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The Characteristic of Dust from Sources During Smoggy Pollution in Chiang Mai Province, Thailand

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Abstract: The objective of research was to study of the particulate matter and metal in dust from sources in the smoggy crisis period in Chiang Mai Province, Northern part of Thailand. The sources of dust were sampling of forest fire ash, straw ash and corn ash and road dust. The ash collecting was using hand sweeping method and the road dust was using the vacuum cleaner. The fourteen of metals in dust samples were analyzed by using Flame Atomic Absorption Spectrophotometer (FAAS). The result found that the highest concentration of metal was of forest fire ash and the lowest concentration of metal was corn ash.

Key words: Sources dust, smoggy pollution, chiang mai province, Thailand, particulate matter

INTRODUCTION

In the past, recent years smog problem have profoundly affected the Northern region, especially Chiang Mai Province in various aspects. Smog problem has been classified as "serious" and "urgent" by Thai governments since 2003. Smog crisis in Northern Thailand starts in the dry season from February to April of every year, especially in March of which the problem becomes most serious. During this period, the Northern region is covered by fine particulate matter <10 μ (PM10) higher than safety standard, i.e., 120 mg/m^3 within 24 h (Thongsanit and Srirattana, 2016). Data shows that during the dry season of the past several years, level of particulate matter <10 μ reached the level that is harmful to people's health as well as the environment (Thongsanit *et al*., 2003). Therefore, it increases environmental impacts and importantly, causes the problem of the particulate matter that is dust in the air. This problem affects the respiratory system and human health.

The expansion causes air pollution problem because the dust quantity increases as the city expansion increases (Thongsanit and Pakomma, 2014). The dust has an adverse effect to health and visibility. It adsorbs metal, organic substances and inorganic substances on its surface. The adsorbed matters could transform to an acid when combined with water stream in the air, either rain and stream. It can damage buildings, because troubles and annoyance among people. Many reports indicated that the quantity of dust has effect on human and it has been found to be associated with the daily mortality rate. This research objective is to study on the concentration of heavy metal in the sources of dust in smoggy crisis period in Chiang Mai area.

MATERIALS AND METHODS

The dust collection was carried out using 30×30 cm of future board. This board was used as a sample template for sampling the dust along the ash sampling area. The dust samples were forest fire ash, straw ash and corn ash (Fig. 1a). Three samples of each ash were collected in the after burning of forest, rice field and corn field. The road dust sampling on the main street, the 3 samples were collected. Then, the dust accumulated for one day in the determined area of 1 m^2 was collected using the vacuum cleaner (Fig. 1b). All samples were analyzed using Flame Atomic Absorption Spectrophotometer (FAAS) for lead (Pb), Iron (Fe), Manganese (Mn) Chromium (Cr) Cadmium (Cd) Calcium (Ca) Silver (Ag) Potassium (K) Nickel (Ni) Magnesium (Mg) Zinc (Zn) Cupper (Cu) Silicon (Si) and Aluminum (Al).

Fig. 1: a) Dust sampling in forest fire area and b) road dust area

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RESULTS AND DISCUSSION

The concentration of the fourteen metals in corn ash were found ten of metals, Fe, Al, Ca, K, Mn, Si, Mg, Zn, Cu and Cr. The results show in Table 1. The pile graph of corn ash show in Fig. 2, the highest concentration was iron (Fe) at 35%. The past research in China found metals of the organic of corn were K, Si, Cl, Ca, Mg and S (Li *et al*., 2014). The research of the metals of corn ash were Si, K, Al, Ca, Fe and Mg (Aho *et al*., 2013).

The concentration of the fourteen metals in straw ash were found seven of metals, Fe, Mn, Ca, Mg, Zn, Cu and Si. The results show in Table 2. The pile graph of straw ash show in Fig. 3, the highest concentration was Calcium (Ca) at 52%. The past research China found metal of the organic of straw ash were Ca Mg Mn Fe Al Cu Zn Si and P (Qiu, 2001).

The concentration of the fourteen metals in forest fire ash were found eleven of metals, Fe, Mn, Cr, Ca, K, Ni, Mg, Zn, Cu Si and Al. The results show in Table 3. The pile graph of straw ash show in Fig. 4, the highest concentration was calcium (Ca) at 34%. The concentration of the fourteen metals in road dust were found 13 of metals, Fe, Mn, Cr, Ca, Ag, K, Ni, Mg, Zn, Pb, Cu Si and Al. The results show in Table 4. The pile graph

