Ground Level Monitoring of Particulate Matter in West Oakland

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Introduction:

West Oakland is a low-income community near the heavily industrialized Port of Oakland. The ships, as well as thousands and thousands of trucks and trains, travel in and out of West Oakland everyday, transporting goods from around the world. These vehicles use diesel fuel and produce Particulate Matter (PM) as well as other pollutants (Bailey, 2004). The amount of toxins produced as a result of 22,000 daily truck trips in West Oakland is equal to the amount generated by 127,677 cars doing the same trip (Pacific Institute, 2003). As a result of these circumstances, West Oakland is the site of the highest pollution levels in Alameda County.

About ten to fifteen percent of Oakland schools are within 500ft from a freeway with 100,000 or more cars passing by each day. Those schools have higher levels of students who qualify for free and reduced lunch (Alameda County Public Health Dept., 2008). Children who breathe highly contaminated air are more likely to become ill or to develop asthma. When PM is breathed into the lungs, it can then seep into the bloodstream and cause aggravations that result in allergies or asthma. The smallest PM sizes (<2.5 µm) are known to cause the most problems (Bagley, 1996) having been linked to increased hospital admissions for asthma attacks, chronic obstructive lung disease, bronchitis, pneumonia, heart disease, and excess deaths (Dockery et al., 1989, Peters et al., 2001). This project was undertaken to test mobile PM monitoring technology that may provide communities like West Oakland with a greater understanding of PM behavior and occurrence at ground level. In conducting our research we sought to determine whether there were higher levels of PM at certain locations in West Oakland using two different PM monitoring devices.

Materials & Methods:

Particulate Matter samples were collected and analyzed as we walked along the streets of West Oakland. To accomplish this we used a TSI DusTrak aerosol monitor and a Fluke Particle Counter 983. The DusTrak device was placed in a backpack and the intake tube was placed at shoulder height. The DusTrak instrument operates by drawing a sample of ambient air through a 2.5µm filter every second, and records results in milligrams per meter cubed. A GPS Tracking System was also placed at shoulder height on the backpack to track where each sample was collected. The Fluke device was used to collect one liter air samples at various locations along the same route taken while using the DusTrak. With the Fluke device, concentration levels of 0.3, 0.5, 1, 2, 5 and 10µm particle sizes were measured.

Our sample route began at the WOEIP (West Oakland Environmental Indicators Project) headquarters located at the intersection of 14th St. and Wood St. and followed a loop around the neighborhood as shown in Figure 4. Samples were collected using the Fluke at the following locations: 14th St. and Wood St., 10th St. and Wood St., 8th St. and Willow St., 7th St. and Wood St., 7th St. and Campbell St., 7th St. and Mandela Pkwy, 12th St. and Mandela Pkwy, 12th St. and Center St., 17th St. and Peralta St., 16th St. and Campbell St., and 14th St. and Campbell St. Samples were collected between the hours of 3pm and 5:30pm on July 13, 14, 15, 19, 20, 21, 22, 29, September 22, October 6 and 20th of 2010, sometimes twice daily.

DusTrak data was uploaded to a website developed and hosted by the Intel Corporation. This site was used to store and generate maps all of the DusTrak data.

Figure 1. Fluke Data collecting

Results:

Based on the average PM values measured using the Fluke device, the highest PM concentration levels for 0.5µm, 2µm 5µm, and10µm particle sizes were found at the intersection of 7th St. and Wood St. (Figures 6, 7, 8 and 10). We also determined that the highest concentration levels of the smallest diameter PM, 0.3µm, were found at the intersection of 17th St. and Peralta St. (Figure 11). For 1µm diameter PM there was a high point at 7th St. and Campbell St. as well as 7th St. and Wood St. (Figure 9). Using the DusTrak device we found that 2.5 µm diameter PM on average was in the "Moderate" Air Quality Index (AQI) range (15 – 40 µg/m³) throughout our sampling route (Figure 5), However, within the "Moderate" range we found that 12th St. and Peralta St. and 7th St. and Wood St. had higher averages of 23 – 28 µg/m³ compared to averages of 16 – 20 µg/m³ along the majority of Mandela Parkway (Figure 5). Other locations such as 10th St. and Wood St. and 16th St. and Campbell St. also had higher averages within the "Moderate" range. Increased average PM 2.5µm was often influenced by identifiable point source pollution. For example, on October 20, 2010, the AQI in West Oakland was primarily in the moderate range, but there were a few "hot spots," where the DusTrak spiked to the "Very Unhealthy" range (>150 – 250 µg/m³) when we walked by. One of the highest "hot spots" was on 7th St. and Wood St., the PM count being 180 µg/m³ (Figure 3). At the time we were walking by, there was construction on the elevated train tracks in the middle of the street; a diesel fuel burning truck passed by and the extra dust that was littered on the asphalt was pushed upward from the truck. The dust combined with the truck's emissions added to the DusTrak's PM intake, which resulted in a noticeable spike. Another "hot spot" was found near the parking lot of a liquor store on 7th St. and Willow St. on October 20th. When we walked by people were smoking in a car and the DusTrak spiked to 160 µg/m³ (Figure 3).

