Atmospheric Particulate Counts in the Chinatown Area of Oakland, California

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Introduction

Oakland's Chinatown is right at the center of the busy business district of downtown Oakland, California. It is one of the most inhabited and congested areas in the city of Oakland, averaging 4,000 vehicles and 3,000 pedestrians per hour at an intersection in the center of the neighborhood.

Particles produced from the exhaust of trucks, buses, cars, as well as from construction can settle into the bronchi of people's lungs. The burning of fossil fuels from automobiles or dust from industrial and construction sites produce aresol, or particulate matter, in the air. Many of these particles consist of either sodium chloride from the ocean, acids, or ammonium compounds. Larger particles (10 micrometers) usually fall to the ground while smaller particles stay in the atmosphere. Also, larger particles usually do not present a problem as they are filtered out before they reach the lungs, but any particles smaller than 10 micrometers can settle into the lungs and bronchi and induce asthma attacks, irritate cardiovascular tissue, and lead to lung cancer and possibly death. Particles less than 2.5 micrometers can actually move from the lungs towards other organs and cause atherosclerosis and vascular inflammation. Also, these particles may contain dangerous or toxic materials that when breathed in can also cause dangerous health effects. It is estimated that particulate matter pollution causes 20,000 to 50,000 deaths per year in the US alone.

The goal of our project was to test various intersections of Oakland's Chinatown to see if the air quality meets EPA standards. Hopefully, by conducting this experiment, we will be able to raise awareness in the neighborhood about air quality issues. By providing statistical facts and consequences of pollution, people will hopefully take action and create changes in their style of living, which can help the environment and the air around them.

Method:

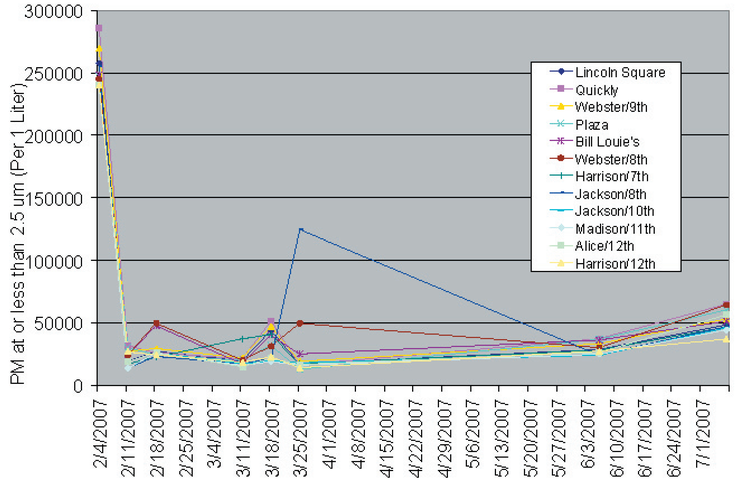
Since Chinatown consists of several blocks, it would be difficult to keep consistent data if we did tests at all of the locations. Our research team knew that there were certain areas that are more populated than others, so we started to collect data from those areas. We picked out twelve of the busiest intersections and concentrated our experiment there. Our experiment spanned several months, during which we collected particulate data. We were primarily concerned with particles 2.5 micrometers and smaller, as smaller particles are easily inhaled and directly affect the respiratory system. We were interested in identifying all of the intersections that may have had significantly higher measurements.

We predict that the measured results of one or a few particular points, when statistically analyzed, will stand out as a mathematical outlier, meaning that outlying points have results that are significantly higher when compared with the rest of the data gathered at other points of interest. This can lead to the assumption that the particulate count at some points most likely vary significantly due to increased traffic. This will narrow down points of interest, where we can test those specific outlying points for particulate emission factors to figure out why those points have significantly higher measurements

Beginning in February and ending in July of 2007, we took measurements on weekends. To take measurements we used the FLUKE 893 Particle Counter, which measures particulate matter by drawing in a liter of air and measuring particles using a laser. We also used several other technologies to measure particulate matter such as the Explorer and another device which collects particles also, but their data were not sufficient enough. We took down data from the FLUKE and analyzed the data to locate any trends in particulates. We also compiled data on the different time of day and season we collected the particulate data which can significantly affect our data trend.