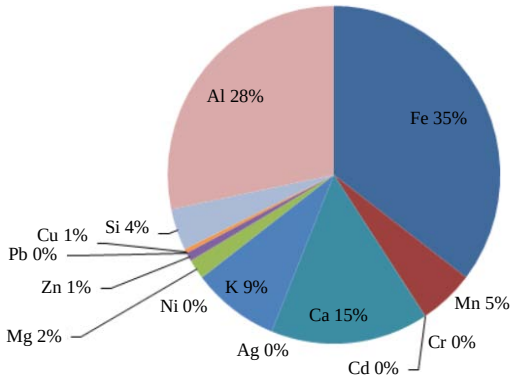

Fig. 2: The pile graph of metals in corn ash 1

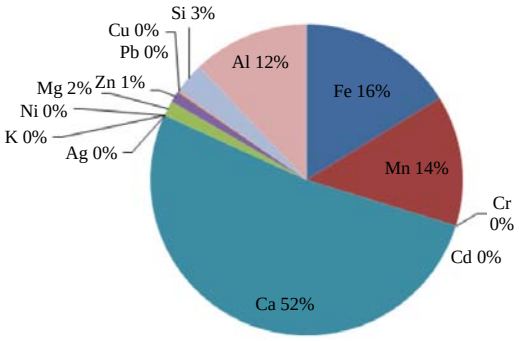

Fig. 3: The pile graph of metals in straw ash 2

Table 1: The concentration of metals of corn ash (mg/g)

Metals	Concentrations (mg/g)
Fe	3.315
Mn	0.502
Cr	0.002
Cd	0.000
Ca	1.438
Ag	0.000
K	0.796
Ni	0.000
Mg	0.178
Zn	0.078
Pb	0.000
Cu	0.036
Si	0.374
Al	2.649

Table 2: The concentration of metals of straw ash (mg/g)

Metals	Concentrations (mg/g)
Fe	1.730
Mn	1.445
Cr	0.000
Cd	0.000
Ca	5.557
Ag	0.000
K	0.000
Ni	0.000
Mg	0.167
Zn	0.125
Pb	0.000
Cu	0.016
Si	0.342
Al	1.289

Table 3: The concentration of metals of forest fire ash (mg/g)

Metals	Concentrations (mg/g)
Fe	2.932
Mn	2.030
Cr	0.023
Cd	0.000
Ca	6.523
Ag	0.000
K	2.586
Ni	0.201
Mg	0.209
Zn	0.091
Pb	0.000
Cu	0.022
Si	0.595
Al	3.751

Table 4: The concentration of metals of road dust (mg/g)

Metals	Concentrations (mg/g)
Fe	3.824
Mn	0.378
Cr	0.031
Cd	0.000
Ca	6.667
Ag	0.223
K	0.742
Ni	0.019
Mg	0.265
Zn	0.222
Pb	0.037
Cu	0.094
Si	0.366
Al	1.622

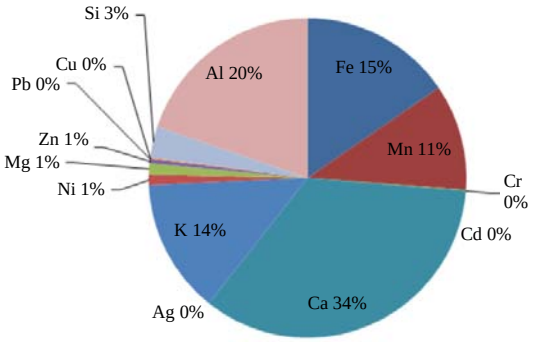

Fig. 4: The pile graph of metals in forest fire ash 3

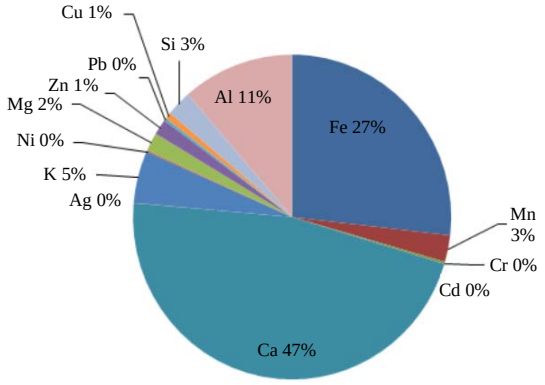

Fig. 5: The pile graph of metals in road dust

of straw ash show in Fig. 4, the highest concentration was calcium (Ca). The percentage of Ca was 47% Fig. 5.

CONCLUSION

The result found that the highest concentration of metal was of forest fire ash 18.96 mg/g and the lowest concentration of metal was corn ash. Corn ash were found ten of metals, Fe, Al, Ca, K, Mn, Si, Mg, Zn, Cu and Cr. Straw ash were found seven of metals, Fe, Mn, Ca, Mg, Zn, Cu and Si. Forest fire ash were found eleven of metals, Fe, Mn, Cr, Ca, K, Ni, Mg, Zn, Cu Si and Al. Road dust were found thirteen of metals, Fe, Mn, Cr, Ca, Ag, K, Ni, Mg, Zn, Pb, Cu Si and Al. The highest of metal in corn ash, straw ash and forest fire ash and road dust were Fe, Ca, Ca and Ca, respectively.

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