.8 percent of the mean particulate concentration). The organic carbon content in the particulates was also found to be relatively high. Corresponding measurements of rooftop and groundlevel particulate concentrations showed no significant difference.

A comparative study between the different particulate monitoring instruments (namely, the high volume sampler, the high volume cascade impactor, and the beta dust monitor) showed that they relate satisfactorily with one another.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian daripada keperluan untuk ijazah Master Sains.

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Pengawasan berterusan bahan-bahan pencemar udara di Malaysia, sehingga kebelakangan ini, boleh dikatakan tidak ada. Pemasangan tiga buah unit sistem mikro-komputer untuk pengawasan udara (MCSAM), tiap-tiap satu di Kuala Lumpur, Kajang dan Universiti Pertanian Malaysia (UPM) telah membolehkan pengawasan dilakukan secara berterusan terhadap beberapa bahan-bahan pencemar udara yang dipilih.

Daripada data yang diperolehi dari sistem tersebut, beberapa pemerhatian telah dibuat. Partikel-partikel ampaian, oksid-oksid

nitrogen, karban monoksida dan, pada tahap yang kecil, sulfur dioksida, menunjukkan dua puncak yang jelas didalam pola harian mereka. Puncak-puncak tersebut adalah ketara diwaktu pagi dan lewat petang. Pola harian nitrik oksida, nitrogen dioksida dan ozon adalah "normal", dimana nitrik oksida memuncak dahulu, diikuti oleh nitrogen dioksida dan akhirnya oleh ozon beberapa jam kemudian.

Walaupun pola harian tersebut berlainan sedikit dari tempat ke tempat, namun mereka menunjukkan keserupaan yang agak istimewa dari musim ke musim (yaitu, monsun timor laut, monsun barat daya, dan dua musim peralihan).

Perubahan kepada paras oksid-oksid nitrogen dan ozon tidaklah jelas dari bulan ke bulan. Karban monoksida pula menunjukkan paras yang hampir serupa dari bulan ke bulan. Partikel-partikel ampaian, bagaimanapun, menunjukkan puncak yang jelas di pertengahan tahun. Musim kemarau yang berlanjutan, pembentukan inversi yang kuat dari permukaan tanah, serta pengaruh meteorologi tempatan yang berikutan, telah dipercayai menyebabkan paras partikel-partikel menjadi tinggi.

Daripada analisis taburan kekerapan, paras karban monoksida dan oksid-oksid nitrogen pada hari "kerja" didapati lebih tinggi daripada hari minggu/hari cuti. Untuk partikel-partikel ampaian, bagaimanapun, perbezaan sedemikian tidak ketara. Ini mungkin disebabkan, pada sebahagian besar, oleh masa kediaman diudara yang agak panjang untuk partikel-partikel tersebut.

Analisis tambahan keatas partikel-partikel ampaian telah juga dijalankan dengan menggunakan alat-alat yang lain. Daripada bacaan-bacaan yang diperolehi oleh "high volume cascade impactor", didapati bahawa pecahan halus merupakan bahagian yang paling dominan didalam partikel-partikel ampaian (74.8 peratus dari kepekatan purata partikel-partikel tersebut). Kandungan karban organik didalam partikel-partikel ampaian juga didapati tinggi. Pengukuran kepekatan partikel-partikel ampaian diatas bumbung dan dipermukaan tanah tidak menunjukkan perbezaan yang bererti.

Kajian perbandingan diantara alat-alat yang digunakan untuk mengukur kepekatan partikel-partikel ampaian (yaitu, "high volume sampler", "high volume cascade impactor", dan "beta dust monitor") menunjukkan hubungan yang memuaskan diantara satu sama lain.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND STATEMENT

The atmosphere that surrounds our Earth is one key factor that has made it possible for life to exist on it. The average human makes use of about 30 pounds of air each day, using it to oxidize food for energy and warmth (Lynn, 1976). Because it surrounds us so intimately, we haved used it without thought -- to burn the food in our bodies, to burn fuel in our furnaces and to burn petroleum in our car. And almost equally without thought, we have used it to carry away our wastes -- wastes from the furnaces and the car and from our thousand other activities. The atmosphere is, however, limited; although it seems essentially infinite from our individual human perspective, only a relatively thin layer is accessible to us for our use in sustaining life and diluting wastes.

Most of us are prepared to accept some environmental deterioration in exchange for a higher standard of living and a greater abundance of consumer goods. But, as living standards rise, man-made air pollution is seen first as a major irritation and then as a threat to the quality of life. Excessive pollution can affect health and certain types of pollution can even render some areas unfit for normal habitation. Air pollution has thus