4.3 Napa (Fuller Park)

4.3.1 Site Location and Meteorology

The Napa site represents a 'non-urban' location which has neither natural deposits nor industrial sources of asbestos. It is in an agricultural area of low population, located 35 miles north of San Francisco, with no industrial pollutant sources. The sampling site was at Fuller Park, located in downtown Napa at the intersection of Jefferson St. and Oak St.

The weather data are presented in Figure 4.3-1. The sample day (9/23/81) was sunny with the relative humidity decreasing from approximately 80% in the early morning to less than 50% in the late afternoon. The temperature ranged from 10°C to 25°C and the winds were from the west and intermittent with maximum velocities of two mph. Skies were clear with minimum visibilities of 20 miles. The weather tower was not used due to the obstruction of trees in the park. The weather sensors were fastened to the top of a cargo van approximately ten ft above the ground. The sensors measured the local effect on the filter samplers. Observations of wind speeds above tree level were judged to be no greater than five mph from the west. The weather sensors, particle counters and cyclone samplers were located in a clearing 200 ft from the west side of the park (Figure 4.3-2). As at San Jose, the park provided a buffer zone which minimized vehicle exhaust. The peak vehicle traffic observed occured around 9:30 a.m. at an average rate of 12 cars/min.

4.3.2 Asbestos Filter Sampling

Filter sampling was conducted with two paired, four-hour samples in both the morning and afternoon. The cyclones were placed approximately 20 ft apart, with sampling pumps at ground level and the cyclone inlets approximately six ft above the ground. Details of sampling times are in Table 4.3-1.

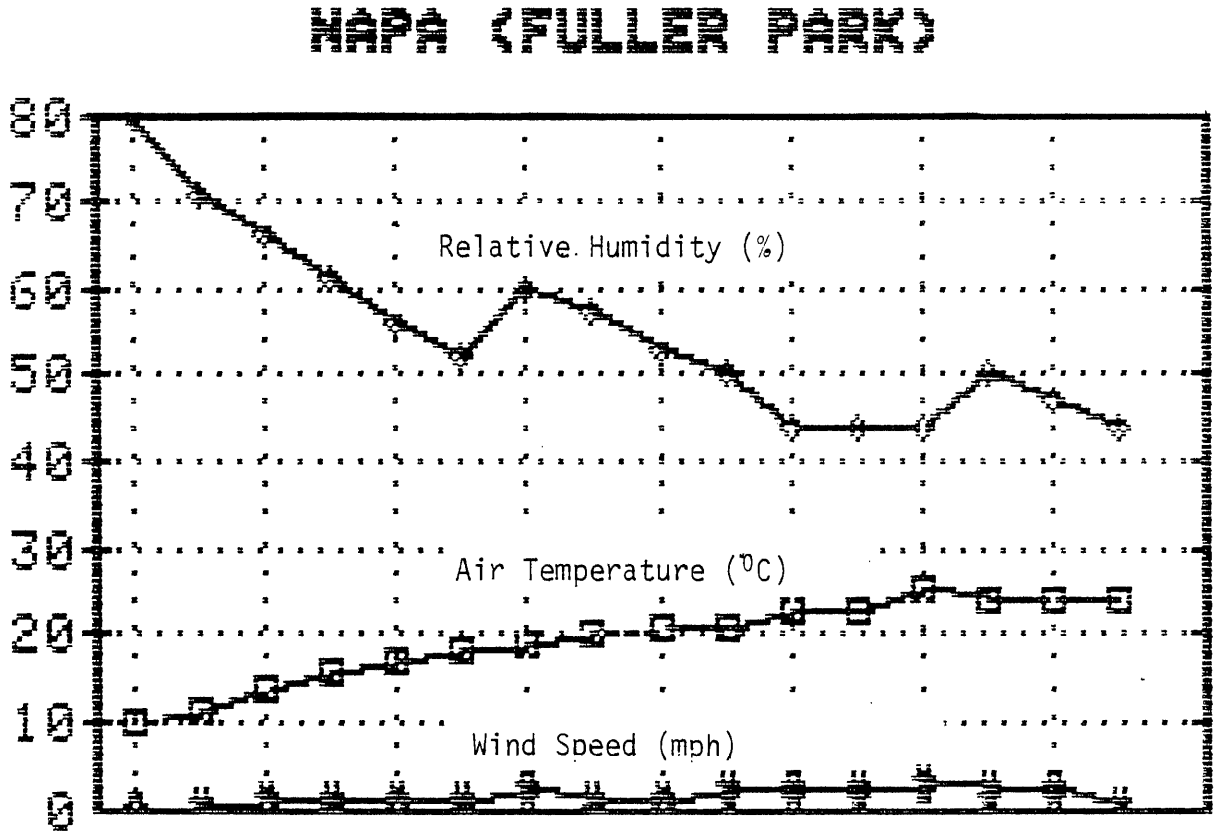


Figure 4.3-1 Meteorological Data Summary for Napa (Fuller Park). Based on one-half hour sampling intervals.

Figure 4.3-2. Napa Sampling Site (Fuller Park).

View north across the sampling location in the park.

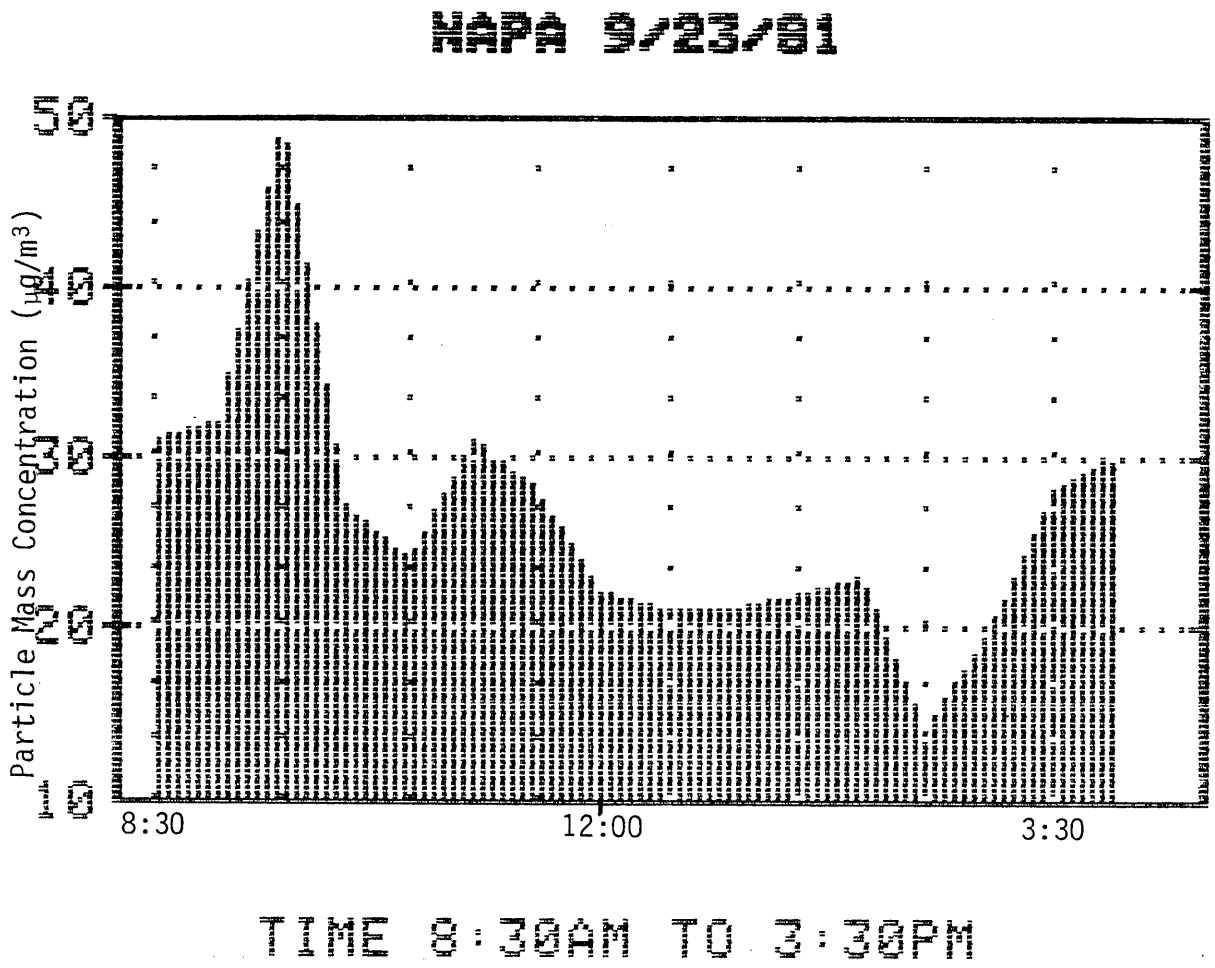


Figure 4.3-3. Optically-Derived Particle Mass Concentration Trend with Time at the Napa Site. Mass data were collected at one-half hour intervals using the RAM® Optical Mass Counter.

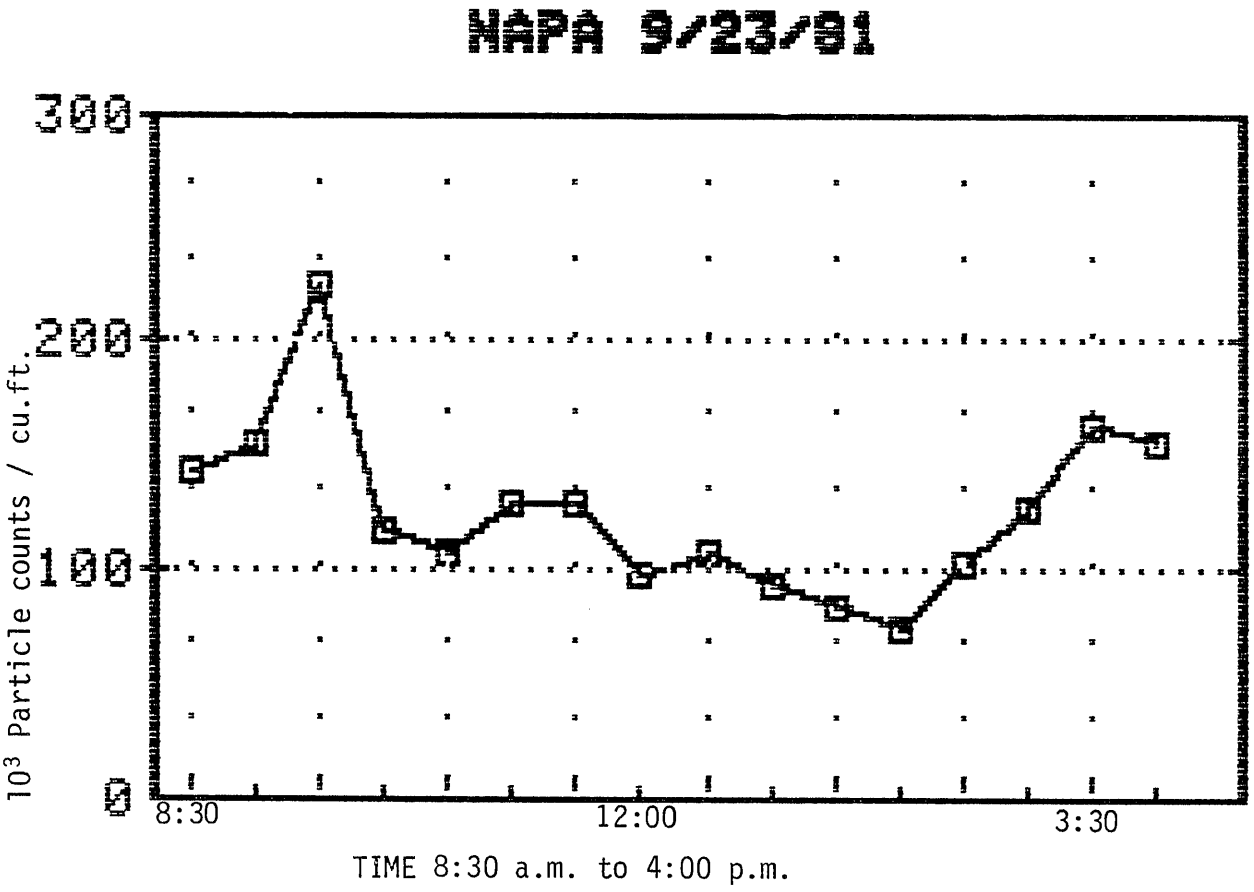


Figure 4.3-4. Optically-Derived Particle Count Trend with Time at the Napa Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

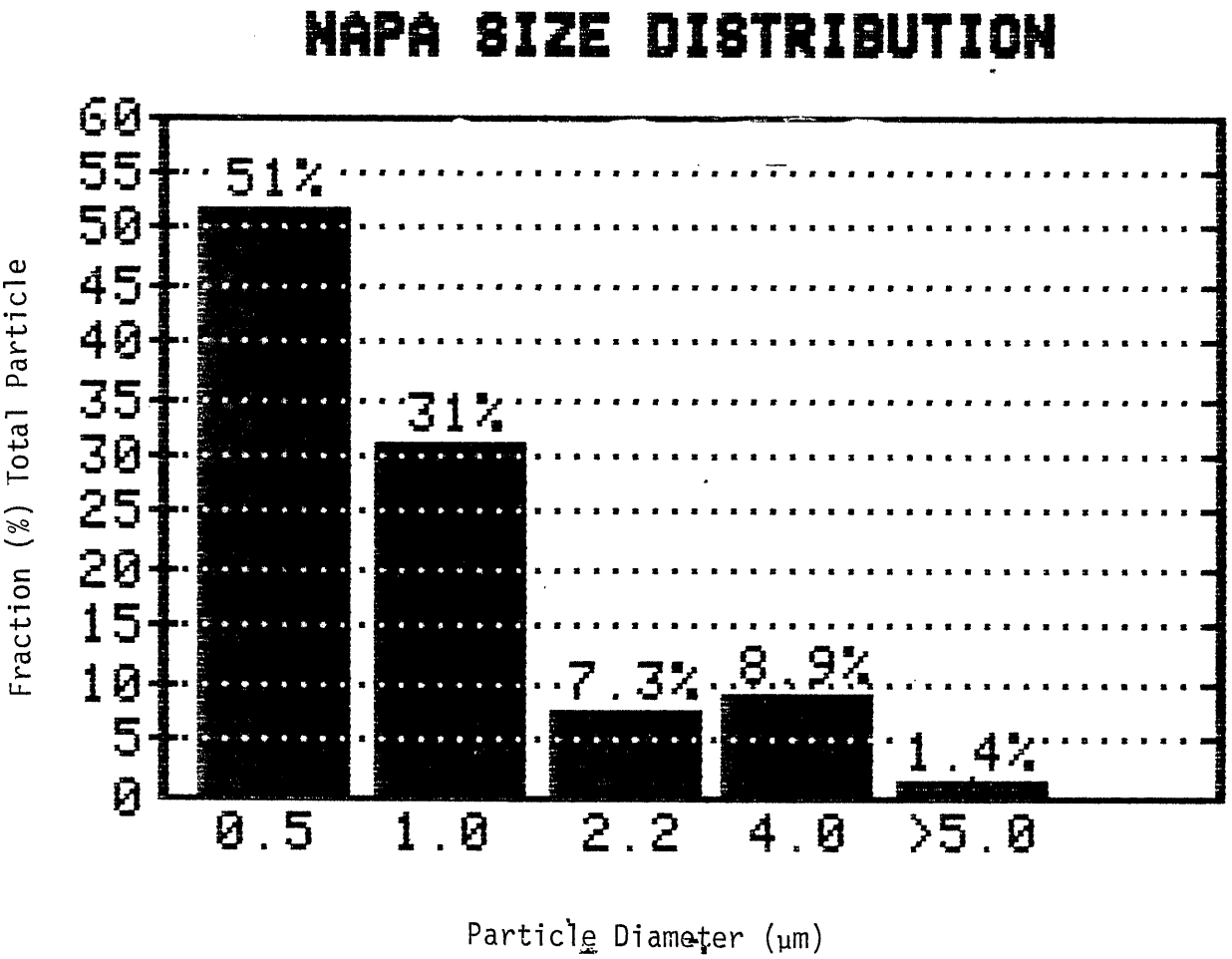


Figure 4.3-5. Particle Size Distribution at the Napa Site. Data represent eight-hour averages.

4.4 Sonora (County Administration Building)

4.4.1 Site Location and Meteorology

The Sonora site represents a non-urban source with natural deposits of serpentine asbestos occuring in numerous outcrops. The population density is low, with a seasonal (summer and fall) influx of tourists.

To avoid the possible effects of emissions from congested traffic in the narrow streets lined with two-story buildings, the roof of the County Administration Building was chosen for sampler location. The County Administration Building is located one block off Washington Street at Jackson Street, near the area of greatest population density. The samplers were placed on a table on the 40-ft roof with the weather sensors fastened three ft above the outer ledge. The top photo in Figure 4.4-1 shows from north to south at the sampling equipment; the bottom photo shows from west to east.

The sampling day (9/24/81) weather conditions are graphed in Figure 4.4-2. Relative humidity decreased sharply from 60% around 9:00 a.m. to 30% around 11:30 a.m., with a temporary increase around 3:00 p.m. Air temperature ranged from 21°C to 25°C and easterly winds no greater than four mph prevailed during the sampling period. Skies were clear with visibility greater than 20 miles.

4.4.2 Asbestos Filter Sampling

The filter sampling was conducted with paired, four-hour samples both in the morning and in the afternoon. The cyclones were placed atop a table approximately three ft apart. The samplers were eight ft above the eastern edge of the roof (Figure 4.4-1), and were two ft above the retaining ledge that surrounded the building.

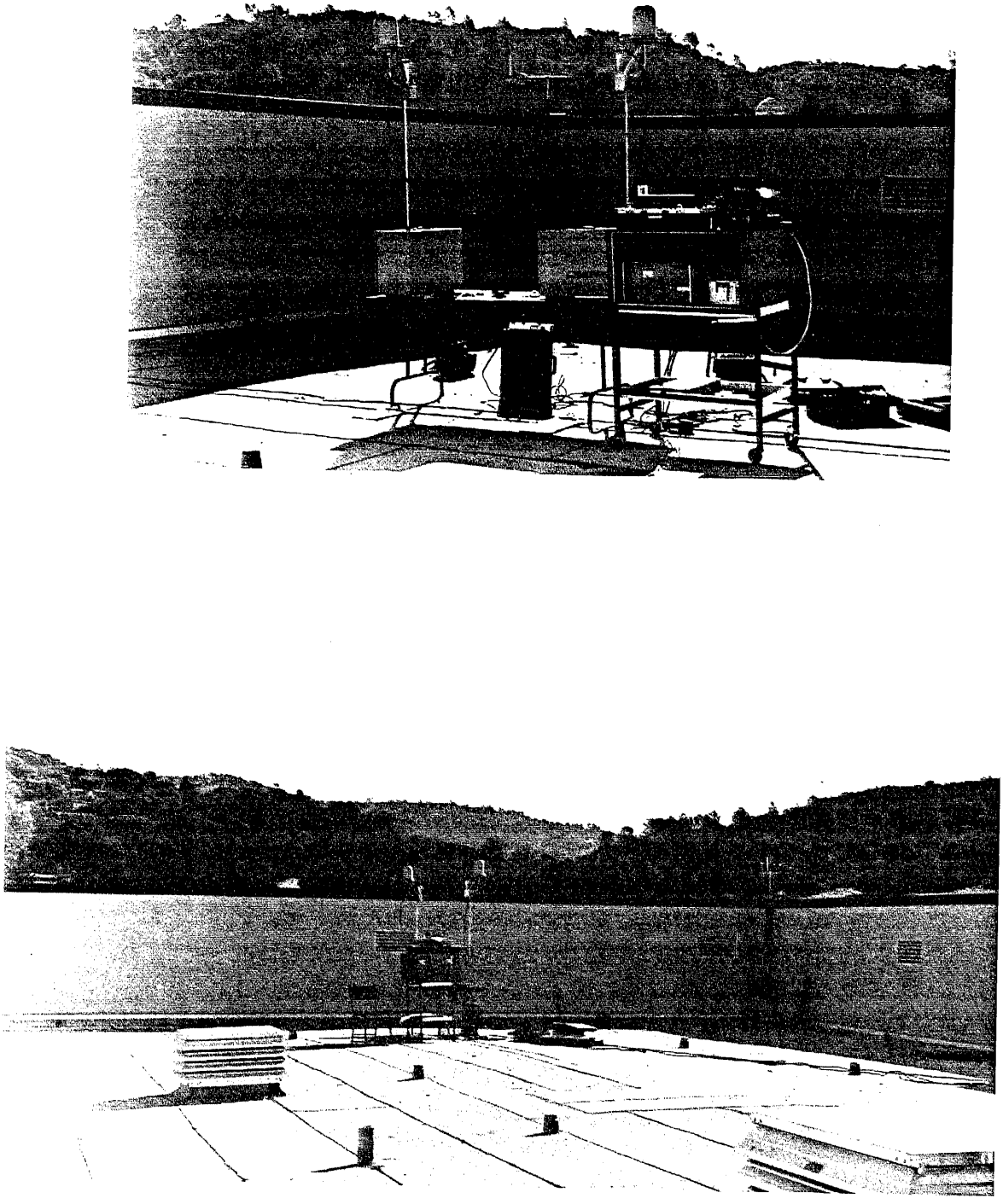


Figure 4.4-1. Sonora Sampling Site (County Administration Building).

Top Photo: View south at the paired sampling arrangement.

Bottom Photo: View east.