Particulate Counts less than 2.5 um in Diameter Per Liter Collected

Graph



Date Collected

Data Chart

	Date									At Each Location		
Location	2/4/2007	2/11/2007	2/18/2007	3/11/2007	3/18/2007	3/25/2007	6/6/2007	7/7/2007		Mean	Minimum	Maximum
	Measurements (in um)											
1 Lincoln Square	257363	19233	27290	19427	44045	17147	28649	48354.67		29163.67	17147	48354.67
2 Quickly	285705	31616	26084	21243	51509	16260	37346	64904		35566	16260	64904
3 Webster/9th	269762	27453	29404	21994	47240	19188	33311	52973.33		33080.48	19188	52973.33
4 Plaza	247966	30399	24280	19883	32228	12871	36763	60295		30959.86	12871	60295
5 Bill Louie's Corner	248110	23898	47784	17060	40212	25104	36220	51253.67		34504.52	17060	51253.67
6 8th/Webster	244737	23898	49812	20131	31225	49654	30152	64218		38441.43	21031	64218
7 Harrison/7th	239295	17169	22529	37310	40707	16906	28269	46726		29945.14	16909	46726
8 Jackson/8th	255319	13889	23138	17280	21304	124672	24155	46983		38774.43	13889	124672
9 Jackson/10th	241789	13336	25938	17398	19657	18016	24116	45947.33		23486.9	13336	45947.33
10 Madison/11th	239579	13557	25816	15905	19082	16221	24966	44418.67		22852.24	13557	44418.67
11 Alice/12th	240372	18635	26301	14864	21598	16694	26244	56426		25823.14	14864	56426
12 Harrison/12th	239997	26812	24412	18545	22878	14139	27457	37000		24463.29	14139	37000
At Each Day												
Mean	250832.8333	21657.92	29399	20086.67	32640.42	28906	29804	51624.97				
Minimum	239295	13336	22529	14864	19082	12871	24116	37000				
Maximum	285705	31616	49812	37310	51509	124672	37346	64904				

8th Street and Webster Scramble Intersection

9th Street and Webster

Bill Louie's Corner

Discussion/Conclusion:

After we conducted our experiment and gathered results, we set about to compare our results to an EPA standard or equilvalent. However, we were unable to seek out such a standard as the only EPA standard for air particulate count is in weight, and the FLUKE particulate counter measures in the number of particulates. After contacting FLUKE customer service, we realized that the FLUKE was made only to compare realitive measurements. Hence, we will have to analyze our results realitive to one another. However, as mentioned, there is no statistical outlier amougst the twelve locations, hence we can conclude that there is a relatively uniform particulate count throughout the area, which means that our initial hypothesis was a failure since there was no particular location that stood out as an obvious statistical outlier.

Therefore, we will have to seek out an alternative method to analyzing the particulate count in Oakland's Chinatown to determine if it does meet some official government standard. Also, we want to discover why there is no official EPA or equivalent standard for particulate counts, since they pose such an obvious and immediate hazard to the public's health. This question may only be answered through further research investigations.

Also, we experienced experimental error on the last measurement on July 17 because of excessive dust in the measuring device. We then graphed, averaged, and analyzed the results of our findings, and discovered that the data tabulated on the day of the annual street fest were outliers, though other days showed a trend. We will also need to conduct further research to understand why one of these locations had the highest measurements as it is not located at the busiest traffic intersection in the neighborhood. However, this has led us to conclude that traffic and congestion from automobiles cannot be the primary cause of high particle counts in the Oakland Chinatown area.

Results

The primary data we are concerned with is the number of particles at or less than 2.5 um in diameter in a liter of air collected by the FLUKE. All data collected on the first day, 2/04/07, are outliers when compared to the rest of the data collected at the respective points of interest. Hence, we have chosen to ignore data collected on 2/04/07 in our further mathematical analysis so that we do not skew results. The mean standard deviation of our data is 15066.7 um, and our average mean was 30588.42 um. The minimum was 14139um, and the maximum was 124672um. When we analyzed the mean measurement of each point of interest, we discovered that they do not vary enough for the results of one or few points to stand out as a statistical outlier, as we initially predicted would occur. However, Location #2 holds the record for having highest calculation of particulate matter on multiple days when compared to the rest of the data, though Location #8 has the greatest average calculations. Location #10 has the lowest average measurement of particulate matter. Also, the data collected did not show a clear trend to favor change as the year progressed, after data collected from day one is ignored as an outlier. However, we were not able to compare our data to any official government standard as of thus far, so we do not have a standard measurement to compare it to. Also, further testing at Location #2 and location #8 will be needed to rule one of these locations as definitively having the highest measurement.

Resources:

- http://en.wikipedia.org/wiki/Particulate_matter
- http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1004&context=its/tsc
- http://www.tsc.berkeley.edu/newsletter/winter05-06/scramble.html
- http://www.npi.gov.au/database/substance-info/profiles/69.html

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