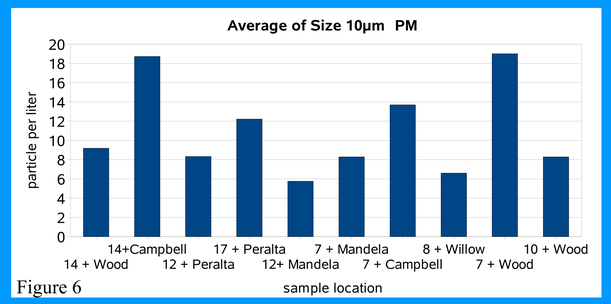


Figure 6

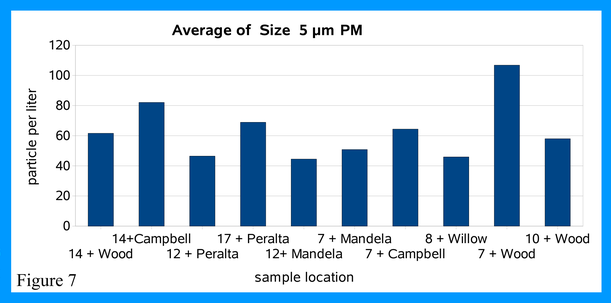


Figure 7

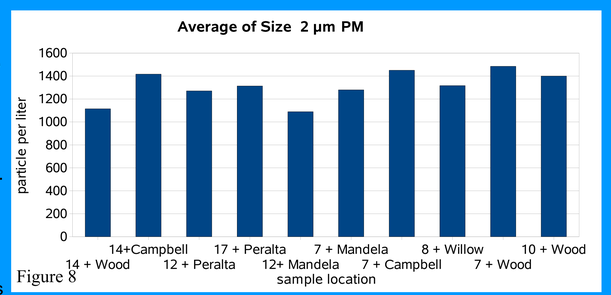


Figure 8

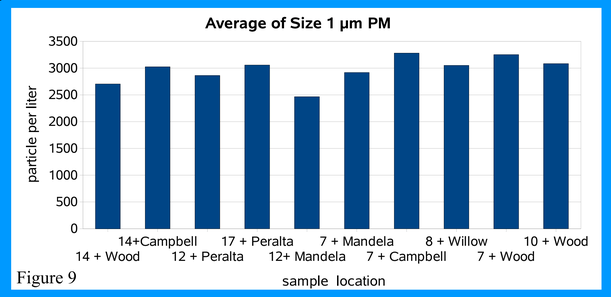


Figure 9

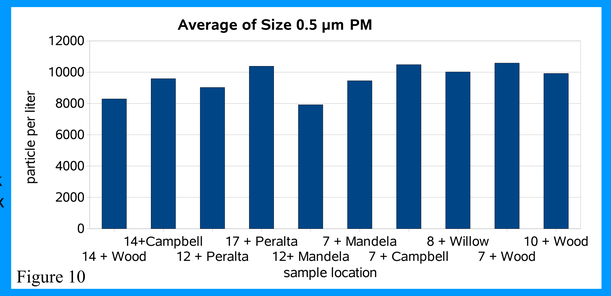


Figure 10

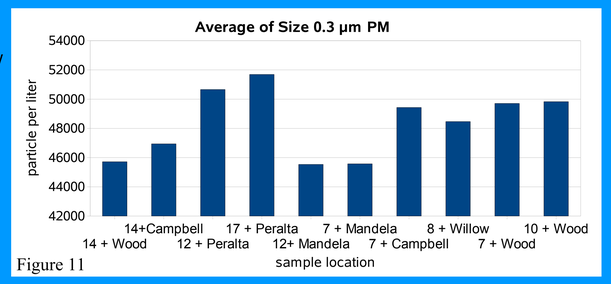


Figure 11

Figure 2. Dustrak Sampling

Figure 3: Map of DusTrak data collection on 10/20/10 in and around 7th st. and Wood.

