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Elemental Analysis of Air Particulates along the Meycauayan River

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Abstract: Meycauayan City is a bustling city with a vibrant manufacturing business and fast-growing population. This high amount of human activity and lack of waste disposal facilities resulted in uncontrolled environmental degradation. The Meycauayan River was not spared and it has gained notoriety as being one of the world's dirtiest rivers. This level of pollution certainly has a huge impact on the health and well-being of the residents, as well as other organisms in the area. That is why this study has been done to determine the elemental composition of the air particulates in order to provide a baseline level to be used in policy-making and interventions for the rehabilitation of the river and all affected areas. This study found that there are ten elements that are found in significant amounts in certain sampling sites, namely, Carbon, Nitrogen, Oxygen, Sodium, Magnesium, Silicon, Potassium, Calcium, Niobium, and Mercury. This suggests that some places with certain human activities are producing these harmful pollutants. More studies are required to identify the sources of these pollutants.

Key Words: Meycauayan River; air particulates; elemental analysis

1. INTRODUCTION

According to the latest census of the Philippine Statistics Authority (2015), Meycauayan City, with a population of 209,083 people, is the ninth most populous city in Region III. In the Meycauayan official home page (2017), the city is described as "a major economic and industrial hub" in Region III. The Asian Development Bank (2009) reported that the city's chief source of income is in

manufacturing, notably leather tanning, jewelry making, and lead battery recycling. Unfortunately, most industries don't have waste treatment facilities, so the toxic chemicals end up in the soil, river, and the atmosphere. These factors contribute to the pollution of the Meycauayan River. This is not only a problem in Meycauayan, as the River is part of the Marilao-Meycauayan-Obando River System (MMO), which eventually drains into Manila Bay. This means that pollutants do not stay in one place, but rather, travel to great distances from the source.



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In addition, the Blacksmith Institute, a New York-based organization that monitors polluted places around the world, included Meycauayan in the “Dirty Thirty” list of the most polluted places in 2007, together with Bangladesh, the only Southeast Asian countries to do so.

This level of pollution causes several health risks to all organisms living in these places especially respiratory disorders, and infections.

Hence this paper is done in order to provide a baseline data of the chemical composition of these particulates in the hope that the information produced can be used by concerned agencies for monitoring the effectiveness of the rehabilitation efforts done on the Meycauayan River.

The limitation of this study is that only the stage 6 samples from four barangays were analyzed up to this point because of the limited availability of the SEM-EDX unit and its occasional periods of maintenance and repair.

2. METHODOLOGY

Air samples were collected from eight barangays along the river, namely: Barangay Caingin, Barangay Banga, Barangay Calvario, Barangay Camalig, Barangay Langka, Barangay Perez, Barangay Iba and Barangay Malhacan. The barangays were chosen to represent the different land classifications according to use whether agricultural, industrial, residential, or just open space. Collection was done during the summer season. On the first day samples were taken from Barangays Caingin, Banga, and Calvario at around 15:00-18:00. On the second day samples were taken on the rest of the barangays at around 8:00-12:00.

An air pump is used to suction surrounding air with a sampling flow rate of about 83.5 SCFH, or 2.35 m³/h (Narido, 2013). This pump is connected to the Staplex six-stage air sampler where air is filtered by glass-fiber filters. Each stage has a certain diameter which corresponds to the airway diameters within the human lungs where particulates deposit. Air is suctioned for fifteen minutes per location. The filters were changed every barangay and labeled according to sampling site and stage. All in all, there were forty-eight (48) filters used.

A quadrant is taken from each filter and coated with gold using JEOL JFC-1200 Fine Coater. The prepared filter is then studied using the JEOL JSM-5310 Scanning Electron Microscope (SEM) with an accelerating voltage of 15-20 kV and spot size of 7. For elemental analysis the attached Energy Dispersion X-ray (EDX) feature of the SEM was used with a spot size of 12. Ten particles from each filter were studied for morphology and elemental composition. The imaging software used was SemAfore version 5.2.1.

3. RESULTS AND DISCUSSION

The elemental concentration (wt %) for each sample was obtained and tabulated. One-way ANOVA was used to determine whether particulates from different sites and from control have significant differences in elemental compositions or not.

There are ten elements with significant differences in content as to sampling location, namely, Carbon, Nitrogen, Oxygen, Sodium, Magnesium, Silicon, Potassium, Calcium, Niobium, and Mercury.

There are nine elements with no significant differences in content as to sampling location, namely, Sulfur, Aluminum, Chlorine, Titanium, Iron, Zinc, Barium, Manganese, and Lead.

These results reflect the activities around the sampling sites, but more studies are yet to be done to establish this connection.

4. CONCLUSIONS

There are some elements in particulate matter that are more pronounced in some areas than others. But as this study is just a baseline, more studies are required to determine the causes for the said differences, and also correlate the level of air pollution with that of the soil and water.

Pollution not only has local but potentially global impact as well. Hence every sector in the society, from the government, NGO's, academe, and private individuals should collaborate and be involved in preserving and creating a healthy environment.



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