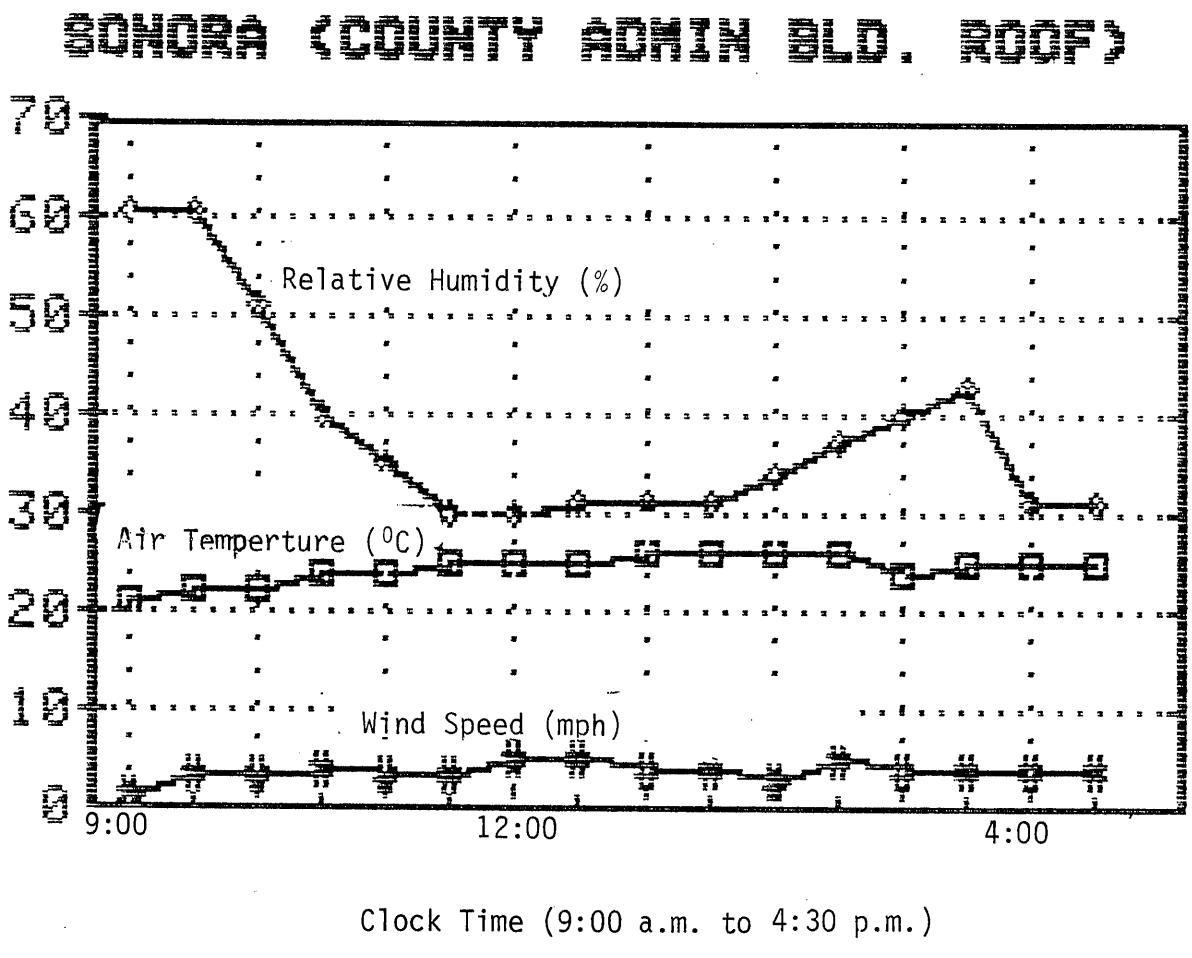


Figure 4.4-2. Meteorological Data Summary for Sonora. Based on one-half hour sampling intervals.

4.4.3 Suspended Particle Monitoring

The particle counters were placed no more than four ft from the asbestos sampling inlets. The directly measured particle count and particle mass data from Sonora provided an accurate distribution of particles free from the presence of secondary aerosols (Figure 4.4-3). The particle count data in Figure 4.4-3 present the trend over the sampling day for optical mass concentrations from the RAM® mass counter. Mass concentrations decreased from 35 $\mu g/m^3$ in the early morning, to approximately 10 $\mu g/m^3$ in the afternoon. This decreasing trend is real and not affected by the relative humidity.

Concentrations of particles in the <0.7-μm aerodynamic diameter range are shown in Figure 4.4-4. Particle counts ranged from approximately 160,000 particles/cu. ft in the morning to 50,000 particles/cu. ft in the late afternoon. Electron microscopic observation of the filter sample showed very little contribution from automobile exhaust. The size distribution of particles (Figure 4.4-5) was bimodal, with a high of around 63% at 0.5 μm and a secondary peak of approximately 8% at 4.0 μm.

4.4.4 Asbestos Levels

Of the chrysotile levels shown in Table 4.4-1, only the morning samples were above detection limit. One paired sample level was 12,000 fibers/m^3 and the other was 6,900 fibers/m^3. Afternoon levels of chrysotile asbestos, as well as all amphibole levels, were at or below the minimum detection limit of 2,400 fibers/m^3 of air.

4.4.5 Analysis Summary

Measured asbestos fiber concentrations (fibers/m^3) were much lower than those determined from SAI's previous analyses of archived samples taken on cellulose Hi-Vol filters in 1973 and 1974 (Table 4.4-2). In Table 4.2-2, fiber concentration, total mass and total surface area are given for fiber

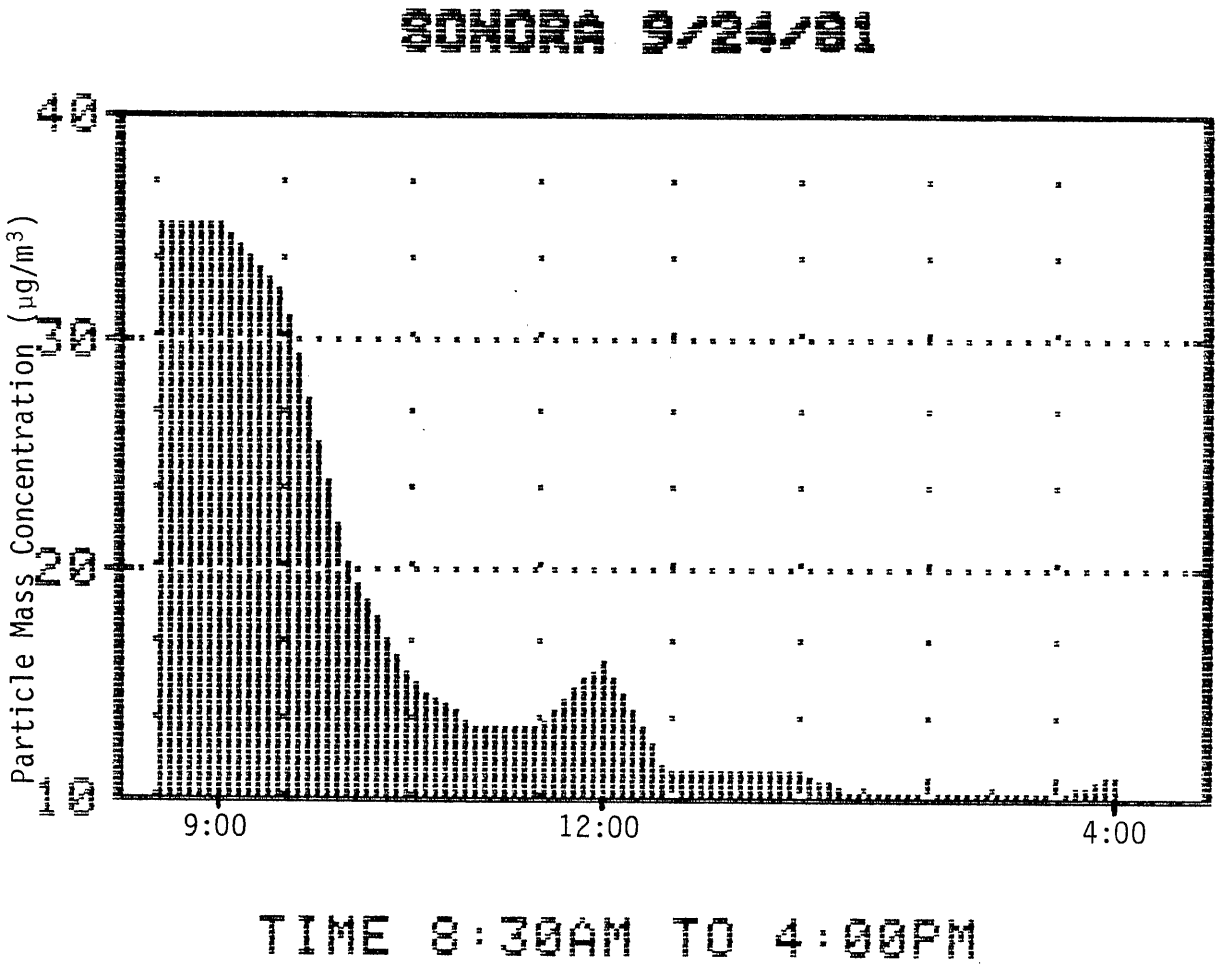


Figure 4.4-3. Particle Mass Concentration Trend ($\mu g/m^3$)versus Time at the Sonora Site. Mass data were collected at one-half hour intervals using the RAM ®Optical Mass Counter.

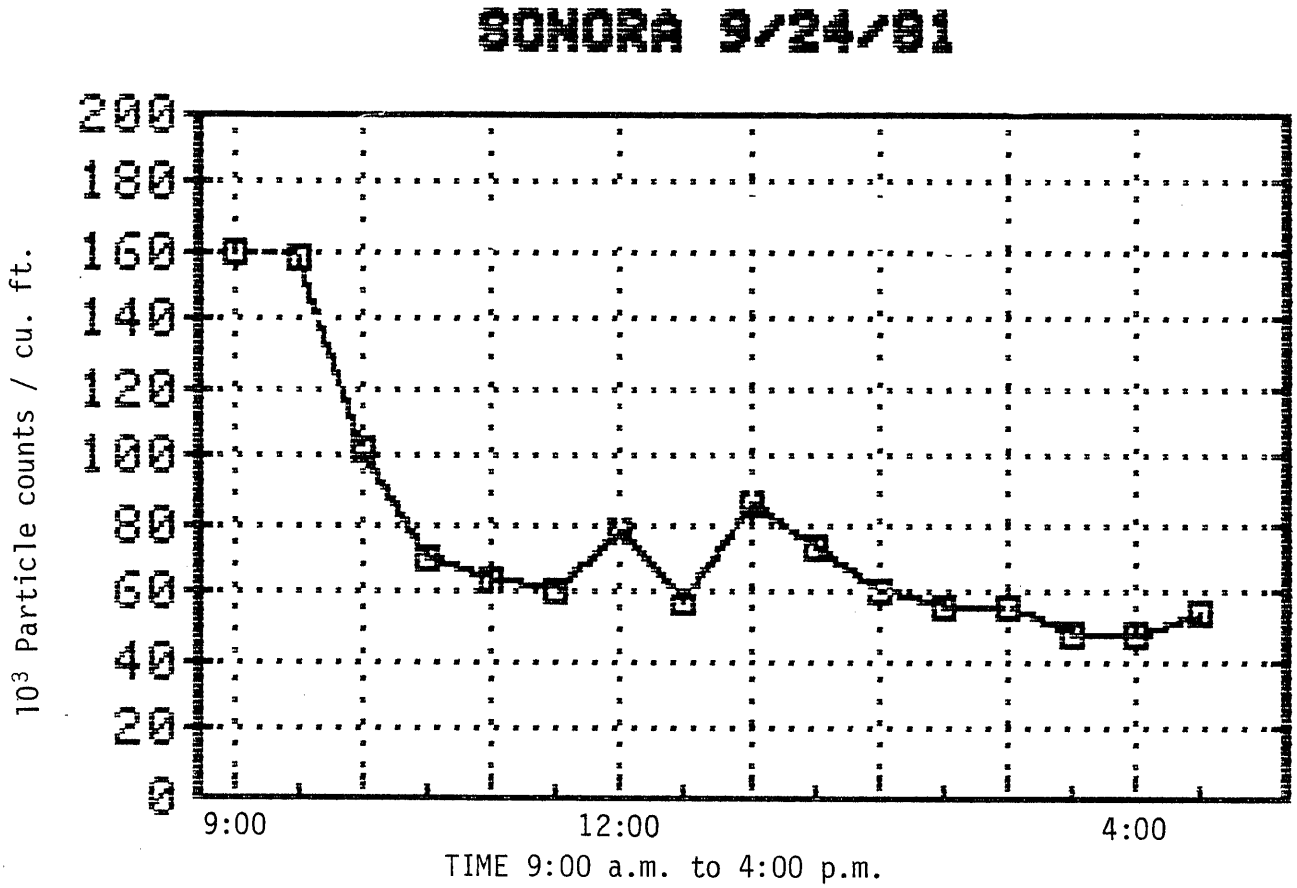


Figure 4.4-4. Optically-Derived Particle Count Trend with Time at the Sonora Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

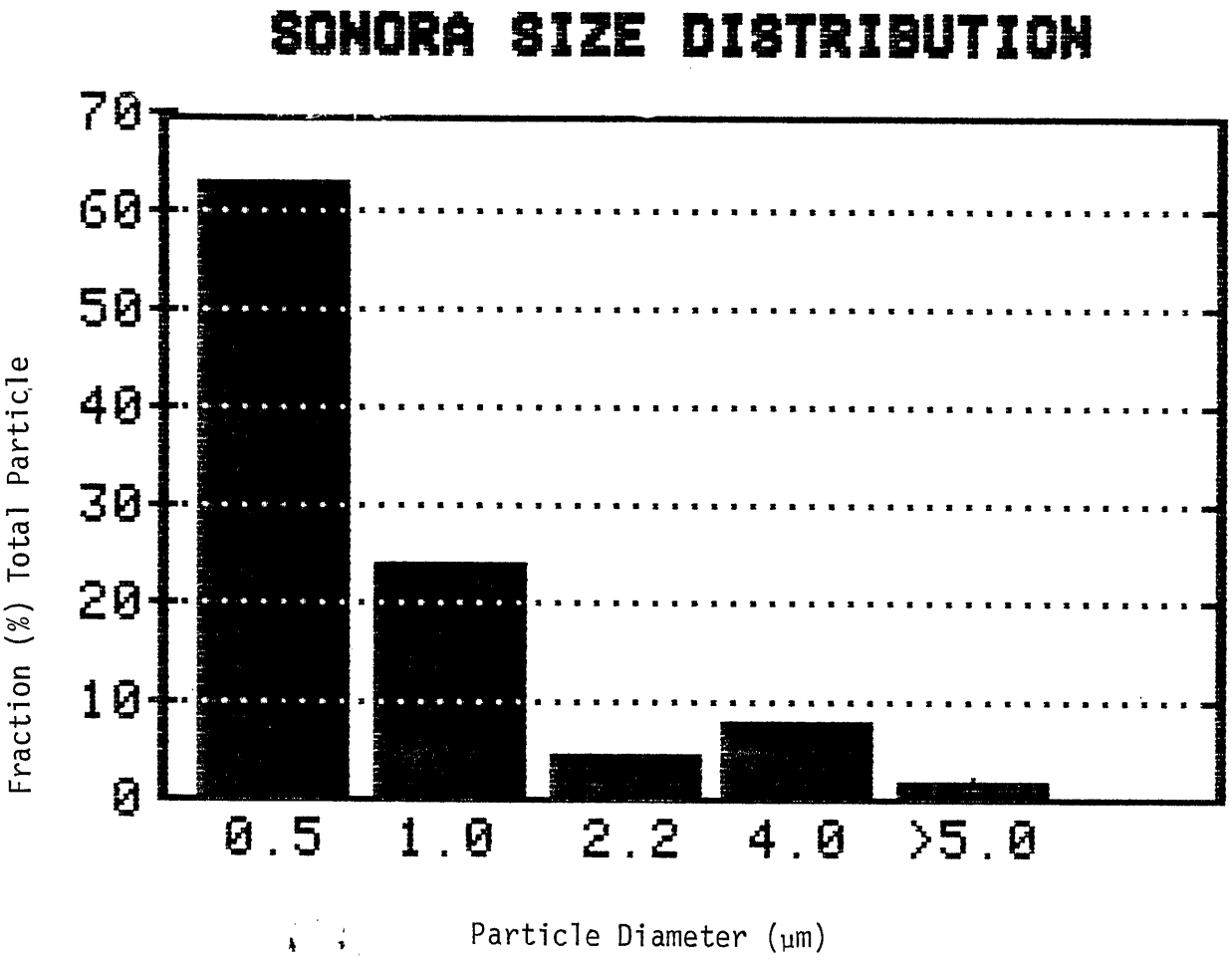


Figure 4.4-5. Particle Size Distribution at the Sonora Site. Data represent eight-hour averages.

Table 4.4-1. Sonora Summary of Sampling and Analysis Parameters.

Sample	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (°C)	Rel. Hum. (%)	Wind Direction (°true)	Wind Speed (mph)	Particles/cu.ft. x 10^3 > 0.3 < 0.7μm	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-25	9/24	Sampler 2 roof	10:05	240	3720.0	23	~60	270	2.5	130 ± 51	1.2×10^4	2.4×10^3 (DL)
A-26	9/24	Sampler 1 roof	10:40	247.1	3830.1	24	~60	270	2.5	60 ± 8	6.9×10^3	2.3×10^3 (DL)
A-27	9/24	Sampler 2 roof	14:40	240	3720	25	43	270	3.0	50 ± 4	2.4×10^3 (DL)	2.4×10^3 (DL)
A-28	9/24	Sampler 1 roof	14:39	236.8	3670.4	25	43	270	3.0	50 ± 4	<DL	<DL

Table 4.4-2. SEM Chrysotile Asbestos Summary for Air Samples Collected in 1973 and 1974.

LOCATION	SITE	COLLECTION DATE	10^3 fibers/m^3 (≤5μm length)	10^3 fibers/m^3 (>5μm length)	10^3ng/m^3 (≤5μm length)	10^3ng/m^3 (>5μm length)	10^3 $\mu m^2/m^3$ (≤5μm length)	10^3 $\mu m^2/m^3$ (>5μm length)
Sonora	55922	08-08-73	3251	448	221	147	2513	1578
Sonora	55922	10-25-73	232	24	118	15	379	127
Sonora	55922	09-20-74	704	12	46	18	456	105
Sonora	55922	12-30-73	247±145	44±23	37±21	24237±33748	234±130	5205±6243
Sonora	55922	06-28-74	106	8.4	13	380	89	333
Sonora	55922	09-25-73	388	38	43	16	332	185
Sonora	55922	04-05-74	231	26	31	27	201	122
Sonora	55922	07-22-74	153	9.5	86	1461	204	752
Sonora	55921	07-15-73	378	73	73	202	401	526
Sonora	55921	05-24-73	1031±253	79±60	268±130	435±214	1305±106	2100±183
Sonora	55921	03-23-73	86	14	3.8	103	45	216
Mariposa	22741	07-11-72	417	31	44	7.2	360	104
Camino	09663	04-10-73	7.5	0.0	0.4	0.0	4.5	0.0
Placerville	09664	04-10-73	29	13	1.6	7.5	15	61
Van 401 ELD	09001	08-14-73	14	0.0	0.5	0.0	6.3	0.0
Modesto	50557	07-26-72	66	16	10	160	59	232
Stockton	39252	07-25-72	29	0.0	5.1	0.0	40	0.0
Leevining	26772	09-20-72	8.3	0.0	1.2	0.0	16.5	0.0
Madera	20001	11-20-72	46	1.9	1.3	11	21	37
Madera	20002	03-13-73	79	8.3	3.1	2.8	38	23
Bridgeport	26773	04-07-73	10	3.4	0.1	39	2.0	74
Van 201 ELD	09301	06-15-73	18	0.0	11	0.0	33	0.0
Sample blank #29 (same ashed blank dilution as sample filters)			0.0	0.0	0.0	0.0	0.0	0.0
Sample blank #2 (10 fold ashed blank dilution as sample filters)			7.0	0.8	0.3	3.4	4.4	9.6
Sample blank #3 (10 fold aerosol O.T. and filtered water blank)			0.0	0.0	0.0	0.0	0.0	0.0

length greater than and less than 5 μm. (5 μm is the cutoff for measurement by optical microscopy.) Surface area is calculated for right cylinders using actual fiber length and diameter as measured by microscopy. The data for the archived filter samples were obtained after low temperature ashing of the Whatman® cellulose filters. Large bundles of fibers were found, and ambient concentrations ranged from 100,000 to 1,000,000 chrysotile fibers/m^3. Although these samples contained large fiber bundles, greater than 90% of the fibers were still less than 30 μm in aerodynamic diameter. The difference in fiber concentration between archived and current samples is probably not due to the Hi-Vol sampling equipment. The consistently high levels of asbestos from 1973-1974 more likely indicate that construction or some other disturbances may have influenced samples collected during that period. Weather on and around our sampling day (9/24/81) was extremely calm and the possibility of somewhat higher levels of asbestos would exist if wind resuspension had played a role. Comparison of the optical mass data with the mean yearly TSP data (see Section 5.0) indicates that the Sonora site was sampled on a day with lower than average TSP levels.

4.5 Century City Braking Intersection

4.5.1 Sampling Design and Location

Selecting a site which could be monitored for brake emissions required the following conditions:

1. Site should represent a focal point for automobile braking to ensure the proper orientation of samplers.
2. Traffic counting should be accurate.
3. The site should not be subject to purging winds.
4. The sampling should contrast high and low traffic conditions.
5. The site should be sampled on clear days.

These requirements were considered in choosing the intersection of Santa Monica Blvd. and Avenue of the Stars in Century City (Los Angeles). The complex intersection is a divided thoroughfare which consists of 'Big' Santa Monica Blvd. and 'Little' Santa Monica Blvd., both running east and west. They each are four lane roads with additional turn lanes on the latter. Avenue of the Stars runs south and has six lanes that empty into the divided intersection. The divider is approximately 50 ft wide and occupies another six lanes. Fourteen lanes in this intersection were used as sources for potential braking. East-west and north-south views of the intersection are presented in Figure 4.5-1.

Traffic counting was performed by California Department of Transportation on both sections of Santa Monica Blvd. The Century City intersection is bordered on the south side by 20-story buildings and on the north side by a golf course with 20-ft high trees. The north side is elevated above the south side and the trees act as a windbreak along Santa Monica Blvd. Santa Monica Blvd. is the main thoroughfare for downtown business. A shopping mall is southwest of the intersection. Sampling was done on Sunday (10/18/81) and Monday (10/19/81), in order to contrast high and low traffic levels. These particular days were clear with generally calm winds (less than five mph). Clear skies (visibility >20 miles) indicated that any asbestos levels detected would originate at the intersection.