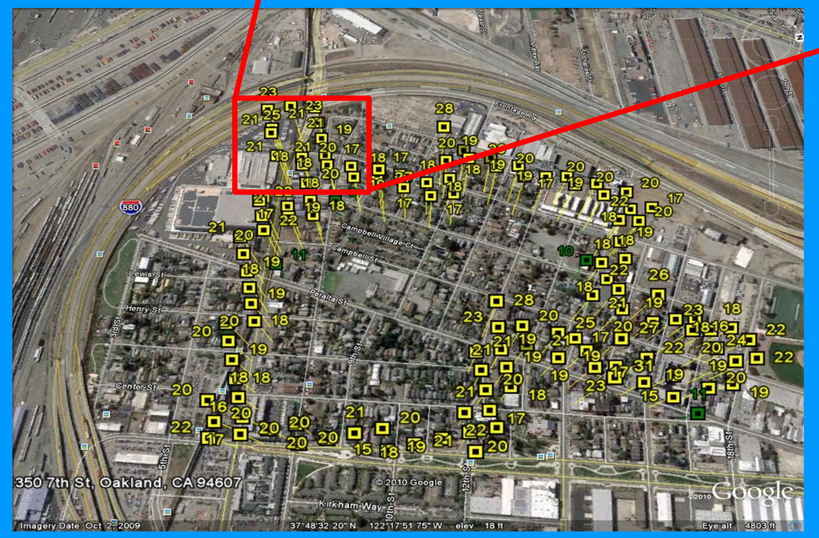
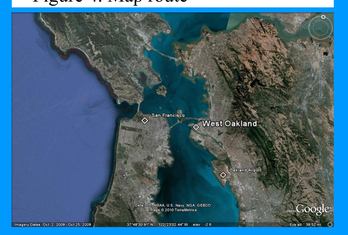


Figure 5: Map of Average DusTrak PM 2.5 µm on sample loop

Figure 4. Map route



Discussion and Conclusions:

Our results indicate that the highest average concentration levels of PM sampled by the Fluke for sizes 0.5, 2, 5, and 10 µm, as well as high average levels as sampled with the DusTrak occurred a the intersection of 7th St. and Wood st. We believe that PM is at higher levels in and around 7th St. and Wood St. because of the high levels of vehicular traffic associated with a nearby freeway, along which trucks travel to and from the Port of Oakland and other industrial facilities. Other noted contributions to increased PM concentration levels include cigarette smoke and smoke from outdoor barbecue devices. These non-industrial sources caused temporary spikes in concentration levels that resulted in "Very Unhealthy" conditions as determined using the AQI scale in more residential areas like 12th St. and Peralta St. The sources of other spikes, like those found near the intersection of 17th St. and Peralta St., have not yet been determined. Varied wind patterns and unknown industrial practices throughout the community could be influencing our results, and only further data collection and observation will help us understand PM concentration patterns. By walking through the neighborhood we were able to locate sources of PM that a stationary PM monitor on the top of a roof (as prescribed by the government monitoring agency) could not locate. This method could benefit young children and the elderly by alerting them to triggers of their asthma.

Based on our preliminary results, we suggest that the following measures be taken to reduce the PM concentrations in West Oakland: 1) Trucks should be re-routed so as not to travel through the side streets, but remain only on the main streets and 2) Individuals should reduce their use of cigarettes and barbecue devices around sensitive groups. Also, new clean technology that reduces PM emissions from diesel burning-trucks should be used more frequently, and idling of trucks on streets and ships while at the Port should be prohibited. Ships should be forced to obtain their electricity from the city's electrical grid rather than through the use of their own on board diesel burning generators. In addition, a larger shift toward electric cars and clean transportation will reduce PM and other air pollutants in West Oakland. Further, polluting industrial sites should be encouraged to routinely monitor their facilities and involve community members in the monitoring of nearby homes and businesses.

Acknowledgments:

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