atmosphere

MDPI

Supplementary Materials: Using a Low-Cost Sensor to Estimate Fine Particulate Matter: A Case Study in Samutprakarn, Thailand

Supichaya Roddee [1], Supachai Changphuek [1], Supet Jirakajohnkool [1], Panatda Tochaiyaphum [1], Worradorn Phairuang [2,3], Thaneeya Chetiyanukornkul [4] and Yaowatat Boongla [1,*]

Table S1. List of acronyms used in study.

Abbreviation	Term
°C	Degrees Celsius
µg	Microgram
µg/m^3	Microgram per cubic meter
AA	Ambient air
AQ	Air quality
AQI	Air quality index
AQS	Air quality standards
AP	Air pollution
BAM	Beta attenuation monitor
CO	Carbon monoxide
DFH	Dust from home
DFH 1	1st dust from home
DFH 2	2nd dust from home
DFH 3	3rd dust from home
DFH 4	4th dust from home
EPA	Environmental Protection Agency (federal)
GIS	Geo-graphical information systems
km	kilometer
LCD	Liquid crystal display
LCS	Low-cost sensors
L/min	Liter per minute
m	Meter
m^3	Cubic meter
Min.	Minimum
Max.	Maximum
NA	Non-available
NO_2	Nitrogen dioxide
O_3	Ozone
PCD	Pollution Control Department
PMS	Plan-tower laser dust sensor
PM	Particulate matter

Abbreviation	Term
PM_{10}	Particulate Matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than 2.5 microns
$PM_{1.0}$	Particulate matter with an aerodynamic diameter less than 1 microns
RH	Relative humidity
SEA	Southeast Asia
S.D.	Standard deviation
SO_2	Sulfur dioxide
SPSS	the Statistical Package for Social Science
Temp.	Temperature
TEOM	Tapered element oscillating microbalance
TMD	Thai Meteorological Department
USA	United States of America
US EPA	United States Environmental Protection Agency
vs.	Versus
WHO	World Health Organization

Tapered element oscillating microbalance (TEOM)

A tapered element oscillating microbalance (TEOM) detects aerosol particles in real time by detecting their mass concentration. It uses a small vibrating glass tube whose oscillation frequency changes when aerosol particles are deposited on it, increasing its inertia. The United States Environmental Protection Agency has certified TEOM-based devices for monitoring environmental air quality.

The Tapered Element Oscillating Microbalance (TEOM) employs an oscillating tapered glass tube (the tapered element) which is clamped at one end and fitted with filter on the other end. As air is pulled through the tube at a constant rate, particles collect on the frequency in an identifiable manner based upon the known spring rate of the tube. From this change, mass can be determined and, applying the flow rate, mass concentration can be calculated. The device is shown in TableS2. The ambient air enters an EPA standard PM-10 size selective inlet. Because this standard dictates the flow rate of 1 m^3/hr (16.7 L/min), and the tapered element assembly dictates a lower flow rate, the air is isokinetically split into a 3 L/min sample stream directed to the filter and the remainder (a 13.7 L/min stream) is bypassed. To measure $PM_{2.5}$ concentrations, a sharp cut cyclone is placed immediately downstream of the PM_{10} size selective inlet and prior to the isokinetic flow splitter.

Upon exit from the splitter, air flows through the inlet tube heater, to drive away moisture and to maintain a consistent temperature, and then through a 2.5 cm diameter glass fiber filter. The mass deposited on the sampler decreases the oscillating tapered element's frequency, which allows a mass concentration to be calculated. Because the tapered element is very sensitive to mass changes, continuous monitoring on a real time basis is possible. Upstream of the filter, the incoming air is heated via an inlet tube that is maintained at a constant temperature, typically 50°C, to avoid measurement problems associated with moisture or thermal expansion of the tapered element. The temperature

can also be set at 30°C. Although the choice of temperature can be made by the user, the default temperature provided by the manufacturer is 50°C.

Table S2. Specific of Tapered Element Oscillating Microbalance (TEOM) ambient particulate monitor.

Specifications	
Principle	vibration
Measurement range	0 to 1 g/m^3
High	3 m.
Flow rate through sample inlet	16.7 l/min (1 m^3/hr)
PM-2.5 flow rate	3 l/min
PM-Coarse flow rate	1.67 l/min
Long-term averaging	1, 8, 24 hr
Temperature of sample stream	30°C
Particulate matter mass concentration	less than 5 μg/m^3 to several g/m^3

Figure S1. TEOM at air monitoring station of Pollution Control Department (PCD) (18T).

Figure S2. TEOM at air monitoring station of Pollution Control Department (PCD) (19T).

References

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