4.5.2 Site Meteorology

Weather conditions for the sampling period (Sunday and Monday) were ideal, and the meteorological variables observed on the two days (Figure 4.5-2) were generally similar. The weather sensors were placed 12 ft above street level on the east side of the center divider. The relative humidity on Sunday ranged from 75% in the morning to 30% in the afternoon. The relative humidity on Monday ranged from 42% in the morning to to 12% in the afternoon. The lower humidities on Monday may have been due to dry Santa Ana winds (from the east). The temperature for both days ranged from approximately 20° C to

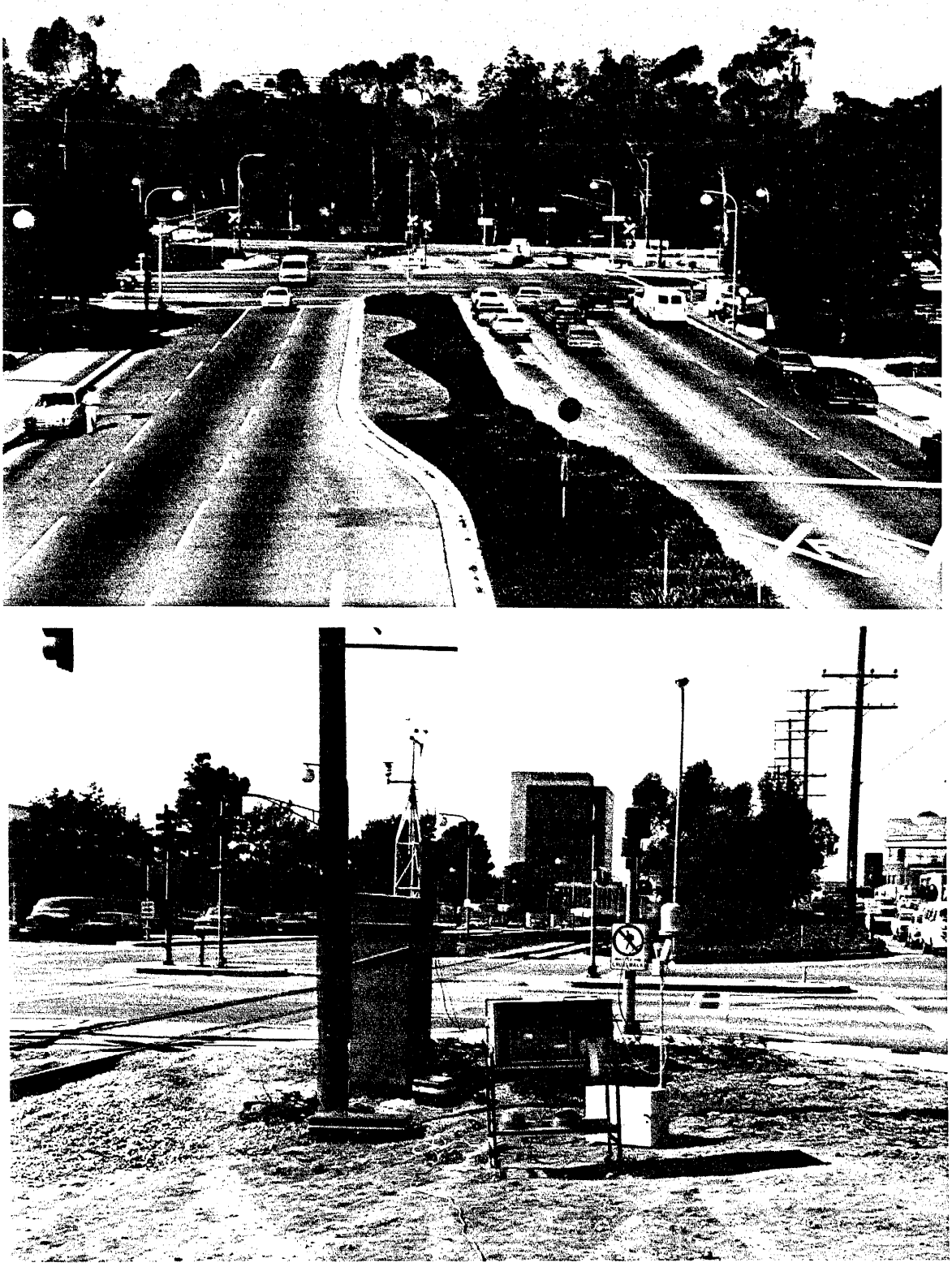
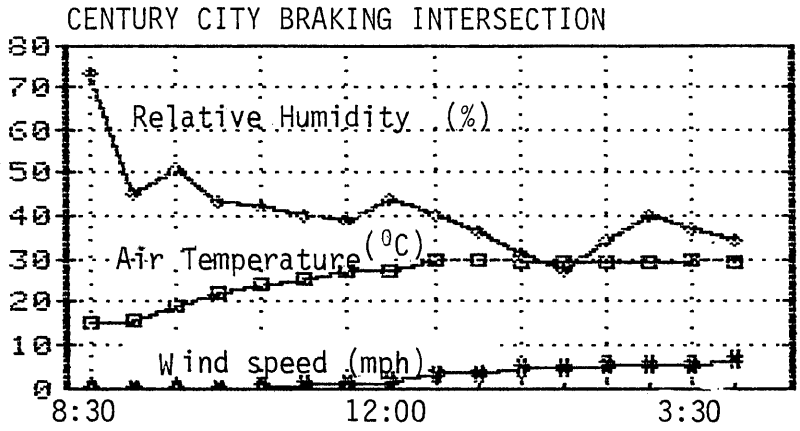


Figure 4.5-1. Century City Sampling Site.

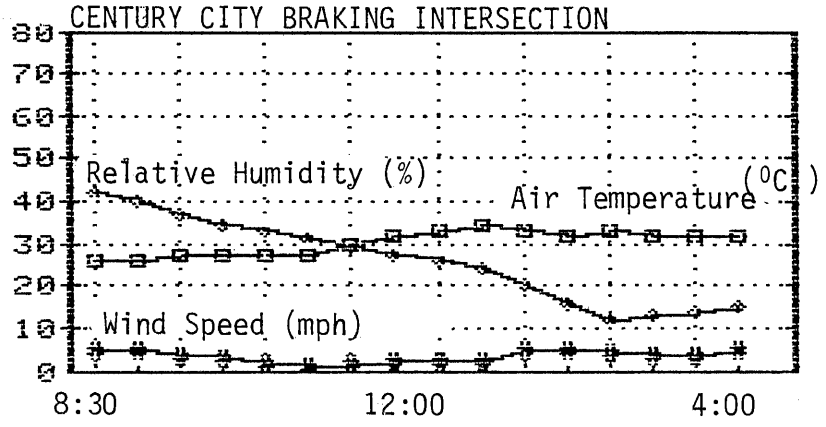
Top Photo: The view north from Avenue of the Stars (Santa Monica Blvd. is left to right in the photo).

Bottom Photo: The view west from the east side of Santa Monica Blvd. The sampler on the west side of the street appears just to the right of the weather tower.



Clock Time 8:30 a.m. to 3:30 p.m.

(Sunday 10/18/81)



Clock Time 8:30 a.m. 4:00 p.m.

(Monday 10/19/81)

Figure 4.5-2. Meteorological Data Summary for Century City. Based on one-half hour sampling intervals at the downwind sampling location.

over 30° C. The winds on Sunday were calm until approximately noon and then a very weak marine flow no greater than six mph developed from the west. Monday morning began with a variable due easterly flow at approximately five mph, decreasing to less than one mph around 11:30 a.m. and again increasing with the afternoon marine flow from the west to approximately five mph. The wind largely purged the intersection of particulate matter. The visibility for both days was greater than 20 miles and the local South Coast Air Quality Management District reported 'good' air quality.

4.5.3 Asbestos Filter Sampling

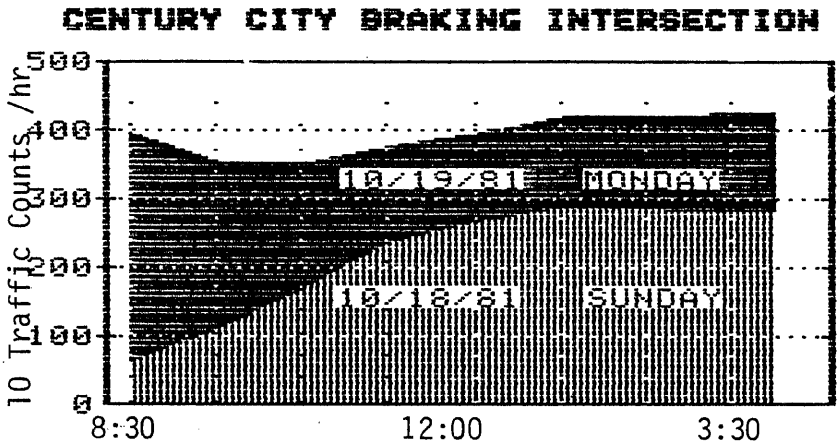
Two filter samplers were placed in the Santa Monica Blvd. center divider, on either side (Figure 4.5-1). To avoid excessive particulate matter loadings on the filters, we collected a larger number of shorter time interval samples. Sampling conditions are reported in Table 4.5-1. The sampling pumps were powered by generators located 100 ft away. Both samplers were only 20 ft away from the traffic and the sampler inlets were 5 ft off the ground.

4.5.4 Suspended Particle Monitoring

The RAM® mass counter was not operational for the Century City location. All readings from the Royco® counter were recorded at the sampler located on the east side of Avenue of the Stars. The inlet of the Royco® counter was six inches from the asbestos cyclone sampler inlet. Mass concentration data, shown in the particle loading data in the lower segment of Figure 4.5-3, were derived from the relationship between particle counts and mass at the San Jose site (Figure 3.4-3). The graphs in Figure 4.5-4 compare mass levels ($\mu g/m^3$) with wind speed (mph), indicating a Sunday decrease from 50 $\mu g/m^3$ to 15 $\mu g/m^3$ corresponding to an increase of easterly wind speed in the afternoon. The highest mass concentrations on Monday corresponded to periods of low wind speed from approximately 10:00 a.m. to 11:30 a.m. It should be noted that the mean traffic counts/hour on Sunday and Monday (Figure 4.5-3) did not correlate with the mass concentrations except for generally higher peak levels on Monday. We concluded from these data that even relatively low wind speeds could significantly purge airborne particulate matter, even at a congested intersection.

TABLE 4.5-1. Century City Summary of Meteorological and Sampling Parameters

Sample	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (C)	Rel. Hum. (%)	Wind Direction (°true)	Wind Speed (mph)	Particles/cu.ft 10^3(> 0.3 <0.7μm)	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-36	10/18	East	9:10	157.6	2442.8	18	45	---	--[c]	270 ± 53	<DL	<DL
A-38	10/18	West	9:20	137.1	2125.1	18	45	---	--[c]	270 ± 53	4.1×10^3(DL)	<DL
A-39	10/18	East	11:10	62.6	970.3	26	39	120	1.0	240 ± 30	N.A.	N.A.
A-40	10/18	West	11:30	67.2	1041.6	27	39	120	1.0	260 ± 32	N.A.	N.A.
A-100	10/18	East	13:45	203.7	3157.4	29	32	250	5.0	170 ± 75	1.5×10^4	<DL
A-101	10/18	West	12:40	28.9	448.0	29	39	230	3.0	170 ± 26	N.A.	N.A.
A-102	10/18	West	14:05	86.1	1334.6	30	30	260	5.0	120 ± 20	4.6×10^4	20×10^4
A-41	10/19	East	7:30	61.0	945.4	24	32	90	5.0	140 ± 34	5.6×10^4	<DL
A-42	10/19	West	7:43	77.1	1195.1	24	32	90	5.0	130 ± 31	N.A.	N.A.
A-103	10/19	East	8:55	78.0	1209.0	26	34	100	4.0	150 ± 34	N.A.	N.A.
A-104	10/19	West	9:10	68.7	1064.9	26	34	100	4.0	200 ± 51	<DL	<DL
A-105	10/19	East	12:20	61.5	953.3	34	24	230	2.0	170 ± 33	N.A.	N.A.
A-106	10/19	West	12:16	58.0	899.0	27	25	130	1.0	170 ± 33	N.A.	N.A.
A-43	10/19	East	13:55	90.5	1402.8	32	12	270	4.0	160 ± 32	N.A.	N.A.
A-44	10/19	West	14:43	164.2	2545.1	32	15	270	4.5	160 ± 33	<DL	<DL
A-45	10/19	East	15:30	60.3	934.7	32	15	270	5.0	120 ± 20	2.8×10^4	9.4×10^3 (DL)



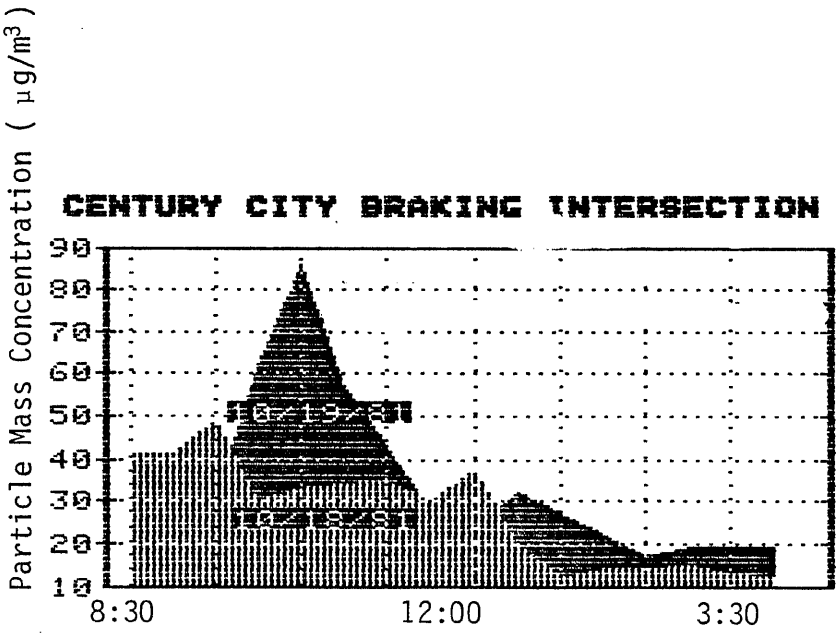
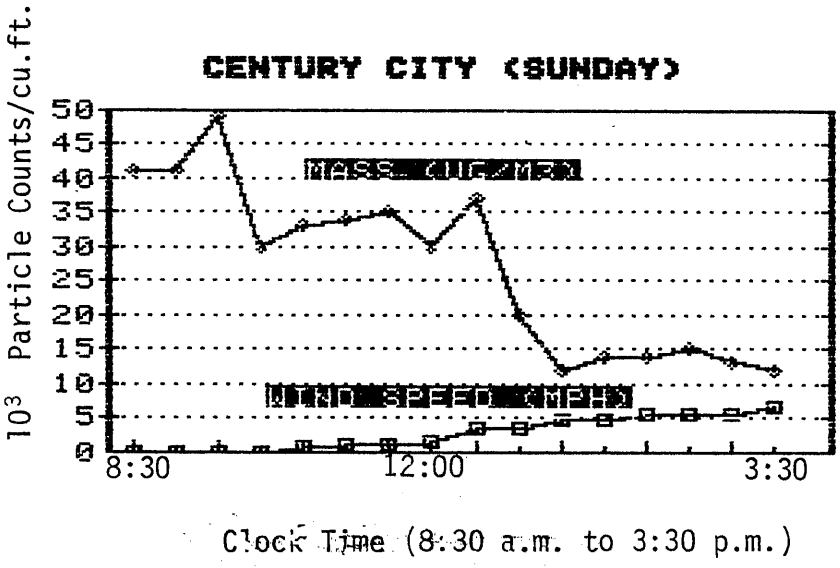


Figure 4.5-3. Century City Traffic Count (from CalTrans) and Optically-Derived Particle Mass Concentration Trends with Time. Data collected at one-half intervals.



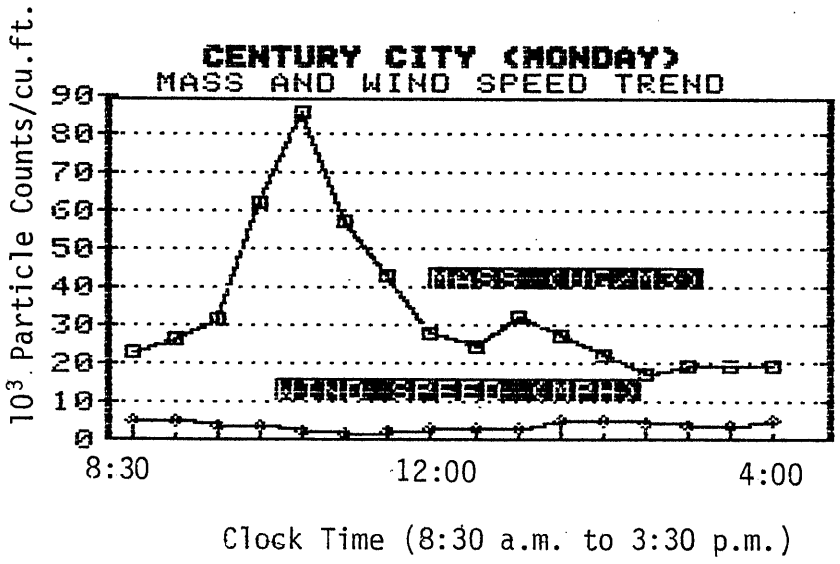


Figure 4.5-4. Daily Trend in Wind Speed and Suspended Mass Concentration at Century City for Two Sampling Days (Sunday, 10/18/81; Monday, 10/19/81).

Concentrations of particles in the asbestos size range (Figure 4.5-5) on Sunday varied from an early morning high of approximately 300,000 to an afternoon low of 100,000 particles/cu. ft. The levels on Monday ranged from a high at 11:00 a.m. of 600,000 particles/cu. ft to an afternoon low of approximately 120,000 particles/cu. ft. The size distribution data presented in Figure 4.5-6 reveal a slightly higher fraction of particles in the larger size ranges on Monday than those collected on Sunday. The distribution was slightly bimodal on both sampling days and was skewed toward the smaller particles, presumably reflecting the effects of automobile exhaust as a dominant source. The size distribution difference between Sunday and Monday does not appear to be significant.

4.5.5 Traffic Measurements

To record traffic flow (cars/hr), CalTrans put traffic counters on the west side of Avenue of the Stars across both of the Santa Monica Blvds. The results were divided into four sets of data representing east and west flow on both streets. A daily traffic count trend plot (Figure 4.5-3) combines all four of the data sets and shows the total number of cars/hour for both streets. At 8:30 a.m. Sunday, traffic flow was approximately 600 cars/hour, reaching a maximum around 2:30 p.m. of nearly 2,800 cars/hour. The 4000 cars/hour on Monday at 8:30 in the morning was almost seven times higher than Sunday for the same time period. The lowest level of traffic on Monday was approximately 10:00 a.m., although this did not correspond to the particle mass concentration levels, which were observed to be at their highest point during this time period.

The heaviest traffic flow was seen at 1:30 p.m. where it flowed at a rate of 4,200 cars/hour; however, this traffic flow can not necessarily be correlated to a heavy use of braking at that same time. In fact, in this sampling there was often lower braking activity at the highly congested intersections due to reduced traffic speeds. Traffic in all directions at the Century City intersection backed up as much as ten cars at each stop light. Also all traffic cleared in each light change even during peak traffic periods, minimizing the frequency of high speed braking.

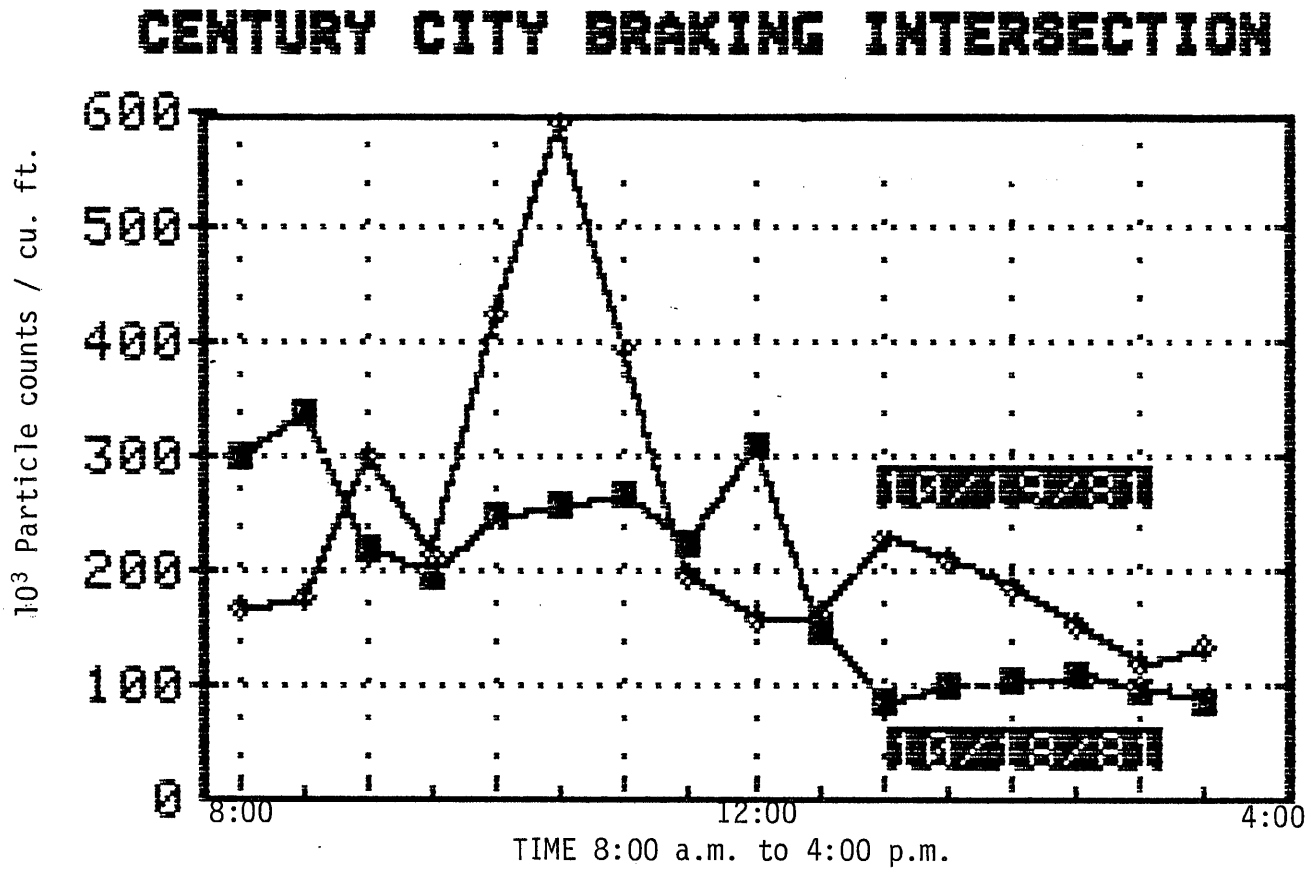


Figure 4.5-5. Optically-Derived Particle Count Trend with Time at the Century City Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

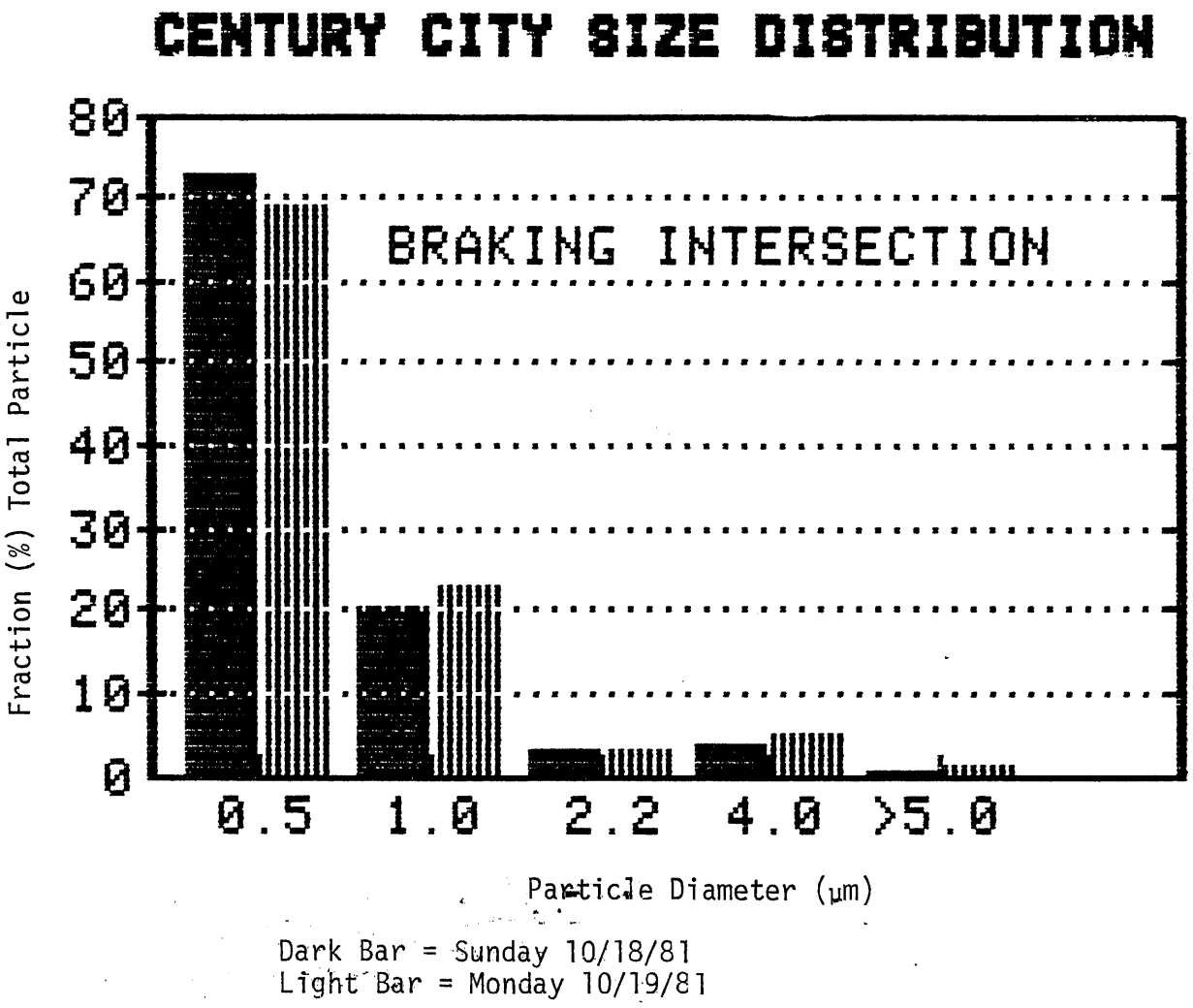


Figure 4.5-6. Particle Size Distribution at the Century City Site. Data represent eight-hour averages.

