1.Title

Analysis of Black Particulate Matter Composition in the Air of Keelung and Discussion of its Sources.

2. Abstract

Keelung, being a harbor city, consistently witnesses the deposition of black, sticky substances on buildings. These black materials may stem from emissions related to transportation (e.g., cruise ships), industrial activities, construction sites, and more. Therefore, we conducted a literature review and designed experiments to explore potential reasons for the formation of these black substances.

3. Research Questions

(1) Understanding Air Pollution in Keelung: Investigating the main substances contributing to air pollution in Keelung is crucial for assessing the health and environmental risks faced by the local population.

(2) Significance of Black Substances: Determining the contribution of black substances to air pollution in Keelung sheds light on their role as potential toxicants and carcinogens. Understanding their sources and characteristics enhances our ability to mitigate their impact on human health and the environment.

(3) Identification of Specific Components: Investigating the composition of black substances found in ventilation fans in provides.This information is essential for designing targeted interventions to reduce emissions and improve air quality.

4.Introduction & Review of Literature

(1) Main air pollutants and characteristics in Taiwan.

Pollutants refer to substances that persist in a certain environment for a certain period of time, in a certain concentration or quantity, but are not needed in the environment. It is worth noting that pollutants are not necessarily toxic. As long as the above conditions are met, they can be called pollutants.

"Currently, Taiwan includes six types of air quality indicators: $PM_{2.5}$, PM_{10}, ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO). Currently, the most common pollutant in Taiwan that exceeds the standard is $PM_{2.5}$, followed by ozone.” (Taiwan Healthy Air Action Alliance, 2016)

"Pollutants are divided into disposable and derivative pollutants. In addition to direct emissions from pollution sources, pollutant concentrations can easily increase under certain conditions." (Ministry of Environment Air Quality Monitoring Network, 2024)

(2) Characteristics and analysis methods of black matter.

The black substance is highly absorbent, mainly exists in tiny particles, and contains carbon components, which may have adverse effects on health and can be easily inhaled into the lungs. Its main source is the combustion process, which is one of the important contributors to global warming. Can be used to evaluate diesel

engine emissions, which may be toxic air pollutants and carcinogens. (Gao Yuyun, 2014)

Black carbon is different from other carbon compounds and is mainly analyzed through thermal and optical principles. Sources of black carbon include transportation emissions, fuel combustion, industrial processes, etc., which have a great impact on climate and health. They are one of the main emission sources of greenhouse gases and are related to short-term climate change. (Gao Yuyun, 2014) Its characteristics include being difficult to remove by chemical reactions, reducing visibility, accelerating the melting of ice and snow, and may cause health problems, so it requires attention. (Gao Yuyun, 2014)

(3) Assess the impact of black matter on the environment and health.

Black matter not only affects air quality, but also poses a threat to human health.

Black carbon and particulates can cause respiratory disease, cardiovascular disease, and neurological problems in the process. (Ministry of Environment, 2022)

5.Research Methods

(1) station position: We choose 4 places to set up our equipment to collect the dry deposition, as fig.1.

fig.1 Observation Site Distribution and Numbering

To ensure the environmental conditions are sufficiently accurate during data collection, we utilize data from the GLOBE Observing Program, including parameters such as temperature and humidity, in our measurements.

(2) equipment components and design.

a.equipment components

			
12cm*12cm fan	12cm*12cm	filter paper	cake box

b. equipment design.

Our design concept is inspired by the article '*Agricultural Environmental Protection*' in Volume 018, Issue 057 of the Executive Yuan Gazette dated March 27, 2012. After discussions with a professor from the National Taiwan Ocean University, we have designed the dry deposition collection device as follows:

(a) Placing the fan below the device to draw gases from top to bottom, allowing external gases to pass through the filter paper before being expelled by the fan.

(b) Choosing a slightly larger square cake box as the outer shell to accommodate the square shape of the fan without affecting the experimental results.

(c) Using cardboard at the bottom to elevate the equipment, ensuring air circulation.