4.5.6 Asbestos Levels

The high particulate matter loading in the samples resulted in shortening the sample time to one hour in some cases. Table 4.5-2 indicates the ratios from asbestos concentration divided by the corrected detection limit for sampling times presented in Figure 3.4-1.

Table 4.5-2. Century City Asbestos Concentrations as Fibers/m^3 and Normalized to Analytical Detection Limit

Sample	Detection Limit (DL;fibers/m^3)	Asbestos Concentration (fibers/m^3)	Concentration/DL Ratio
	Sunday (10/18/81)		
A-36 E	3,500	<3,500	<1.0
A-38 W	4,100	4,100	1.0
A-100 E	2,900	15,000	5.2
A-102 W	7,500	46,000	6.1
	Monday (10/19/81)		
A-41 E	9,200	56,000	6.1
104 W	9,200	<9,200	<1.0
A-44 W	3,300	28,000	8.5
A-45 E	9,200	<9,200	<1.0

Each sample shown in Table 4.5-2 is followed by a letter designating which side (east or west) of Avenue of the Stars it was collected. Because of the variable sample times, the low fiber levels observed (none higher than 56,000 fibers/m^3 for chrysotile) should be compared only as their ratios to the detection limit. The highest level observed (sample A-41; 56,000 fibers/m^3) was only six times higher than the detection limit and was subject to some error. The amphibole levels for all the Century City samples were at or below the detection limit.

4.5.7 Analysis Summary

An important consideration was the comparison of the highest sample level at Century City with those at other sites sampled. Clearly, there was no distinction between this braking intersection and other sites. The only possible correlation was the comparison of sample A-36 with sample A-41. Both of these samples were taken on Sunday and Monday early in the morning at a time when the contrast in traffic flow was greatest. The chrysotile asbestos level was higher by a factor of ten on Monday. Conclusions from these data should be cautiously drawn. The heavy traffic volume can not always be correlated with asbestos generation since the traffic levels at incidences of braking can not necessarily be correlated. The TEM counting of sample A-41 showed most of the fibers on one out of the three grids counted. The higher levels in this sample could be a direct result of a series of emergency brakings at some point during the sampling.

The mean level of chrysotile asbestos above the detection limit for Sunday was measured at 31,000 fibers/m^3 and for Monday, 42,000 fibers/m^3. Their difference was not significant. Amphibole asbestos levels were not found above detection limit, and no 'elevated' levels of asbestos above detection limit could be directly related to vehicular braking.

4.6 San Fernando Valley

4.6.1 Site Location and Meteorology

The San Fernando Valley site is an urban area with no natural asbestos deposits or industrial or vehicular asbestos sources. The site is heavily populated. The Van Nuys-Sherman Oaks Park was the site chosen, in the south-central portion of the Valley located at the intersection of Hazeltine St. and Huston St. Since the park was two miles from the intersection of the nearest freeways (Highways 101 and 405), vehicular exhaust did not directly contribute to particle counts. The sampling equipment was put on top of the diving towers of the municipal pool (Figure 4.6-1). Automobile-related smog was the main source of particles in the area. The samplers were approximately 300 ft from any direct exposure to traffic, although traffic was minimal throughout the day. The heaviest traffic was on Hazeltine St., 600 ft from the samplers on the east side of the park. The average traffic flow was no greater than 450 cars/hour.

The sampling day (10/20/81) was warm and clear due to a mild Santa Ana (easterly) wind, and morning visibility was approximately 20 miles. In mid-afternoon, the Santa Ana dissipated and the returning smog reduced the visibility to less than 10 miles. The top section of the weather tower was placed on top of the 5-m diving tower and this elevated the sensors to approximately 30 ft above ground (Figure 4.6-1). The summary of weather conditions is contained in Figure 4.6-2. The relative humidity ranged from approximately 56% in the early morning to a low of 35% around noon. The temperature ranged from approximately 18° to 28°C. The sky was very clear in the morning, with high cirrus clouds appearing around noon. The wind direction shifted during the day from the east to a variable westerly flow. The wind speed ranged from variable zero to two mph in the morning, to six mph in the afternoon.

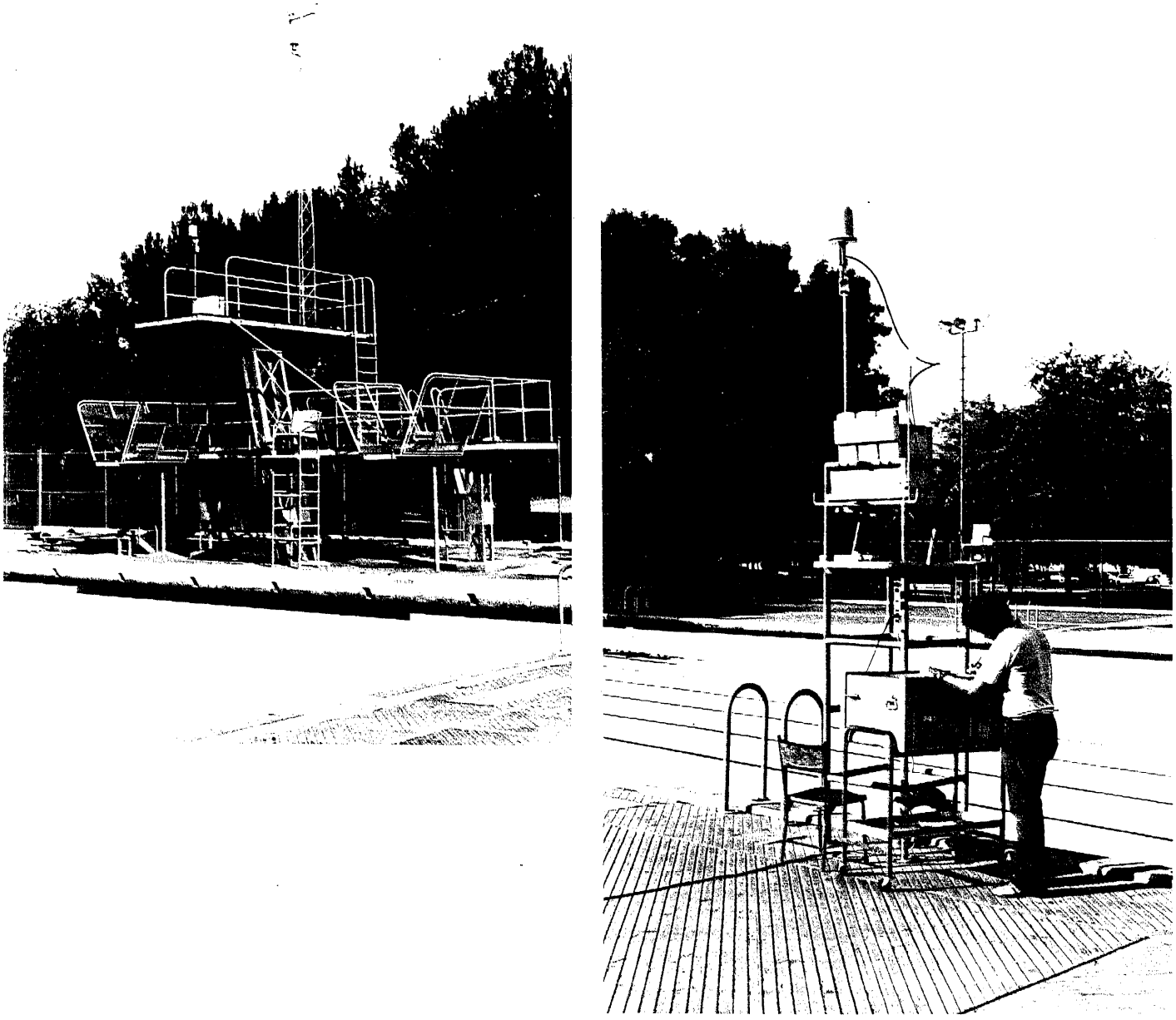


Figure 4.6-1. San Fernando Valley Sampling Site (Van Nuys/Sherman Oaks Municipal Pool).

Left Photo: The northern sampler location of the cyclone assembly and weather tower located on top of the 5-m diving tower.

Right Photo: The lifeguard tower sampling location on east side of the pool.

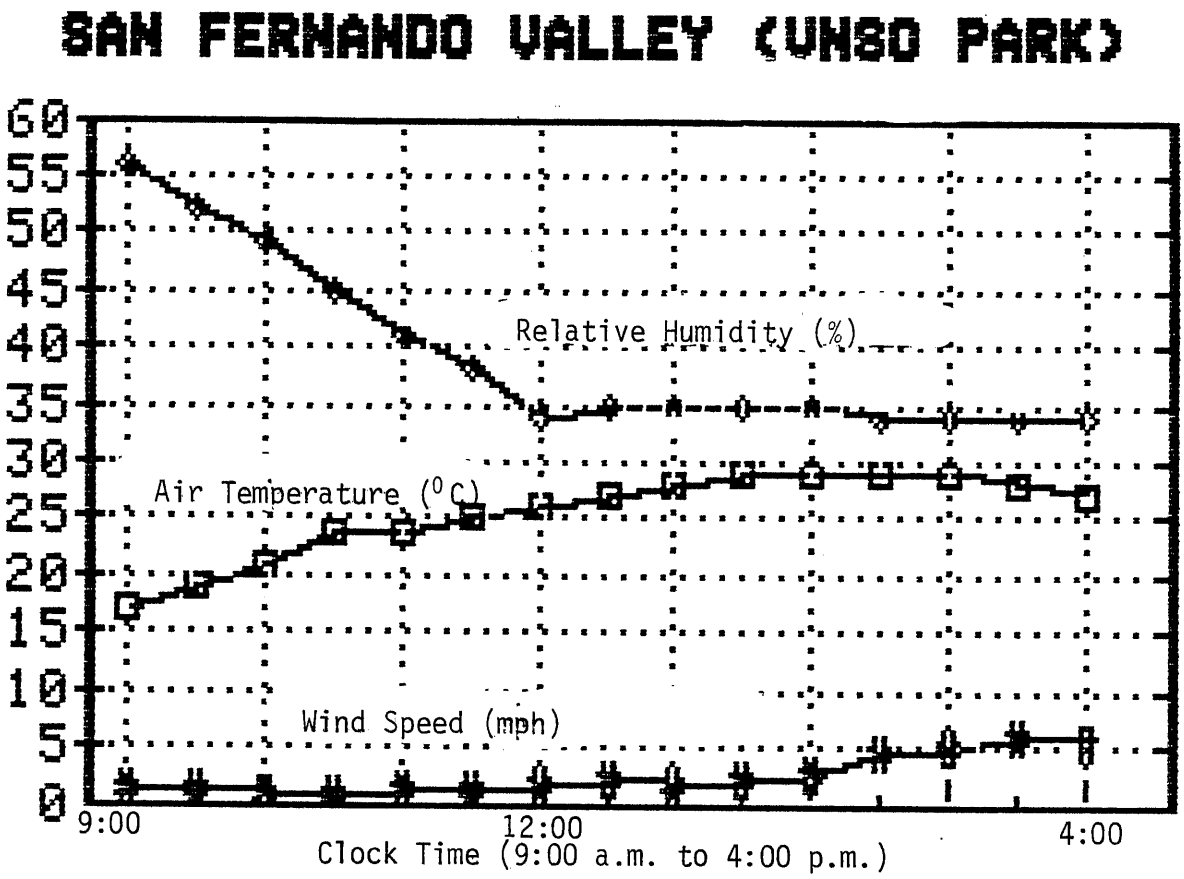


Figure 4.6-2. Meteorological Data Summary for San Fernando Valley (Unso Park). Based on one-half hour sampling intervals.

4.6.2 Asbestos Filter Sampling

The non-paired placement of the samplers is shown in the two photos in Figure 4.6-1. One sampling train was placed in the lifeguard tower at the eastern edge of the 50-m pool with the filter inlet approximately 13 ft above the cement deck. The other sampler was placed at the north end of the pool on top of the diving tower, approximately 23 ft above the ground. Collection times ranged from approximately one and one-half to four hours.

4.6.3 Suspended Particle Monitoring

The RAM® mass counter was not used at the San Fernando Valley location and all readings with the Royco® counter were taken at the lifeguard tower. The inlet of the Royco® counter was placed approximately two ft from the cyclone sampler inlet. The particulate matter concentration data presented in Figure 4.6-3 detail the mass trend over the entire sampling period. These data were derived from the linear regression drawn from the San Jose data due to the similarity in size distribution and automobile emissions observed under TEM. The mass levels ranged from a high at 10:00 a.m. of 60 $\mu g/m^3$ to a temporary low around noon of 20 $\mu g/m^3$. An increase to approximately 54 $\mu g/m^3$ around 3:00 p.m. was due to visibly noticeable smog.

Concentrations of particles in the <0.7-µm aerodynamic diameter range is presented in Figure 4.6-4. The fluctuation in levels range from 460,000 particles/cu. ft in mid-morning, to 200,000 particles/cu. ft in the early afternoon, to 440,000 particles/cu. ft in the mid-afternoon. As seen in Figure 4.6-5, the size distribution is bimodal, with 73% of the particles in the 0.5-µm size range and a secondary maximum of 4.0% of particles in the 4.0-µm size range.

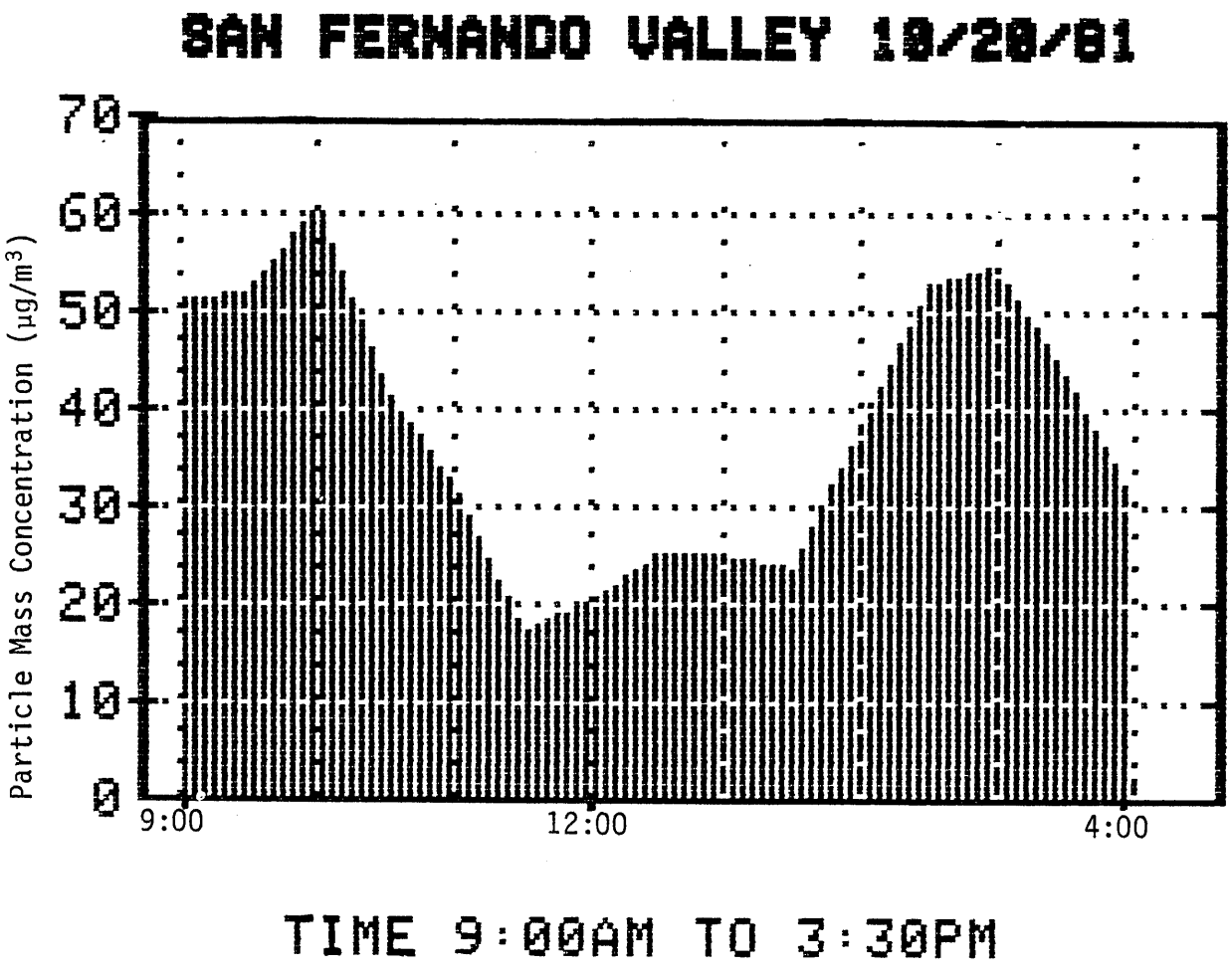


Figure 4.6-3. Optically-Derived Particle Mass Concentration Trend with Time at the San Fernando Valley Site. Mass data were collected at one-half hour intervals using the RAM ® Optical Mass Counter.

4.6.4 Asbestos Levels

The asbestos levels at the San Fernando Valley site ranged from the limit of detection to a high of only 28,000 chrysotile fibers/m^3 in sample A-48. This sample was collected at the lifeguard tower between 1:00 p.m. and 4:00 p.m. (Table 4.6-1). The average value for chrysotile asbestos was 15,100 fibers/m^3. All amphibole measurements were at the analytical detection limit (~2,400 fibers/m^3).

4.6.5 Analysis Summary

Asbestos levels in the San Fernando Valley site were low. No correlation exists between asbestos levels and atmospheric particulate matter loading; this is substantiated by data from the South Gate and Century City sites. These sites were affected by the same secondary aerosol sources and climatic conditions, and all three sites had levels below 60,000 fibers/m^3. No fibers longer than 5.0 μm were found at any of these sites.

4.7 Bakersfield (CARB Meteorological Station; Oildale)

4.7.1 Site Location and Meteorology

The Bakersfield site, representing an 'urban' location, is situated at the CARB meteorological station on Chester Ave. The area's population is exposed to pollutants from large-scale agriculture and oil production activity. Because of geographic location, local climatic conditions and extent of its petroleum-related industry, Bakersfield air pollution problems can at times become severe. Despite the severity of other air pollution problems, a lack of NESHAP-registered asbestos users and natural asbestos sources in the area indicates that only low levels of fibers would occur.

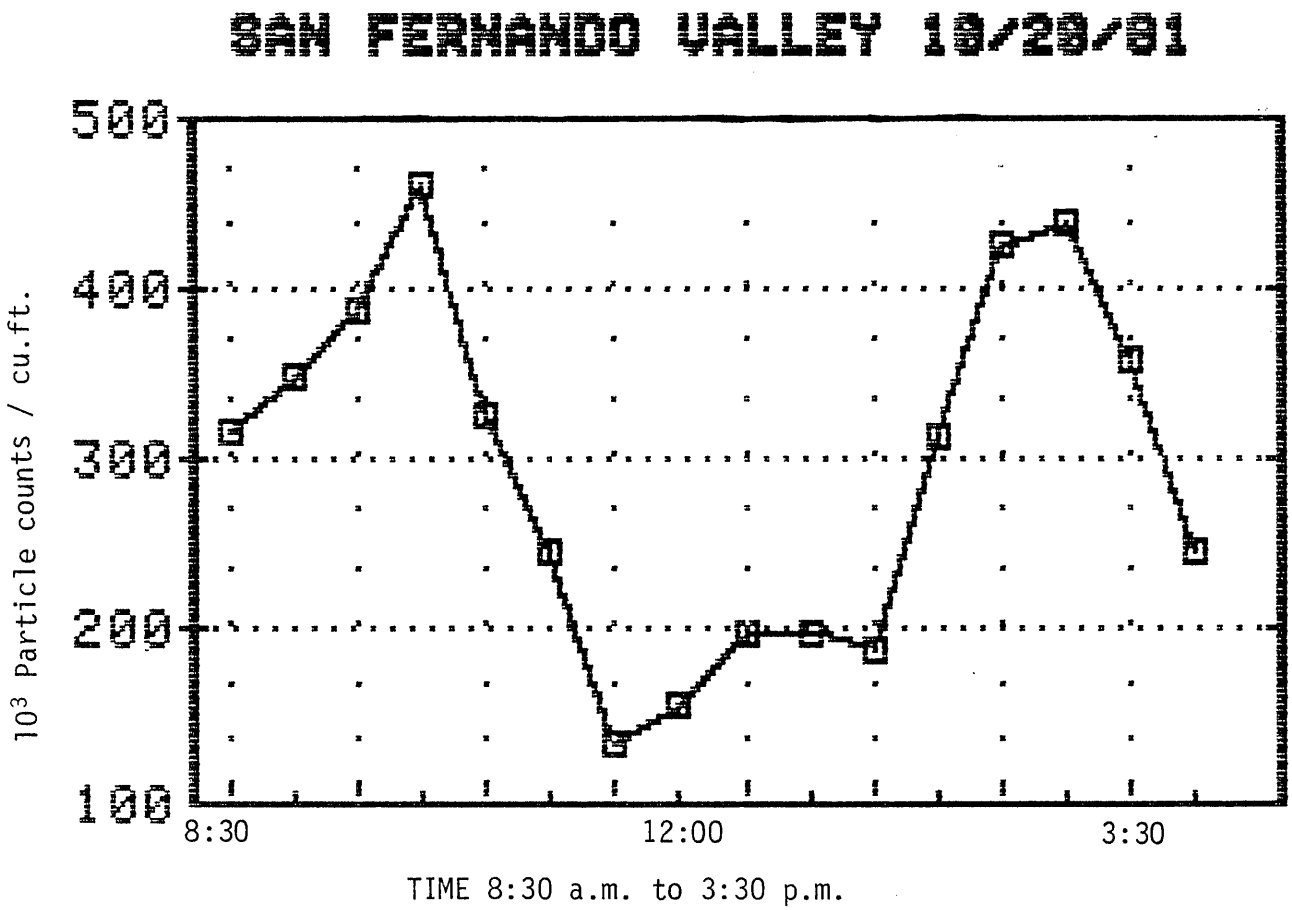


Figure 4.6-4. Optically-Derived Particle Count Trend with Time at the San Fernando Valley Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

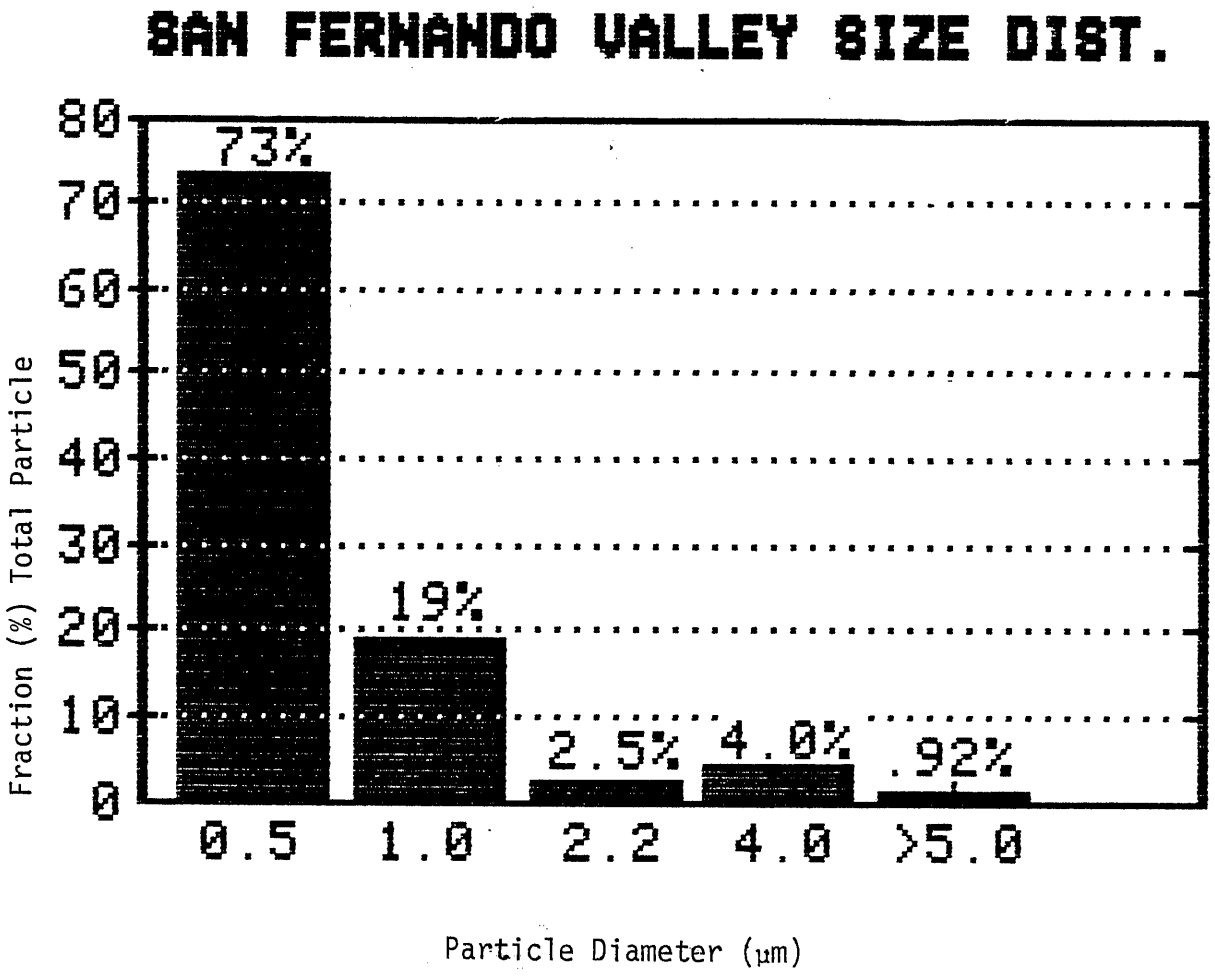


Figure 4.6-5. Particle Size Distribution at the San Fernando Valley Site. Data represent eight-hour averages.

Table 4.6-1 SAN FERNANDO VALLEY SUMMARY OF METEOROLOGICAL AND SAMPLING PARAMETERS

Sample	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (°C)	Rd. Hum. (%)	Wind Direction	Wind Speed (mph)	Particles/cu.ft. x 10^3 > 0.3 < 0.7μm	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-65	10/20	Diving Tower	10:05	241.2	3738.6	22	34	80	0.5	280 ± 118	<DL	<DL
A-64	10/20	Lifeguard Tower	10:17	240.8	3732.4	22	34	80	0.5	280 ± 118	1.6×10^4	<DL
A-47	10/20	Diving Tower	13:37	118.5	1836.8	29	34	150	2.0	300 ± 117	1.4×10^4	4.3×10^3 (DL)
A-48	10/20	Lifeguard Tower	14:30	179.5	2782.3	29	34	180	5.0	∿310 ± 106	2.8×10^4	<DL
A-49	10/20	Diving Tower	15:34	112.8	1748.4	26	34	160	5.0	330 98	N.A.	N.A.

The sampling day (10/21/81) weather conditions, presented in Table 4.7-1, were dominated by warm temperatures influenced by an inversion layer that reduced the visibility to two miles. During the sampling period the temperature ranged from 22° to 29°C, and the relative humidity ranged from 55% at 9:00 a.m. to 31% in the afternoon. Wind measurements were taken by the Bakersfield CARB weather instruments and were based on hourly averages. The winds were light and variable with velocities from the west-northwest no greater than two mph.

4.7.2 Asbestos Filter Sampling

One asbestos cyclone filter sampler was placed in the same area as the other CARB monitoring instruments; and one sampler was placed on the roof of the building in the northeast corner (Figure 4.7-1). The samplers were in different locations to preclude contamination from the rock roof to the sampler on the lower level. The sampling equipment at this station was not located directly on top of the rock roof but was sheltered from free air passage on the north side. The variable wind from the northwest decreased our chances for accurate sampling at the CARB particulate matter instrument sampling area. The CARB sampling instruments and one cyclone sampler were located 25 ft above street level, while the other cyclone was on the roof approximately 35 ft above street level.

All particle concentration measurements were made at the lower sampling area because of the physical problem of raising the particle counting package to the roof. Due to the extremely high particle concentration levels, sampling times were shortened in order that filters would not be overloaded.

4.7.3 Suspended Particle Monitoring

Only the Royco® particle counter was available to monitor real-time suspended particle fluctuations at the Bakersfield site. The inlet of the counter was placed approximately six inches from the cyclone inlet on the

Table 4.7-1 BAKERSFIELD SUMMARY OF METEOROLOGICAL AND SAMPLING PARAMETERS

Sample	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (°C)	Rd. Hum. (%)	Wind Direction	Wind Speed (mph)	Particles/cu.ft. x 10^3 > 0.3 < 0.7μm	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-50	10/21/81	Sampler 1 NE Corner	10:10	177.2	2746.6	22	40	320	0	1400 ± 479	<DL	<DL
A-51	10/21/81	Sampler 2 SE Corner Instument Area	10:40	178.7	2769.9	22	40	290	0	1500 ± 563	6.3×10^3	9.5×10^3
A-52	10/21/81	Sampler 1 NE Corner	13:30	181.5	2813.3	29	31	270	0-2	1700 ± 498	3.1×10^3 (DL)	<DL
A-53	10/21/81	Sampler 2 NE Corner	14:35	168.8	168.8	29	31	280	0-2	1700 ± 10^4	5.2×10^4	5.2×10^4

Figure 4.7-1. Bakersfield Sampling Site (CARB meteorological station on Chester Ave.).

Top Photo: View north; sampler location (A) on third floor roof.

Bottom Photo: View south at the sampler location on the instrument level of the station.

asbestos sampler; both were located at the same elevation as the permanent CARB instrumentation. The linear regression relationship between particle concentration and particle mass distribution from San Jose (Figure 3.4-3) was used to derive mass values for Bakersfield. The suspended particle concentrations derived for the Bakersfield site fluctuated throughout the day from a minimum of around 140 $\mu g/m^3$ to a maximum of approximately 260 $\mu g/m^3$ (Figure 4.7-2). This variability was most likely the result of gradual increases in wind speed coupled with the development of a temperature inversion as the day passed.

Concentrations of particles in the <0.7-μm aerodynamic diameter range are presented in Figure 4.7-3. The eight-hour levels do not reflect any distinct trend, although some effects of the air-stagnating temperature inversion conditions, which persisted throughout the day, are apparent. Particulate matter concentrations ranged from a low of 1,000,000 particles/cu. ft at 11:00 a.m., to a high of 2,800,000 particles/cu. ft at 2:30 p.m. The suspended particle size distribution is shown in Figure 4.7-4. The distribution of size fractions is slightly bimodal, with a maximum at 0.5 μm (66%) and a slight increase at 4.0 μm (3.6%). The high particle concentration levels and the size distribution in the Bakersfield area are not the result of automobile exhaust emissions, but rather a combination of resuspended soil from agricultural activity and emission from nearby petroleum-oil related industries.

4.7.4 Asbestos Levels

The levels of asbestos in the Bakersfield site ranged from the analytical detection limit to 52,000 fibers/m^3 in both chrysotile and amphibole categories. The average level of chrysotile was approximately 16,000 fibers/m^3 and the average amphibole level was approximately 17,000 fibers/m^3.

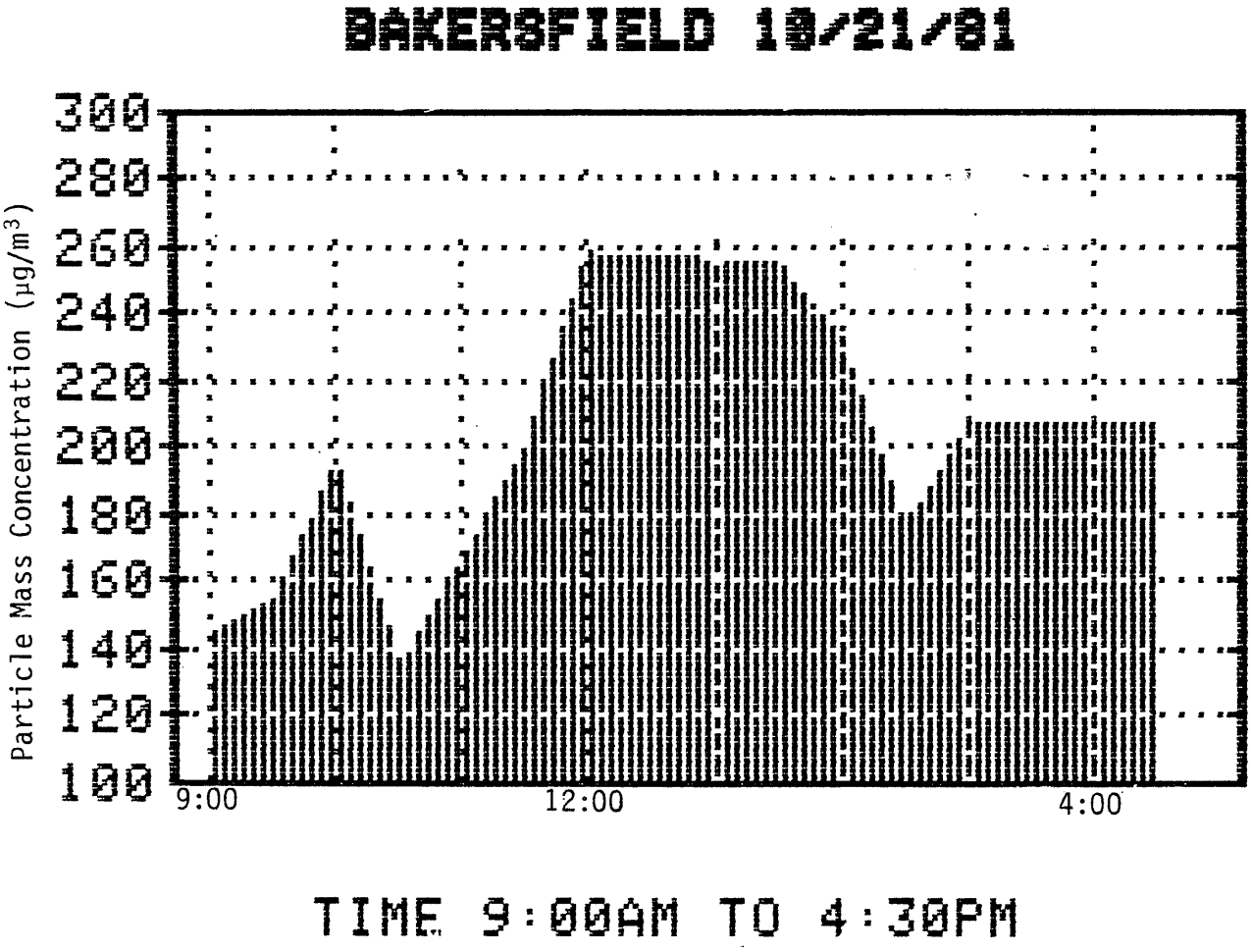


Figure 4.7-2. Optically-Derived Particle Mass Concentration Trend with Time at the Bakersfield Site. Mass data were collected at one-half hour intervals using the RAM ® Optical Mass Counter.

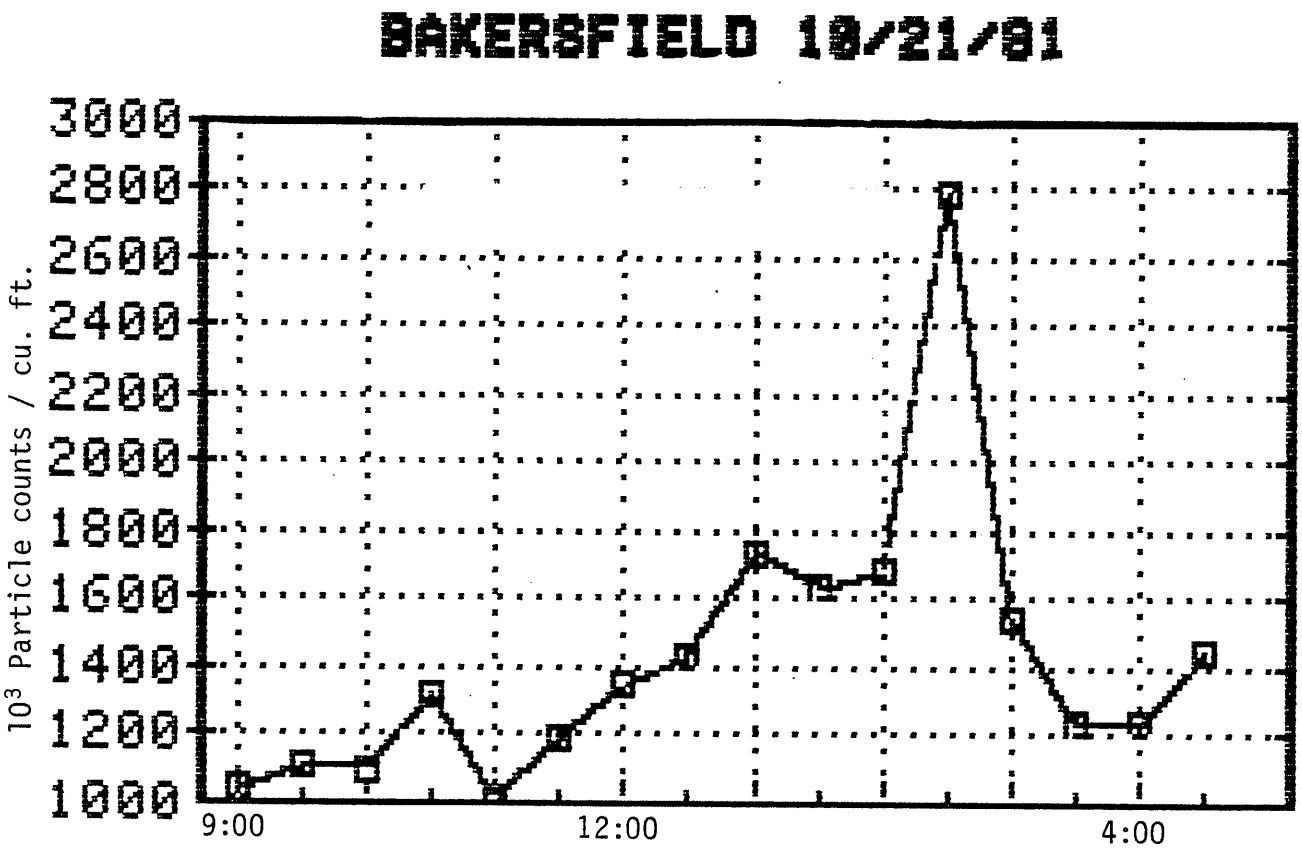


Figure 4.7-3. Optically-Derived Particle Count Trend with Time at the Bakersfield Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

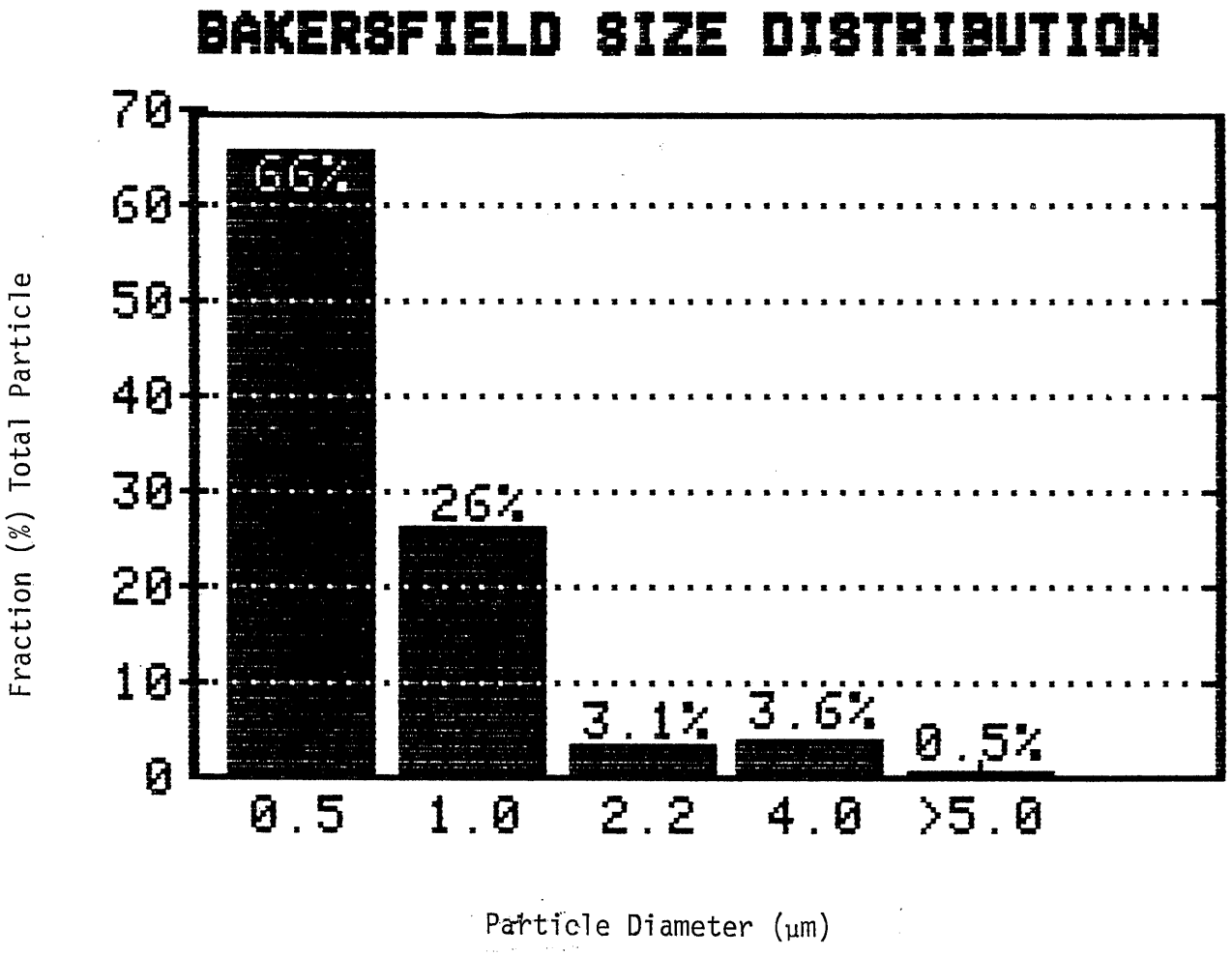


Figure 4.7-4. Particle Size Distribution at the Bakersfield Site. Data represent eight-hour averages.

4.7.5 Analysis Summary

Despite high suspended particle concentrations, asbestos levels were found to be very low, and correlation between suspended particulate mass and asbestos concentrations is not clear. The highest asbestos level recorded was at approximately 2:30 p.m., corresponding to the observed increase in particle counts (Figure 4.7-3). However, insufficient comparative data exist to derive any reliable real trend.

4.8 South Gate (Certified Testing Laboratories)

4.8.1 Site Location and Meteorology

The South Gate site, located at Century Blvd and Stanford St. in southeast Los Angeles, represents a 'localized' emission source, having a high population density in an area of heavy industry having numerous asbestos users (according to the U.S. EPA's NESHAP list). The Certified Testing Laboratories site is located in the center of an industrial area that includes Jorgenson Steel Manufacturing and several metal plating companies within a quarter mile.

The sampling day (10/22/81) was of very poor air quality, with afternoon visibilities at less than one mile. Over the two previous days conditions, had converted from a mild Santa Ana (westerly) wind flow to a mild marine (westerly) flow capped by a heavy, air-stagnating thermal inversion layer. The early morning hours were relatively humid, with fog until approximately 10:00 a.m. All meteorological measurements at this location were taken manually and estimated because of the difficulty of erecting the weather tower between power lines; these data are included in Table 4.8-1. Relative humidity ranged from 80% in the early morning to 55% in the afternoon, which with the fog contributed observable levels of condensation aerosols detected by particle counting instrumentation. Temperature ranged from 18°C in the morning to 26°C at approximately 2:00 p.m. There was no detectable wind until approximately 1:00 p.m., when a very light and variable breeze (less than five mph) began from the west.

4.8.2 Asbestos Filter Sampling

One cyclone sampler was placed on the southern edge of the roof of the building 15 ft above street level (Figure 4.8-1), and the other was placed at the north side of the building on the roof of a motor home with the cyclone inlet approximately 10 ft above ground. The sample times varied from 54 minutes to one hour and forty minutes. The first filter sample collected (A-54; Table 4.8-1), was very heavily laden with particles despite its short collection time, a result of the high particulate matter/aerosol concentration of the early morning fog.

4.8.3 Suspended Particle Monitoring

The RAM® mass counter was not used at the South Gate location; all readings with the Royco® counter were taken five ft from the cyclone sampler at the north side of the building. Figure 4.8-2 shows particle mass concentrations (estimated from the San Jose data; Figure 3.4-3) during the sampling period. Mass concentrations ranged from an early morning high of approximately 1,100 $\mu g/m^3$, to a low of approximately 410 $\mu g/m^3$, the early morning levels a result of the heavy fog conditions. It should be noted that the particle count levels measured at South Gate were ~100 times higher than those at San Jose, causing some uncertainty in the accuracy of deriving South Gate mass concentration levels from the San Jose regression correlation between the two parameters.