We initially used a HEPA filter, but due to the adhesive nature of the black substance, we switched to using 5㎛ qualitative filter paper.

fig.2 Equipment Photos

fig.3 Equipment Photos

6. Results

Table 1: Measurement Data

Measurement Date and Condition / Measurement Equipment Serial Number	❶	❷	❸	❹
	Anle District, Keelung City	Anle District, Keelung City	Anle District, Keelung City	Ren'ai District, Keelung City

Original Weight (Whole equipment)	**167.6g**	**165.4g**	**165.8g**	**165.9g**
2023 Dec.30th~2024 Jan. 2nd (Indoor)	**167.7g (+0.1g)**	**165.5g (+0.1g)**	**165.8g**	**165.9g**
Original Weight	**167.6g**	**165.4g**	**165.8g**	**165.9g**
2024 Jan 6th~Jan 7th (Outdoor on rainy days)	**167.7g (+0.1g)**	**165.5g (+0.1g)**	**165.8g**	**165.9g**

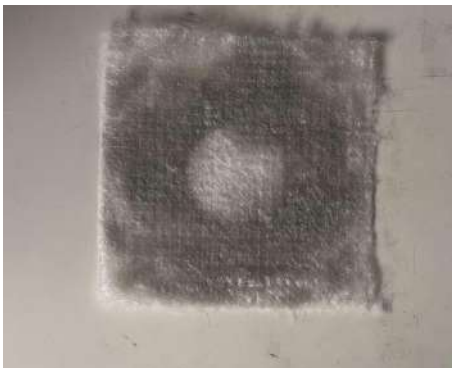

fig.4 The change in the filter paper after measurement (increased by 0.1 grams)2024 Jan 6th~Jan 7th

(1) Indoor dry deposition material is significantly less.
(2) Some dry deposition materials were collected towards the west or southwest, leading to an increase in the weight of the equipment.

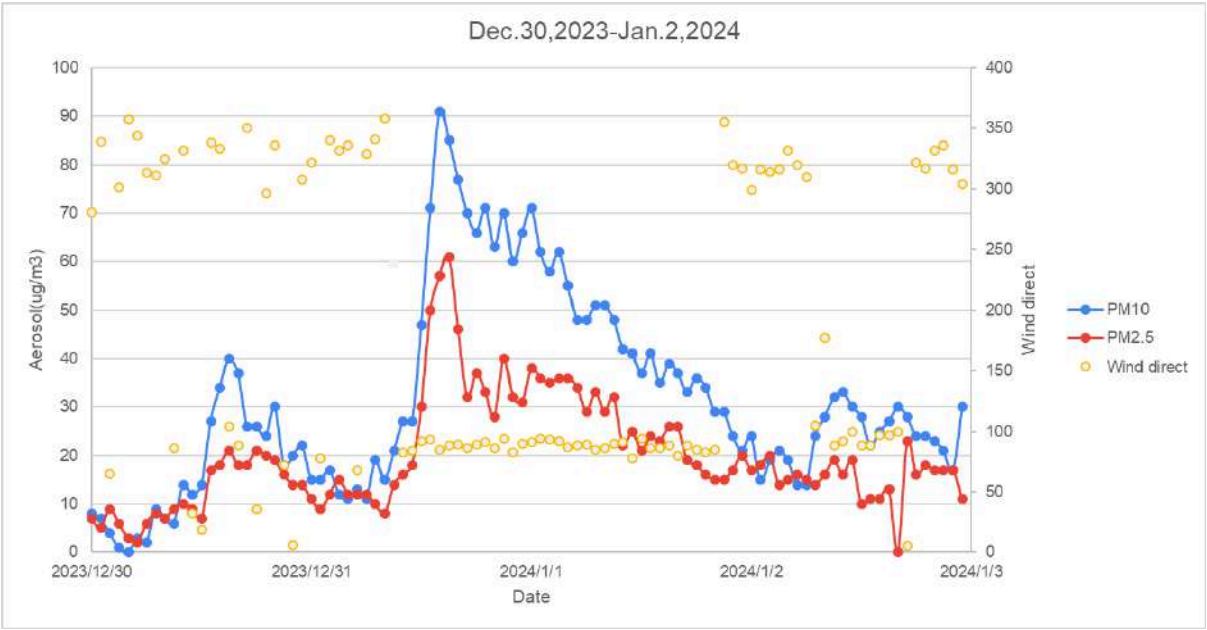

fig.5 We collect changes in wind direction and suspended particles during the period and organize them into line charts.

7. Discussion and Conclusion

(1) We must extend the observation time, but it may involve experiencing different wind directions.

(2) As indicated in Figure 1, observation locations labeled as Number 1 and Number 2 are closer to mountainous areas. Therefore, it is inferred that the amount of dry deposition is also related to the terrain.

8. Bibliography/Citations

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