Concentrations of suspended particles in the asbestos size range (<0.7-μm aerodynamic diameter) are presented in Figure 4.8-3. Particle counts ranged from an early morning high of 4,500,000 particles/cu. ft to an afternoon low of 2,800,000 particles/cu. ft. The size distribution shown in Figure 4.8-4 is skewed in the direction of the fine particles. The absence of a bimodal distribution is indicative of a very high concentration of secondary condensation aerosols from the humid conditions.

Table 4.8-1. South Gate Summary of Meteorological and Sampling Parameters

Sampling	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (C)	Rel. Hum. (%)	Wind Direction (°true)	Wind Speed (mph)	Particles/cu.ft. x 10^3 > 0.3 < 0.7µm	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-54	10/22/81	RV Roof Sampler 2	9:30	53.5	829.3	18	80	---	0	4600 ± 82	<DL	1.1×10^4
A-56	10/22/81	RV Roof Sampler 1	9:50	98.9	1533	18	80	---	0	4600 ± 71	1.8×10^4	1.8×10^4
A-57	10/22/81	Building Roof Sampler 1	10:50	62.7	971.9	20	73	---	0	4600 ± 115	N.A.	N.A.
A-58	10/22/81	RV Roof Roof Sampler 2	11:30	57.3	888.2	24	56	---	0	4400 ± 140	N.A.	N.A.
A-59	10/22/81	Building Roof Sampler 1	12:04	58.7	909.9	25	56	270	0-2	4000 ± 443	9.6×10^3	5.8×10^4
A-60	10/22/81	Building Roof Sampler 1	13:15	59.6	923.8	25	44	270	0-2	3300 ± 200	N.A.	N.A.
A-62	10/22/81	Building Roof Sampler 1	14:25	59.0	914.5	26	55	270	0-5	3000 ± 162	5.6×10^4	<DL

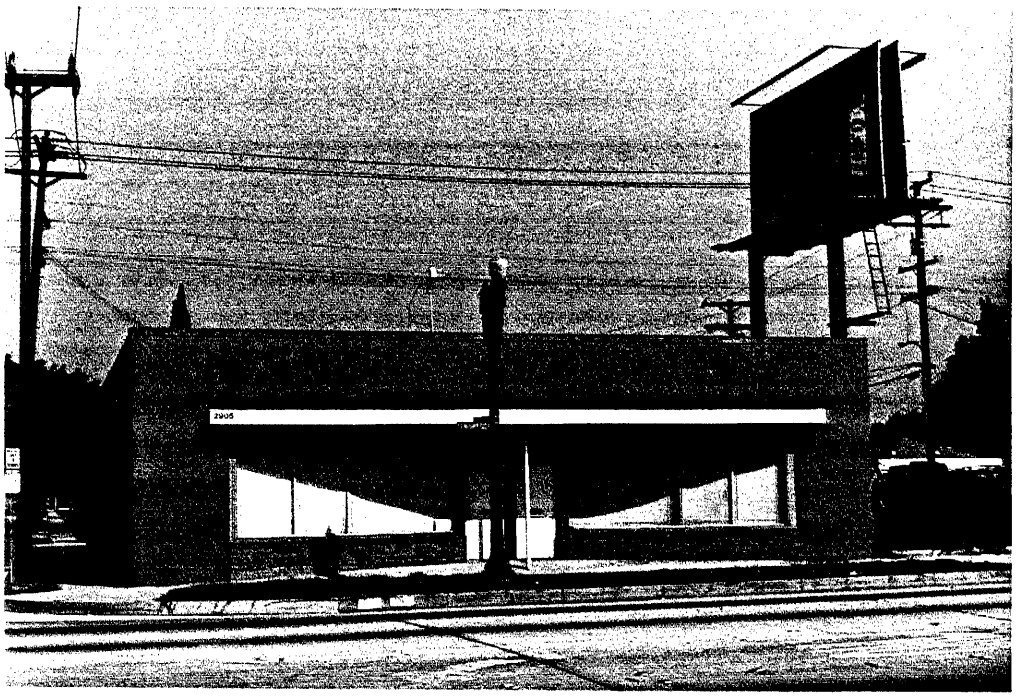


Figure 4.8-1. South Gate Sampling Site (Certified Testing Laboratories).

View north from Century Blvd.

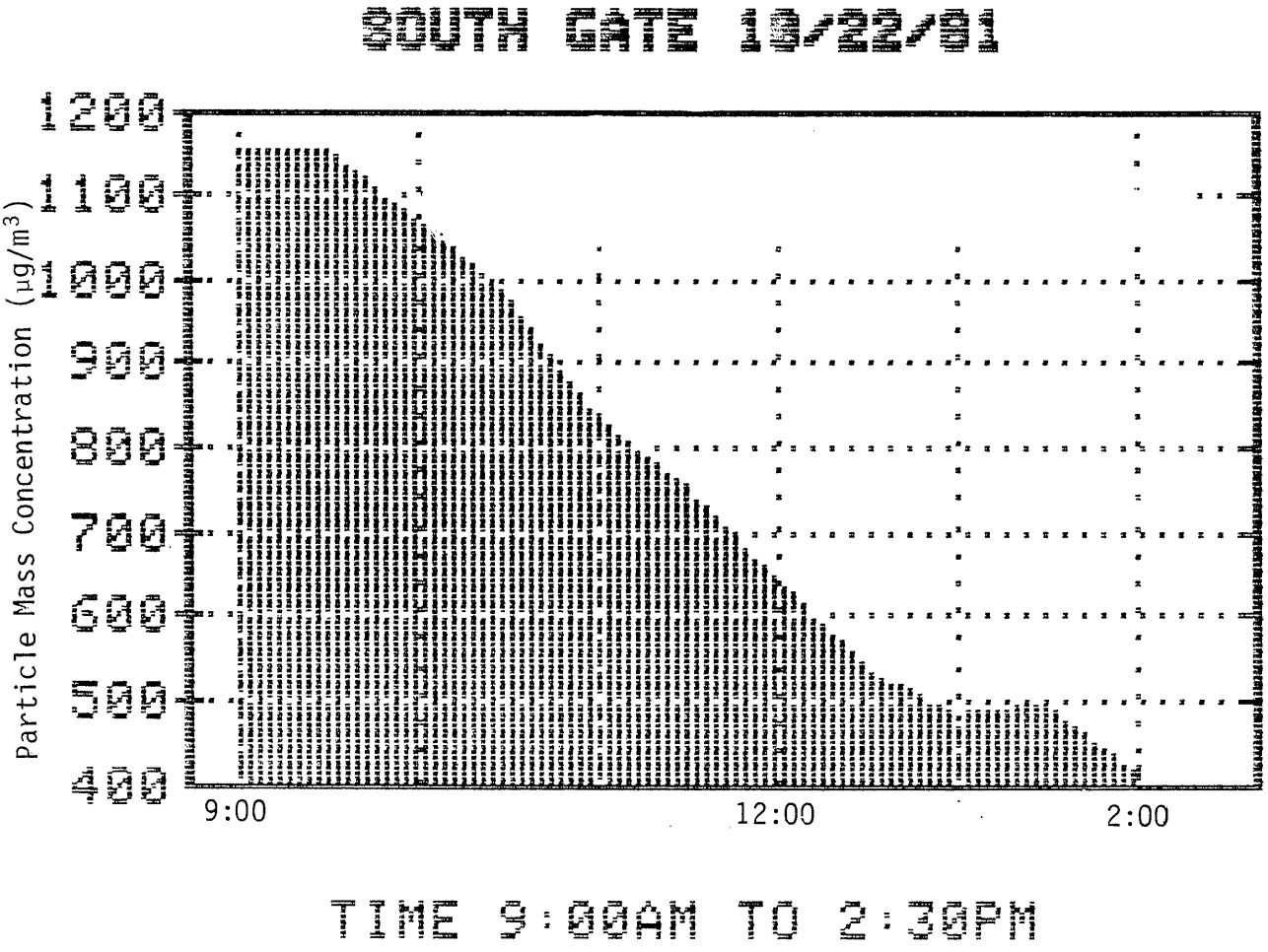


Figure 4.8-2. Optically-Derived Particle Mass Concentration Trend with Time at the South Gate Site. Mass data were collected at one-half hour intervals using the RAM ® Optical Mass Counter.

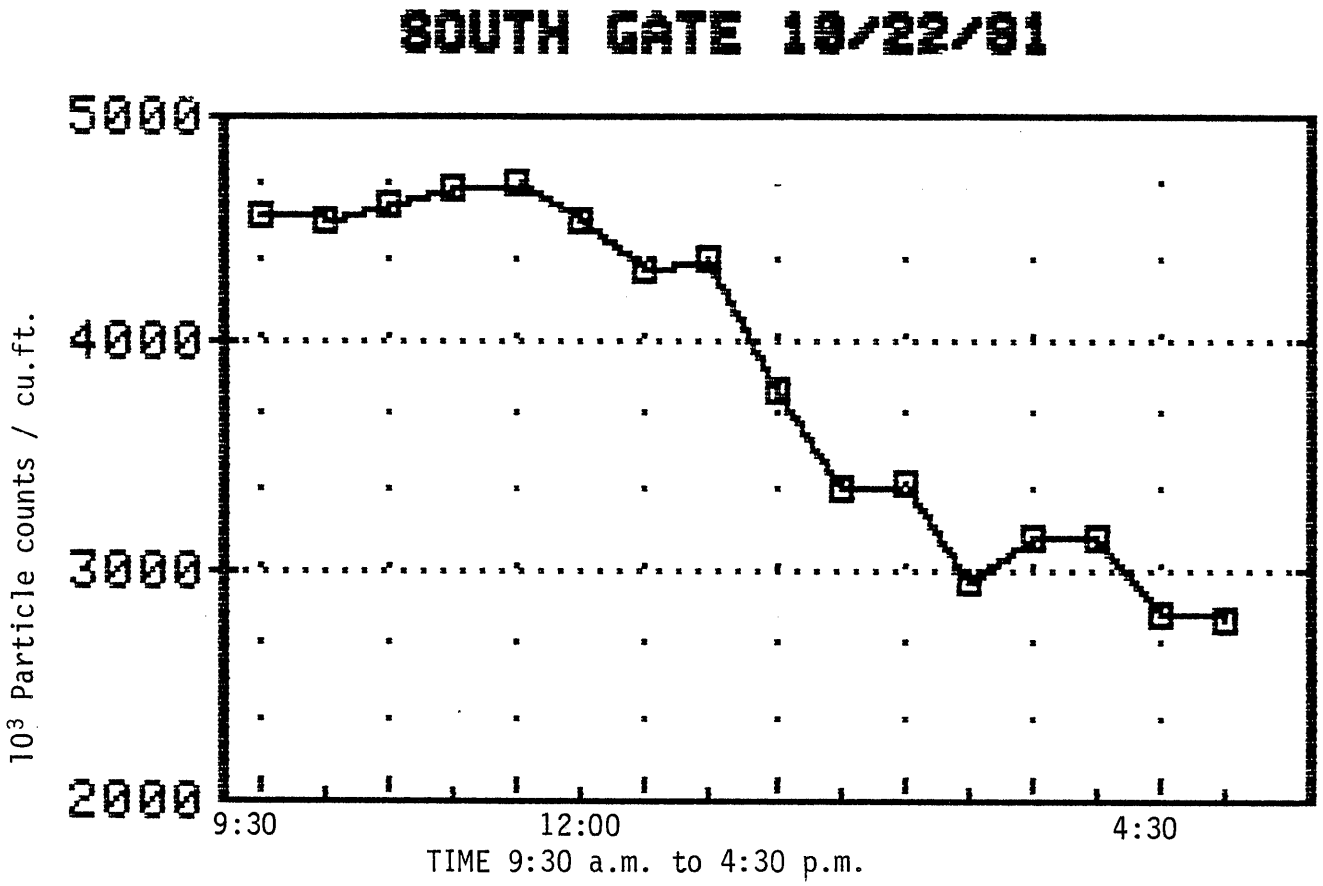


Figure 4.8-3. Optically-Derived Particle Count Trend with Time at the South Gate Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

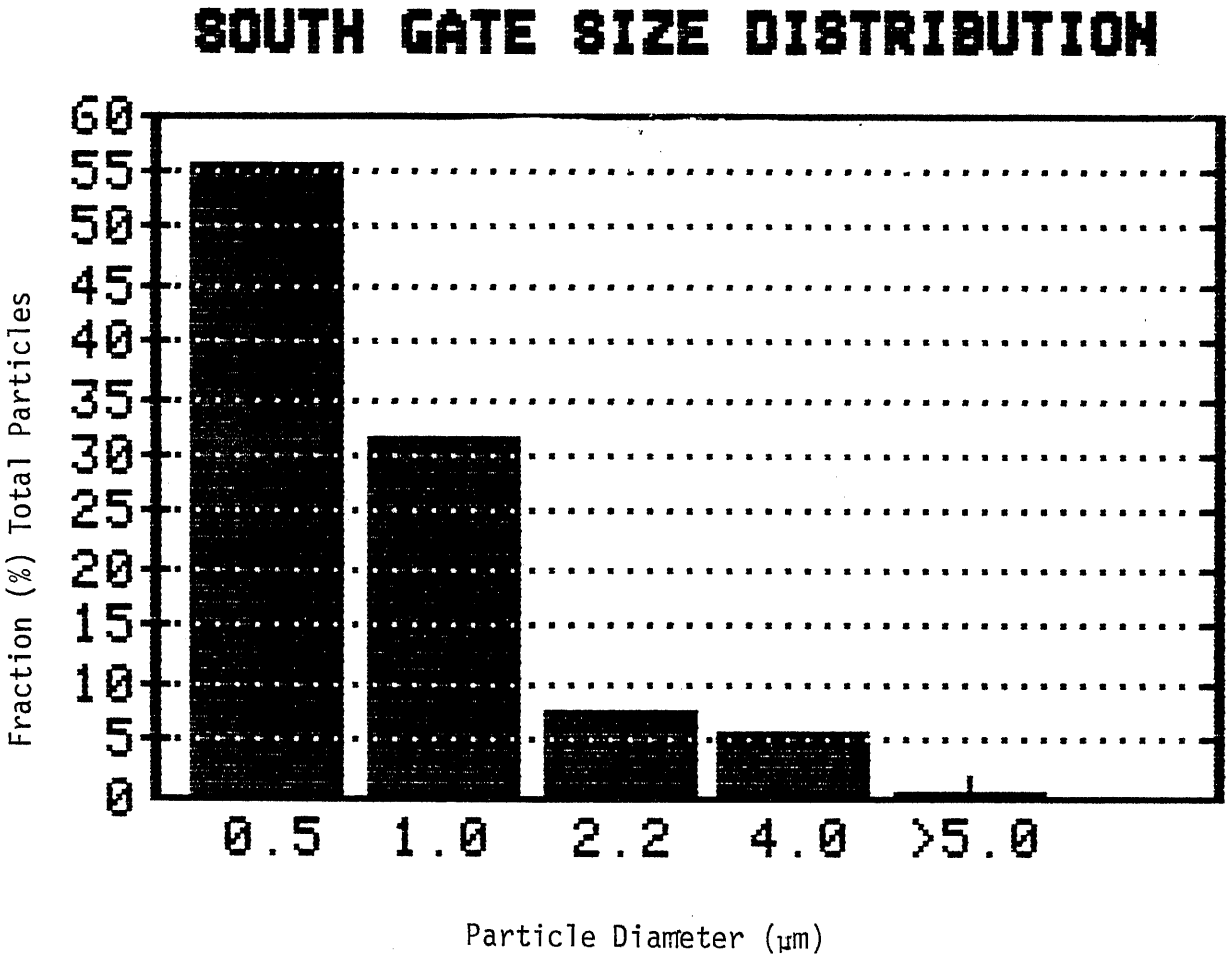


Figure 4.8-4. Particle Size Distribution at the South Gate Site. Data represent eight-hour averages.

4.8.4 Asbestos Levels

The levels of suspended asbestos at the South Gate site were only slightly above analytical detection limit. The highest chrysotile asbestos level recorded, 56,000 fibers/m^3 (sample A-62, Table 4.8-1), is only six times the detection limit of 9,100 fibers/m^3. The highest amphibole level measured was 58,000 fibers/m^3 (sample A-59; Table 4.8-1).

4.8.5 Analysis Summary

The slightly elevated suspended asbestos concentrations at the South Gate site show no correlation with the high particle count levels obtained. These data show no clear relationships between heavy industrial smog and asbestos levels. The asbestos levels at South Gate were only slightly higher than those at background sites, even though suspended particulate matter levels obtained at the same time were twice as high as those measured at San Diego, the next highest site.

4.9 San Diego (San Diego State Weather Station)

4.9.1 Site Location and Meteorology

The San Diego site represents an urban location with no known asbestos sources in the vicinity. The site is in the city of La Mesa, five miles inland from the coast and away from immediate traffic. The San Diego State University (SDSU) weather station, which is atop the Social Sciences Building on the northwest corner of the campus was used for weather data collection. The building, adjacent to a campus parking lot, is situated on a hillside 300 ft above the floor of Mission Valley (sea level).

The SDSU weather station site was chosen as the sampling site for three reasons: (1) it represents a high population center; (2) there are no asbestos users or heavy industries near it; and (3) it was convenient for

sampling. Weather in this area is typically characterized by low clouds and calm winds in early morning, with onshore breezes of 10 to 18 mph usually developing in the afternoon. San Diego's air flow is dominantly from the ocean and, therefore, has no potential for accumulating suspended asbestos.

Atmospheric conditions on the sampling day (12/17/81) were unusually poor with automotive and industrial smog. Presumably, the dominant northeasterly winds were transporting the relatively polluted air from the Los Angeles basin into the San Diego area, which was under the influence of a thermal inversion layer with high humidity. At the start of the sampling, there was no fog at the sampling elevation (~300 ft above sea level), but an extremely heavy fog covered the floor of Mission Valley. Meteorological observations are presented in Figure 4.9-1. Relative humidity ranged from a high of 80% at 8:30 a.m. to a low of 45% at approximately 12:30 p.m., with increase to 66% at 4:00 p.m. Temperature ranged from 10°C in the morning to 22°C at 4:00 p.m.

Winds were from the west in the morning and were variable with speeds ranging from zero to a maximum of six mph. Afternoon winds shifted slightly to a west-northwest flow with speeds of zero to five mph. Visibility was approximately three miles around 10:00 a.m., increased slightly to four to five miles around noon, and dropped to about two miles at 3:30 p.m. when wind speed went to near zero.

4.9.2 Asbestos Filter Sampling

The SDSU weather station platform consists of a suspended wooden stage, approximately 50 ft x 50 ft, on top of a gravel roof at the northwest corner of the building. The cyclone samplers for asbestos collection were placed on the northwest and northeast corners of this stage. Filter samples were collected for periods of one to four hours.

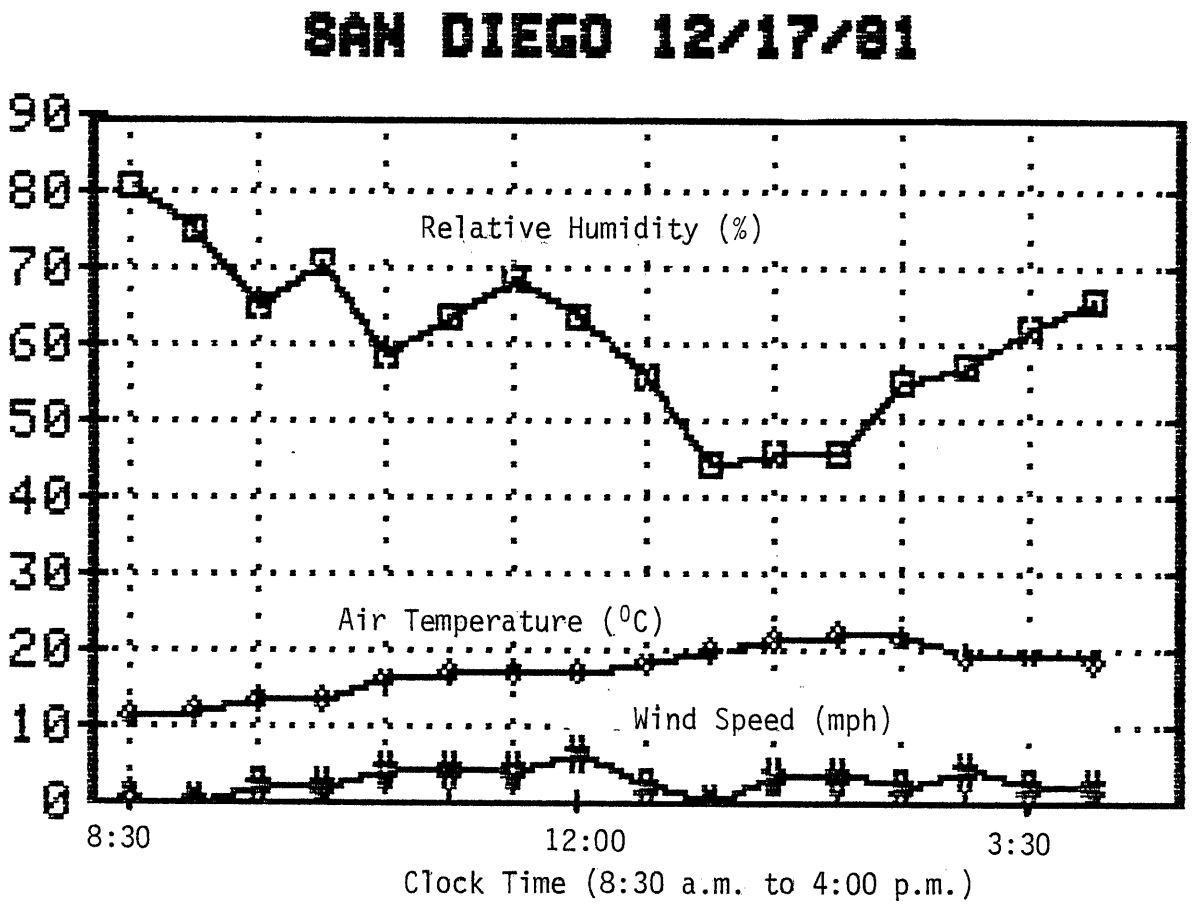


Figure 4.9-1. Meteorological Data Summary for San Diego. Based on one-half hour sampling intervals.

4.9.3 Suspended Particle Monitoring

The RAM® counter was not used at the San Diego location; all readings with the Royco® counter were taken at the 'northwest' cyclone sampler location. The inlet of the Royco® counter was placed approximately one ft from the cyclone inlet. Particulate mass concentrations (Figure 4.9-2) were derived from the San Jose regression analysis (Figure 3.4-3) due to the urban similarities between the two sites. Suspended mass concentrations varied in direct proportion to the observed air quality/visibility conditions. Mass concentrations appeared to cycle throughout the day with peak levels of about 400 $\mu g/m^3$ at 8:30 a.m., 11:00 a.m., noon and 4:00 p.m. (Figure 4.9-2). The 8:30 a.m. measurement was probably entranced by the high humidity. The other peaks were due to smog and diminished winds. The low mass concentrations of approximately 230 $\mu g/m^3$ and 170 $\mu g/m^3$ at 9:00 a.m. and 1:30 p.m., respectively, came after brief periods of increased wind.

Concentrations of suspended particles in the <0.7-μm aerodynamic diameter range are presented in Figure 4.9-3. Fluctuation ranged from highs of about 3,600,000 particles/cu. ft down to approximately 1,300,000 particles/cu. ft, with no systematic decreasing trend in particle count levels through the day. The suspended particle size distribution for San Diego (Figure 4.9-4) was highly skewed toward the fine fraction, with over 80% of all particles in the 0.5-μm midpoint size fraction. The absence of a bimodal size distribution is evidence of high secondary aerosol levels and the dominance of stagnant air conditions.

4.9.4 Asbestos Levels

The levels of amphibole asbestos at the San Diego site ranged from the detection limit of 2,900 fibers/m^3 to a high of only 23,000 fibers/m^3. The levels of chrysotile asbestos ranged from below the detection limit (~2,700 fibers/m^3) to a high of only 4,500 fibers/m^3.

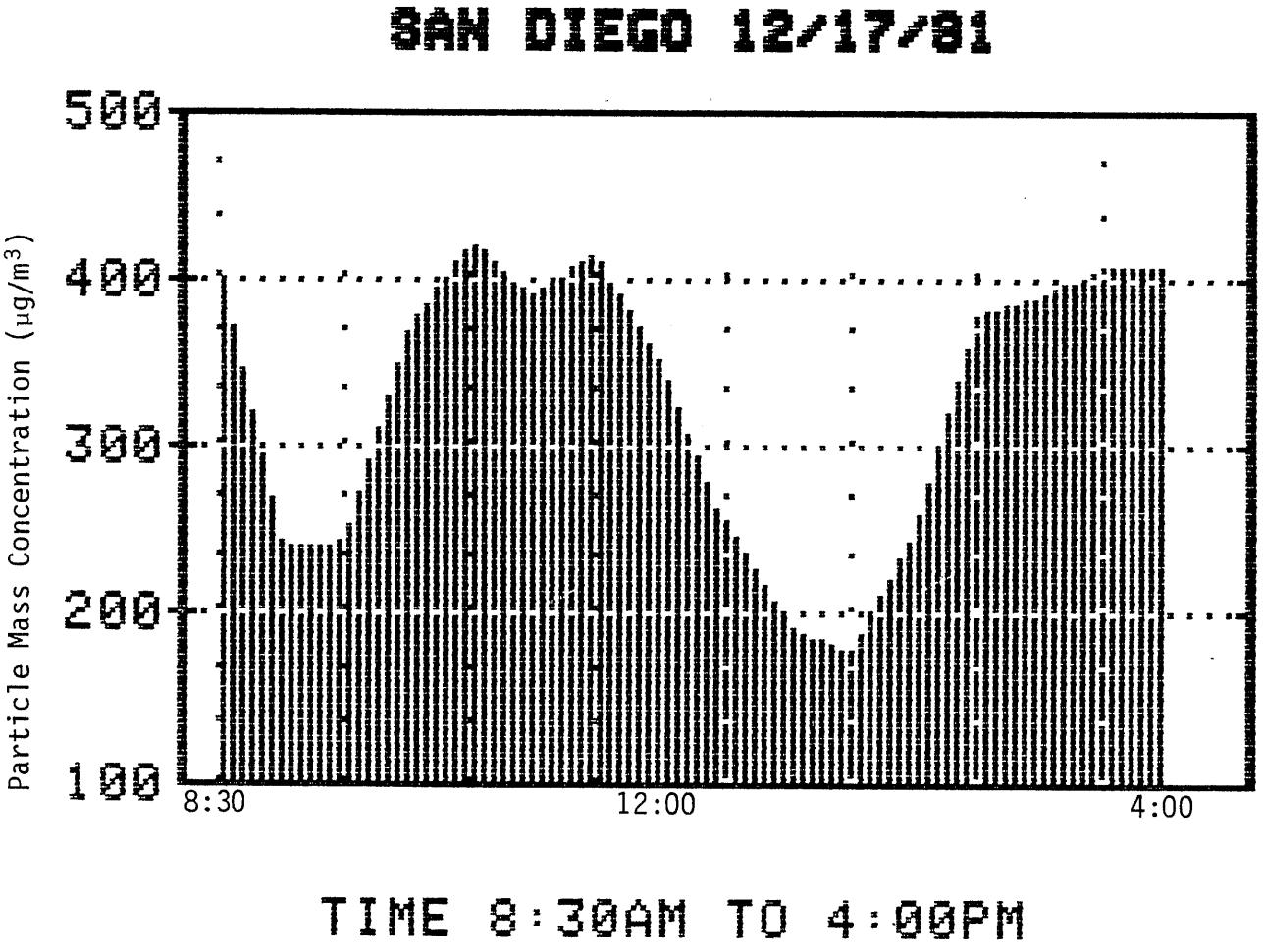


Figure 4.9-2. Optically-Derived Particle Mass Concentration Trend with Time at the San Diego Site. Mass data were collected at one-half hour intervals using the RAM ® Optical Mass Counter.

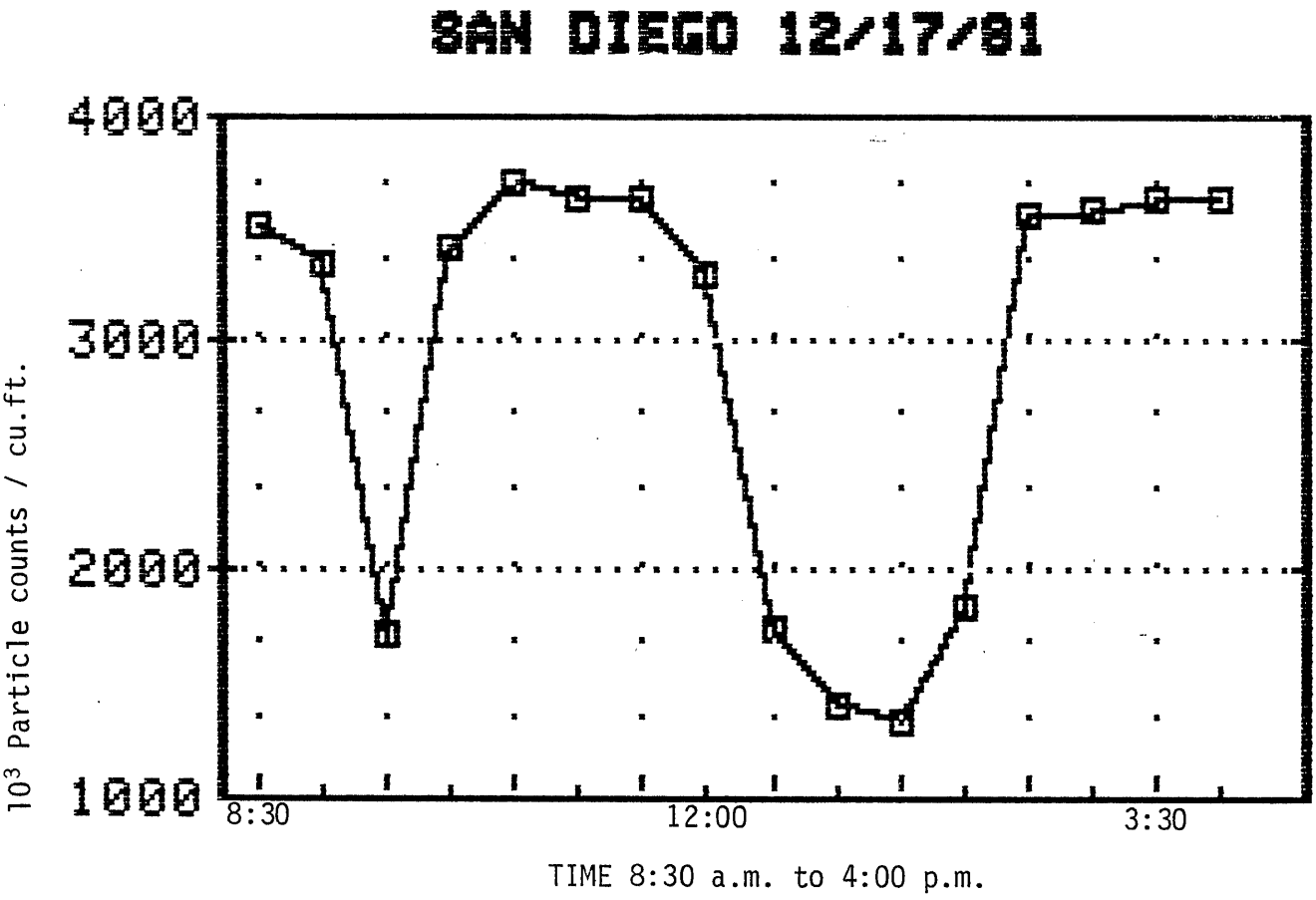


Figure 4.9-3. Optically-Derived Particle Count Trend with Time at the San Diego Site. Data were collected at one-half hour intervals using the Royco ® Optical Particle Counter for aerodynamic diameters <0.7 μm.

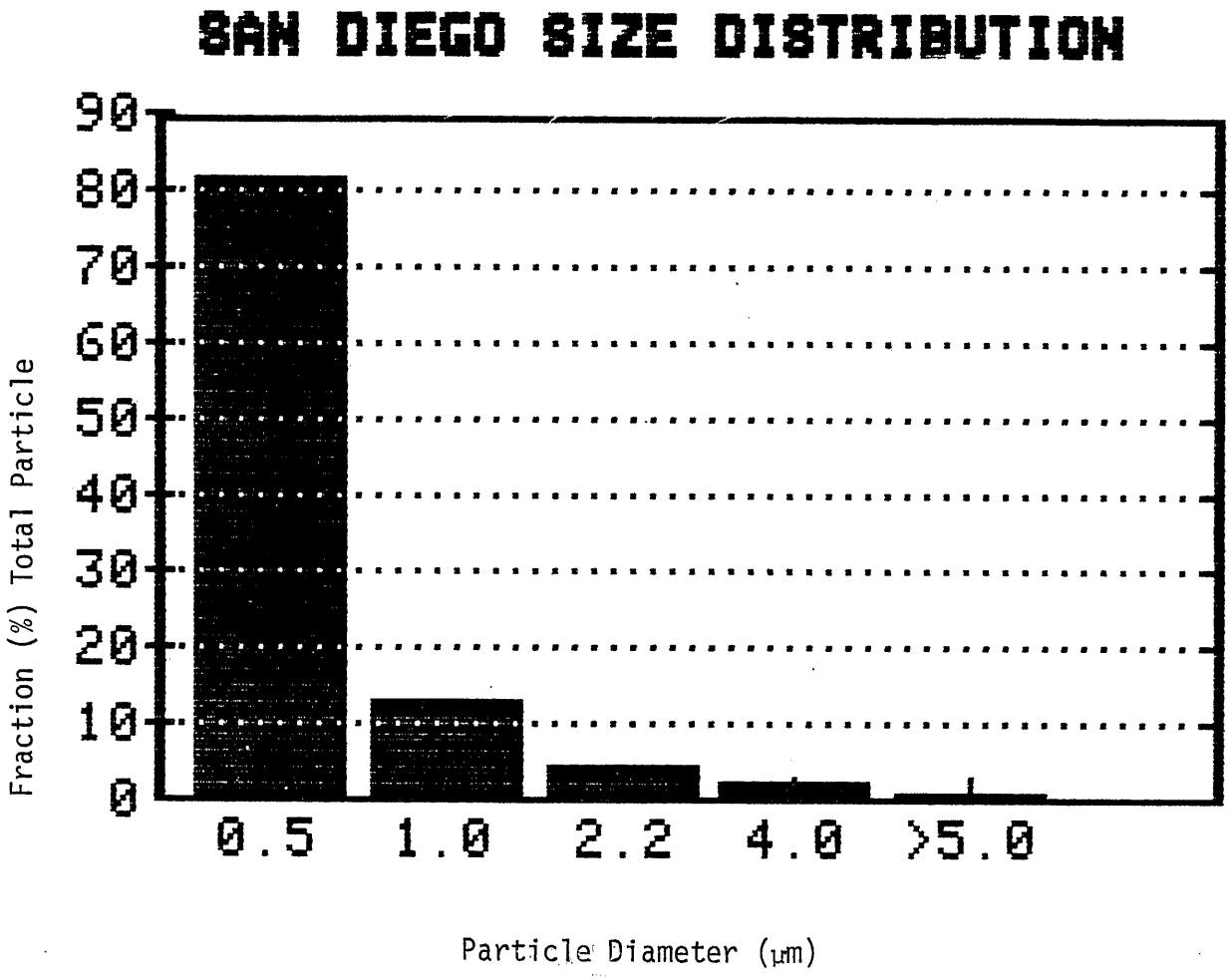


Figure 4.9-4. Particle Size Distribution at the San Diego Site. Data represent eight-hour averages.

4.9.5 Analysis Summary

The sampling conditions for the San Diego site represented a 'worst case' with respect to urban suspended particle concentrations. RAM® mass concentration measurements of the air nearby La Jolla have been made on numerous occasions, with levels ranging from 4 $\mu g/m^3$ on extremely clear days (20 miles visibility) to highs of 60 $\mu g/m^3$ under conditions of high salt and dust suspension. The mass concentrations ranging from 170 $\mu g/m^3$ to 240 $\mu g/m^3$ on the sampling day (12/17/81) at San Diego are much higher.

Because the typical flow of marine air is not a source of asbestos fibers, the only potential sources to San Diego are from an easterly desert air or from the Los Angeles basin. The local soil is not known to contain measurable amounts of asbestos, and soil resuspension by easterly winds is not expected to create elevations in airborne asbestos levels. Since the asbestos sampling conducted in this project reflects influence by Los Angeles air and all of the TEM analyses border on the analytical detection limit (Table 4.9-1), population exposure to airborne asbestos in San Diego is concluded to be minimal even under the poorest air quality conditions.

4.10 Stockton (Manville Plant)

4.10.1 Site Location and Meteorology

In addition to this project, the Stockton site was sampled during a previous CARB-sponsored program in 1981 (Ziskind et al., 1982b). The Manville asbestos cement mill, located approximately one mile north of the Stockton airport, represents a rural, low population, emissions point source. Asbestos cement pipe is constructed using a combination of chrysotile and chrocidolite minerals.

Emissions from the raw fiber grinding process in the plant would be expected to be the major contributor of airborne asbestos fibers to the envi-

Table 4.9-1 SAN DIEGO SUMMARY OF METEOROLOGICAL AND SAMPLING PARAMETERS

Sample	Sampling Date	Site	Sampling Midpoint Time	Sampling Time (Minutes)	Sampling Vol. (liters)	Air Temp. (°C)	Rd. Hum. (%)	Wind Direction	Wind Speed (mph)	Particles/cu.ft. x 10^3 > 0.3 < 0.7μm	Chrysotile Fibers/m^3	Amphibole Fibers/m^3
A-201	12/17/81	Sampler 2 East Side	9:40	194.5	3014.8	12	58	280	2	3100 ± 804	<DL	2.9×10^3 (DL)
A-202	12/17/81	Sampler 2 West Side	9:38	189.5	2937.3	12	58	280	2	3100 ± 804	3.0×10^3 (DL)	8.9×10^3
A-203	12/17/81	Sampler 2 West Side	13:05	210.4	3261.2	21	46	270	0 - .5	4600 ± 904	2.7×10^3 (DL)	2.7×10^3
A-204	12/17/81	Sampler 1 East Side	13:28	248.2	3487.1	21	46	270	2	2900 ± 980	4.5×10^3	2.3×10^4
A-205	12/17/81	Sampler 2 West Side	15:30	68.5	1061.8	19	63	200	2	3600 ± 116	<DL	1.6×10^4

ronment. Effluents from the primary grinding processes in the plant are filtered through the 'D-2' baghouse located near the middle of the facility (Figure 4.10-1). The entire facility is under negative air flow to move all airborne asbestos to the baghouse for filtration.

A major goal in the 1981 program was to quantify emissions from the D-2 baghouse. In the current project, upwind and downwind measurements were made in an effort to examine emissions from the pipe storage yard and the general facility without emphasizing the D-2 baghouse stack.

Meteorological conditions consisted of clear skies and low humidity. Wind direction was consistantly out of the northwest with speeds reaching a maximum of five to ten mph by mid-afternoon. Air temperature ranged from 10°C to 30°C.

4.10.2 Asbestos Filter Sampling

The upwind sampler was positioned to sample an area bordering the Manville property line, and the downwind sampler was located such that possible emissions from the transite pipe storage area and the general operation (other than the baghouse) could be detected. Sampler locations are shown in Figure 4.10-1. The upwind sampler, approximately 1000 ft west-southwest of the plant, was at ground level with the cyclone inlet at its normal five-ft height. The upwind sample was collected between 8:31 a.m. and 12:18 p.m., filtering a total of 3,816 L of air. The downwind sampler was located 75 ft east of the pipe storage yard with the cyclone inlet also five ft off the ground. Sampling was at a flow rate of 15.5 L/min between 9:56 a.m. and 1:30 p.m., for a total filtered air sample of 3,332 L.

The baghouse sampling approach is outlined in detail in a previous CARB report (Ziskind et al., 1982b). Cyclone samplers were placed inside the baghouse at its center and allowed to collect particles during a typical plant cycle, which included a 'bag shake' period. Two samples were collected (A-9 and A-10), consisting of 1,497 L and 2,573 L of filtered air, respectively (Table 4.10-1).

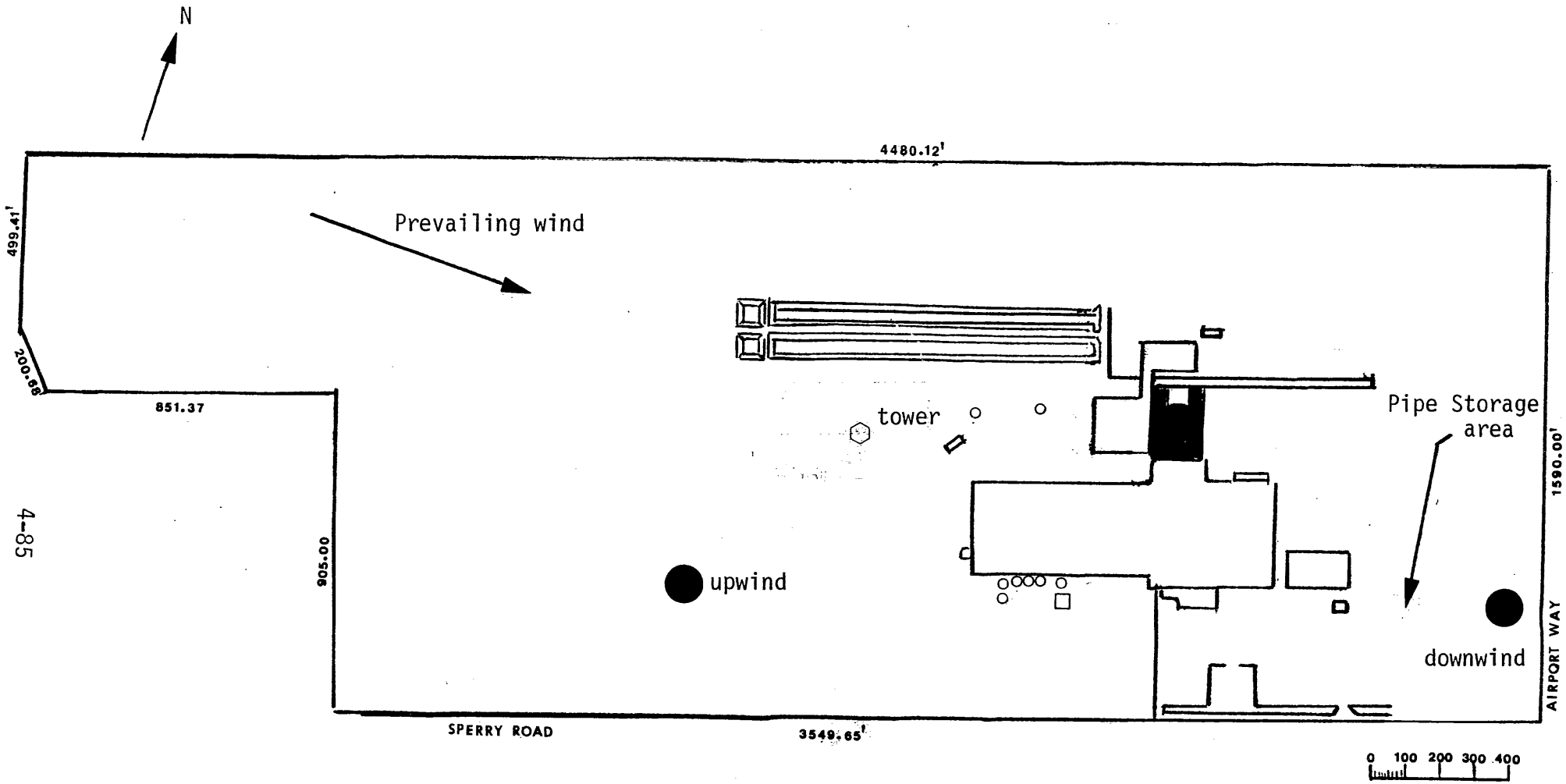


Figure 4.10-1. Manville Pipe Manufacturing Facility.

Table 4.10-1. Summary of Asbestos and Non-Asbestos Particle Concentration Levels Obtained at the Manville Plant.

SAMPLE NO.	ANALYSIS INSTRUMENT	LOCATION	(TOTAL FIBERS/m^3) CHRYSOTILE	AMPHIBOLE	INDETERMINATE	NON-ASBESTOS
A-7A	SEM	Upwind	---	---	2.7×10^5	8.9×10^4
A-7B	SEM	Upwind	---	---	1.3×10^5	1.8×10^5
A-7	TEM	Upwind	---	2.5×10^3	7.5×10^3	2.2×10^4
A-8A	SEM	Downwind	1.0×10^5	---	1.0×10^5	1.0×10^5
A-8B	SEM	Downwind	1.0×10^5	---	1.0×10^5	---
A-B	TEM	Downwind	1.8×10^4	3.7×10^3	3.3×10^4	3.7×10^3
A-9A	SEM	D-2 Baghouse	6.0×10^5	6.2×10^4	---	---
A-9B	SEM	D-2 Baghouse	5.7×10^5	---	---	---
A-9	TEM	D-2 Baghouse	5.7×10^5	2.5×10^4	---	---
A-10A	SEM	D-2 Baghouse	4.4×10^5	5.1×10^4	---	---
A-10B	SEM	D-2 Baghouse	6.3×10^5	2.5×10^4	---	---
A-10	TEM	D-2 Baghouse	4.4×10^5	5.0×10^4	1.9×10^4	---

TEM = transmission electron microscopy

SEM = scanning electron microscopy

4.10.3 Suspended Particle Monitoring

Only a few measurements were made with the Royco® particle counter at the Manville site. Mass concentrations were obtained from the regression analysis of particle counts and masses for the Sonora data (Figure 3.4-4). The estimated mass concentration at both the upwind and downwind locations was approximately 30 $\mu g/m^3$.

The concentration of suspended particles in the asbestos size range (<0.7-μm aerodynamic diameter) was a consistent 330,000 particles/cu. ft at both upwind and downwind locations. Size distribution data were not generated from the small number of measurements taken with the Royco® counter.

4.10.4 Asbestos Levels

Airborne astestos concentrations from TEM analysis performed in this study are presented in detail in Volume II and are summarized along with SEM data from Ziskind et al. (1982b) in Table 4.10-1. TEM data from the upwind location indicated no airborne asbestos above the detection limit of 2,500 fibers/m^3; the downwind site had chrysotile asbestos levels of 18,000 fibers/m^3 and amphibole asbestos levels of 3,700 fibers/m^3. The D-2 baghouse was found to have chrysotile asbestos levels of 570,000 fibers/m^3 (sample A-9) and the baghouse sample 440,000 fibers/m^3 (sample A-10).

4.10.5 Analysis Summary

TEM analysis results indicate only a marginal increase in asbestos levels at the downwind sampling location, the highest measurement being 18,000 chrysotile fibers/m^3.

Although these ambient levels are no higher than those from many California areas, concern should center on the actual emissions from the plant D-2 baghouse, where total asbestos levels averaged 550,000 fibers/m^3. The

emission potential of the Manville facility should remain of some concern. Data from this study indicate that perhaps normally asbestos emissions from the plant are very thoroughly diluted by ambient air. However, under certain meteorological conditions, accumulation of airborne asbestos could result in high concentrations. The stagnation of local air masses from thermal inversion or the condensation of asbestos fibers under conditions of high humidity and fog could possibly increase airborne asbestos levels in the vicinity of the plant.

5.0 DISCUSSION OF RESULTS

Natural and Localized Source Assessment

'Localized sources' are relatively confined areas where high levels of asbestos are emitted from concentrated natural or man-made sources. Of two 'localized source' sites (King City and Manville pipe plant) and one natural source site sampled (Sonora), King City had the highest airborne asbestos concentration level at 140,000 fibers/m^3. This level was measured early in the morning north of the asbestos mill at a location which would normally be 'upwind'. On the morning of sampling, however, meteorological conditions which reduced air circulation in the immediate vicinity probably contributed to the high levels at this location. Wind conditions determine the amount of asbestos which can be picked up into the air, however under reduced air flow it was noted that asbestos levels were higher than under free wind conditions. This can possibly be explained by the fact that these reduced conditions create enough air flow to get the asbestos into the air but not enough air to disperse the asbestos widely in the atmosphere. High humidity, fog and a gentle northerly reverse flow of air during late night and early morning hours led to condensation of suspended particulate matter. Low readings (only 9,400 fibers/m^3) at the normally 'downwind' site south of the plant probably were a result of relatively strong afternoon winds purging the entire area. During the afternoon of measurement, however, winds were not high enough to visibly resuspend dust from the ore or tailings piles near the downwind site. These results emphasize the importance of meteorological conditions and temporal variability.

High concentrations of asbestos fibers were found to be related to all the following factors:

- Available source
- Distance from source
- Dilution from wind speed

- Resuspension due to threshold wind speed
- Mechanical site activity
- Humidity

The Manville asbestos cement pipe facility represents a moderate level point source producing relatively predictable emissions primarily from its 'baghouse'. The downwind concentrations of asbestos found in this survey (~22,000 fibers/m^3) are not elevated when compared to other sites; however, documented emissions of as high as 550,000 fibers/m^3 (Ziskind et al., 1982b) from the primary baghouse indicate that potentially high concentrations of asbestos could develop in the immediate vicinity of the plant under conditions of low wind velocity and high humidity.

The Sonora location represents a natural mineralogical source from serpentine asbestos deposits. The levels measured at the site were also largely a function of meteorological conditions, primarily of wind velocities responsible for resuspending local sediment. The Sonora location represented a unique meteorological situation. On the day of sampling there was no measurable wind and the visibility was very clear. This meteorological event was atypical for this site and the asbestos levels monitored were appreciably lower than anticipated. Because of this situation, it is difficult to draw conclusions on the data and misleading to compare the Sonora results with those from other site locations. In the past, local construction (especially mining and dam construction) disturbed local sediments and may have been responsible for elevated levels. Measurements made by Science Applications, Inc. (Ziskind et al., 1982a) on archived high volume cellulose filters collected through the mid-1970s from the local Air Resources Board total suspended particle (TSP) monitoring stations revealed levels ranging from 100,000 to 1,000,000 chrysotile fibers/m^3. Although these analyses were performed on samples collected with different types of filters and techniques, and employed scanning electron microscopy (SEM), their data should be qualitatively comparable. If a discrepancy exists, asbestos concentrations obtained from scanning electron microscope and high volume filtered air should be lower because of

larger pore size of the filter medium and lower resolution of the SEM. The combined effect should result in less efficient collection and counting of small asbestos fibers.

However, asbestos levels measured during this project by TEM analysis on cyclone-collected samples were only slightly elevated ($\leq$12,000 fibers/m^3) above background.

Industrial, Urban and Background Sites

The balance of this project focused on a matrix of state-wide conditions designed to identify more normal ambient conditions than those where elevated airborne asbestos levels were expected. Included were background sites removed from natural asbestos deposits, and populated industrial sites in the vicinity of commercial asbestos users. 'Background' sites were located at Napa, the San Fernando Valley, Bakersfield and San Diego, and 'industrial' sites were located at San Jose and South Gate (Los Angeles).

Also examined were the potential contributions to airborne asbestos in urban settings from automobile braking. A Los Angeles (Century City) location at the intersection of Santa Monica Blvd. and Avenue of the Stars was monitored over a two day period during heavy and light traffic conditions to measure contributions from automobile braking. The results of automobile braking emission sampling were considered relevant to the measurement of airborne asbestos at other populous sites, since emissions from braking could potentially complicate interpretation of asbestos levels of other sites. Except in rural locations, automobile emissions in general are so ubiquitous that they cannot be ignored in air quality measurements.

Total airborne asbestos levels no greater than 56,000 fibers/m^3 were found at the Century City site. Comparisons of the highest levels above detection limit (Table 1.0-1) from Sunday (51,000 fibers/m^3) to Monday (42,000

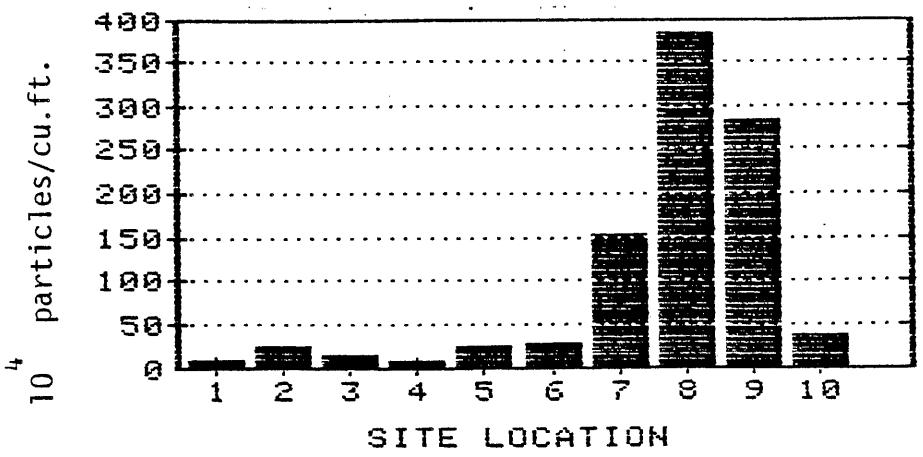
fibers/m^3) at this site showed no significant difference related to light vs heavy traffic. Comparing these results with 'background' sites indicated that although traffic contributions caused slight elevations in airborne asbestos, they were not sufficiently high to interfere with other measurements.

Suspended Particulate Matter and Airborne Asbestos

Figure 5.0-1 diagrams the mean eight-hour daily average of particles/cu. ft in the aerodynamic diameter range (<0.7 μm) for each site. This size range should encompass 99% of all airborne asbestos fibers, and therefore provide a baseline for comparison of particulate matter concentrations at each site. Particulate matter emissions sampled at Napa, Southgate and Bakersfield included secondary aerosols from automobile and industrial emissions.

The tremendous increase in particulate matter levels did not correspond to an increase in asbestos levels, discounting any direct correlation with general mass or particle measurement data, as was found at the San Diego site. Although particle loading levels were very high, asbestos levels were in the same statistical range as those found in Napa County, which was the lowest background site surveyed in the project. (The mean total for asbestos levels above the detection limit for San Diego was 16,500 fibers/m^3, while the mean total for Napa was 12,000 fibers/m^3.

One goal in the original design of this project was to evaluate the relationships between total suspended inhalable and fine particles and those of asbestos particles. Extensive real time data using the Royco® particle counter and the RAM® mass counter were collected at each site. These data showed noticeable variability in particulate matter levels throughout the eight-hour sampling period, the largest variation recorded in the eight-hour sampling period being a factor of four. Century City, the San Fernando Valley, Bakersfield and San Diego all had the same levels of variation over periods as short as two hours.



SITE LOCATION KEY

Site No.	Location	Site No.	Location
1	KING CITY	6	SAN FERNANDO VALLEY
2	SAN JOSE	7	BAKERSFIELD
3	NAPA	8	SOUTH GATE
4	SONORA	9	SAN DIEGO
5	CENTURY CITY	10	STOCKTON (MANVILLE PLANT)

FIGURE 5.0-1. Site Trend in Average Particle Concentration Levels in the <0.7 μm Aerodynamic Diameter Range. Particle concentration data are based on hourly averages with the exception of Site 10.

In evaluating network total suspended particulate, inhalable, and fine particles data for comparative purposes with the real time particulate matter data collected in this study, information compiled by Trijonis and Davis (1981) was used. Table 5.0-1 contains data for total suspended, inhalable and fine particles pertaining to the project sample sites which were averaged over the 1976 to 1980 period. Yearly means, yearly maxima and maximum-to-mean ratios all show the variability of suspended particulate matter over an annual period. All data were collected over 24-hour periods approximately six days apart. The largest variability at any site during this period was measured at the Fourth Street San Jose station, which showed a three-fold increase in the fine particle fraction from the mean to the maximum yearly readings.

Table 5.0-2 shows the mass distributions of particles for selected sites sampled over an eight-hour period with the Royco® and RAM® particle counters. The mean and the daily maximum mass levels were computed in the same manner as the network particle loading data (Table 5.0-2). The ratios of maximum-to-daily mean ranged from 1.3 at San Diego to 2.6 at Century City, with the average maximum-to-mean ratio at approximately 1.7. It is significant that the variation in particulate levels between the maximum and the mean over an eight-hour period (1.7) approached the variation of 24-hour samples over an entire year (2.1 to 2.3; Table 5.0-3). The clear indication is that samplings taken over short time intervals will not accurately represent 24-hour average levels of total suspended, inhalable and fine particles due to short-term temporal variabilities and fluctuations in secondary emissions.

Conclusions from the comparison of suspended particles and actual asbestos levels should be considered only in areas having specific sources. Figure 5.0-2 graphically shows the variation in particle counts for sites sampled during the project, along with the ratio of the high reading. The site with the highest variation in particles <0.7 μm was King City. This site also contained the highest variation in asbestos levels.

Table 5.0-1. Annual Mean and Maximum Particle Concentration Levels For Selected Sites Covering the Period 1976-1980 (from Trijonis 1981).

Site	Station Location	TSP ($\mu g/m^3$)			IP ($\mu g/m^3$)			FP ($\mu g/m^3$)		
		Yearly Mean	Yearly Max	Max/Mean Ratio	Yearly Mean	Yearly Max	Max/Mean Ratio	Yearly Mean	Yearly Max	Max/Mean Ratio
San Jose	Fourth St.	75	168	2.3	39	108	2.8	19	55	3.0
Napa	Jefferson	59	137	2.3	31	78	2.5	15	37	2.5
	Sonora	60	112	1.9	36	68	1.9	15	28	1.9
Sonora	Forest Rd.	41	74	1.8	25	45	1.8	10	18	1.8
Century City	Robertson St.	73	137	1.9	54	99	1.8	30	59	2.0
Bakersfield	Chester Ave.	159	366	2.3	83	219	2.7	38	109	2.9
South Gate	Pico Rivera	125	281	2.3	89	204	2.3	45	102	2.3
San Diego	El Cajon	86	160	1.9	54	103	1.9	27	53	1.9
		Ave. TSP Max/Mean ratio = 2.1			Ave. IP Max/Mean ratio = 2.2			Ave. FP Max/Mean ratio = 2.3		

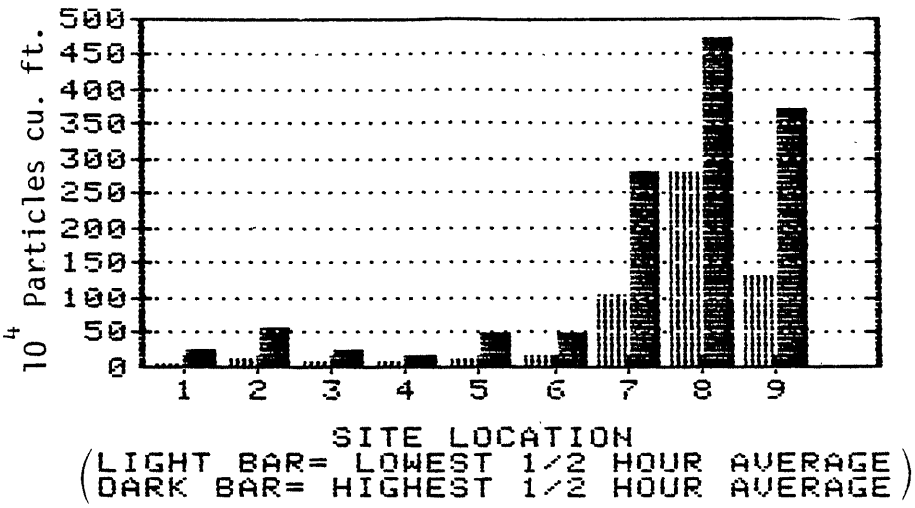
TSP = Total Suspended Particle Concentration

IP = Inhalable Particle Concentration

FP = Fine Particle Concentration

Table 5.0-2. Concentrations of Total Mass, Eight Hour Means and Daily Maxima For Selected Sites Sampled in this Study. Measurements Made by RAM® Optical Mass Counter.

Site	Daily Mean ($\mu g/m^3$)	Daily Maximum ($\mu g/m^3$)	Max/Mean Ratio
San Jose	23	36	1.6
Napa	27	50	1.9
Sonora	16	35	2.2
Century City (Sunday)	27	49	1.8
Century City (Monday)	33	86	2.6
San Fernando Valley	39	58	1.5
Bakersfield	203	257	1.3
South Gate	773	1155	1.5
San Diego	330	421	1.3
Average	Max/Mean Ratio		1.7



SITE No.	LOCATION	PARTICLE COUNT RATIO (HIGH / LOW)
1	KING CITY	6.0
2	SAN JOSE	5.5
3	NAPA	2.8
4	SONORA	3.2
5	CENTURY CITY	4.7
6	SAN FERNANDO VALLEY	3.5
7	BAKERSFIELD	2.8
8	SOUTH GATE	1.7
9	SAN DIEGO	2.8

Figure 5.0-2 Site Variations in Particle Count Levels (< 0.7 μm aerodynamic diameter range) for Nine of the Sampled Locations in this Study.

The lowest level of asbestos at King City (2,400 fibers/m^3) corresponded to a mean of 65,000 particles/cu. ft. The highest asbestos levels of 140,000 fibers/m^3 corresponded to 70,000 particles/cu. ft. Observations of these two sample comparisons showed that particulate matter levels did not directly correspond to asbestos levels. The major difference was the comparative wind speed and the relative humidity. Correlations of particulate matter levels with asbestos levels even at known points will only be valid under identical meteorological conditions.

In areas other than those having point sources, no relationship between asbestos levels and particulate matter levels could be confirmed. As mentioned previously, South Gate and San Diego exhibited the highest suspended particle mass concentrations, having 773 $\mu g/m^3$ and 330 $\mu g/m^3$, respectively (Table 5.0-3). The asbestos levels at these sites, however, were not statistically higher than background. The relationship between the optical mass and total suspended particle levels on and around each sampling day is presented and compared with annual variations in TSP in Table 5.0-3.

Table 5.0-3 compares the data from each sampling day of this study with the yearly average for each site. The sources of data include both EPA and CARB TSP collected at the nearest location to each asbestos sample site. Because network TSP data is taken every sixth day, EPA and CARB TSP data from the exact sampling days are only available from Century City (10/19/81), South Gate (10/22/81), and Stockton (7/23/80). For the other sites in this study, we have based comparisons with annual mean TSP levels (1976-1980), on loadings measured at the closest times available to our asbestos collections. The TSP levels for San Jose, Sonora, Century City (both days), and the San Fernando Valley are all generally lower than the yearly means derived from the 1976 to 1980 time period. The TSP levels for Napa, Bakersfield, and Stockton are average by comparison, and the South Gate and San Diego locations are elevated.

Because differences in sampling duration and location and of the range of normal temporal variability, comparisons between estimated particle

Table 5.0-3. Comparison of Total Suspended Particle Mass Concentrations ($\mu g/m^3$) for the Eight-Hour Sampling Periods Used in this Study and the Mean TSP Data for 1976-1980.

SITE	SAI SAMPLING DATE	TSP Optically - Derived MASS concentration ($\mu g/m^3$) DURING THE 8-HOUR SAMPLING PERIOD	NETWORK TSP ($\mu g/m^3$)	STATION TYPE	EPA or CARB STATION No. (Nearest location)	NEAREST SAMPLING DAY	TSP ($\mu g/m^3$) YEARLY MEAN 1976-1980	TSP ($\mu g/m^3$) YEARLY MAX. 1976-1980
San Jose	9/22/81	23	29	▲	056980004A07	9/19/81	75	168
			22	▲	056980004A07	9/25/81	--	--
			39	0	00377-111	9/19/81	--	--
			34	0	00382-111	9/25/81	--	--
Napa	9/23/81	27	51	0	00783-111	9/19/81	--	--
			34	0	00783-111	9/25/81	59	137
Sonora	9/24/81	16	---	--	--- --- ---	-----	60	112
Century City	10/18/81	27	--	0	0086-111	10/9/81	--	--
Century City	10/19/81	33	89	0	0087-111	10/19/81	121	266
			104	0	0086-111	10/25/81	--	--
San Fernando Valley	10/20/81	39	74	0	00074-111	10/19/81	88	161
Bakersfield	10/21/81	203	155		Health Dept. Station (Bakersfield)	10/19/81	159	366
South Gate	10/22/81	773	140	0	0085-111	10/22/82	125	281
San Diego	12/17/81	330	97	0	00123-111	12/18/81	61	179
			119	0	00104-111	12/18/81		
Stockton	7/23/80	90	82	0	3900252	7/23/80	86	228
			84	0	3900264	--	--	--
			99	0	3900265	--	--	--

▲ = EPA Hi Vol data

0 = CARB Hi Vol data

-- = not available

mass loading data, obtained with the light scattering optical particle counters, and actual TSP data must be done cautiously. At only the San Jose, Napa and Sonora sites were both the RAM® optical mass counter and the Royco® optical particle counter operated in a directly paired analysis approach. The remainder of sites used only the Royco® particle counter; therefore total particle mass concentrations had to be derived from a correlation analysis between total particles count (>0.3 μm aerodynamic diameter) and the RAM® total mass concentrations ($\mu g/m^3$) obtained directly at the Sonora and San Jose sites. Sites such as South Gate and San Diego, which exhibited changes in the size distribution curve towards the finer size particles, were found to have optical mass values higher than should be expected, while the remainder of sites had representative optical mass values for the eight-hour sampling interval. The intent of using the optical count data was to relate the real-time sampling periods to TSP loadings which are available only from yearly mean data. As emphasized earlier, no direct relationships between the TSP levels and asbestos levels were found.

An interesting observation during this survey was the absence of airborne asbestos fibers longer than 5.0 μm at every site sampled except King City. This size range is typically observable by optical microscopy and is of concern in the monitoring of occupational exposure. The fact that only five fibers longer than 5.0 μm were found between all sites indicates the limitations of optical counting techniques in ambient measurement, being able to indicate asbestos presence only in extreme point source environment having very high emissions. Of the five asbestos fibers found during this current study (excluding the Manville pipe facility), only one fiber had a measured diameter greater than 0.2μm. This diameter is the limiting resolution of the optical microscopy method. Because of the resolution limitations of optical microscopy and the small size of fibers in the ambient environment, no correlations can be expected between this technique and transmission electron microscopy.

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7.0 GLOSSARY OF TERMS AND SYMBOLS

This section contains a listing, with definitions, of a number of units of measure, technical terms and abbreviations which appear throughout the text of this report.

Units of Measure

angstrom	10^{-10} meters
°C	degrees Celsius
cc	cubic centimeter (also cm^3)
cm	centimeter (10^{-2} meter)
cp	centipoise; a unit of coefficient of viscosity, defined as the tangential force per unit area (dynes/cm2) required to maintain unit difference in velocity (1 cm/sec) between two parallel planes separated by 1 cm of fluid: 1 cp = 10^{-2} dyne sec/cm = 10^{-2} gm/cm-sec
cu. ft	cubic foot
fiber	a particle with a length-to-diameter ratio greater than three-to-one
ft	foot
in	inch
L	liter
m^3	cubic meter
mesh	number of weaves (wire screen)/sq. in
µg	microgram (10^{-6} gram)
µm	micrometer (10^{-6} meter)
min	minute
mm	millimeter (10^{-4} meter)

Units of Measure (cont.)

mph	miles per hour
nm	nanometer (10^{-9} meter)
pg	picogram (10^{-12} gram)
torr	unit of pressure equal to the pressure that would support one millimeter of mercury

Technical Terms and Abbreviations

aerodynamic diameter	equivalent spherical diameter as related to particle settling in air
AIHL	Air and Industrial Hygiene Laboratory (California)
amphibole	class of hydrated iron magnesium hydrated silicates which include amosite [$(FeMg)SiO_3$], crocidolite [$NaFe(SiO_3)_2 \cdot FeSiO_3 \cdot H_2O$], and anthophyllite [$(MgFe)_7 \cdot Si_8O_{22} \cdot (OH_2)$]
asbestos	hydrated silicates that possess a crystalline structure, that are incombustible in air, and that are separable into filaments, or fibers
asbestos concentration	number of fibers/m^3 of air
CARB	California Air Resources Board
chrysotile	white hydrated magnesium silicate which is fibrous ($3MgO \cdot 2H_2O \cdot 2SiO_2 \cdot 2H_2O$)
cyclone sampler	separation device utilizing air velocity and particle inertia to selectively remove larger particles
DHEW	Department of Health Education and Welfare
EPA	U.S. Environmental Protection Agency
Formvar®	resin substrate used in construction of microscope sample grids
FP	Fine particles, operationally defined as less than 2.5 μm in spherical diameter

ical Terms and Abbreviations (cont.)

	Inhalable particles, operationally defined as less than 15 μm in spherical diameter
	National Bureau of Standards
	National Emission Standards of Hazardous Air Pollutants
	Occupational Cancer Control Unit
	Occupational Safety and Health Administration
e mass ntration	μg of particle/m^4 of air
ite	coarse grained igneous rock of which the olivine form alters readily to the mineral serpentine
ne	group name for minerals encompassing two principal forms: chrysotile and antigorite
rticle tration	numbers of particles/cu. ft of air
	Total suspended particles, defined as collected by a high volume sampler at a rate of 30 to 60 cu. ft per minute for a 24-hour period