Table 3.2.2.17. Relative element concentrations by stage from DRUM impactor.

Stage 2: 5 - 10 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	5,731.07	324.91	5.2286	0.5368
S	256.78	57.27	0.2343	1.2830
Cl				
K	1,096.09	108.36	1.0000	0.8199
Ca	1,018.89	105.27	0.9296	0.3924
Ti	203.00	68.18	0.1852	1.8927
V				
Cr	45.62	17.82	0.0416	
Mn	115.25	21.82	0.1052	0.5097
Fe	2,133.47	132.18	1.9464	1.1574
Ni	30.84	10.00	0.0281	1.7218
Cu				
Zn	63.31	12.00	0.0578	0.1931
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.2.2.18. Relative element concentrations by stage from DRUM impactor.

Stage 3: 2.5 - 5 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	916.80	153.09	0.9637	
Al				
Si	2,573.75	166.73	2.7055	0.2411
S	94.00	38.36	0.0988	0.4697
Cl	278.22	63.82	0.2925	0.5175
K	951.29	105.27	1.0000	0.7116
Ca	764.87	86.55	0.8040	0.2946
Ti				
V	73.96	19.09	0.0778	
Cr				
Mn				
Fe	1,036.69	68.73	1.0898	0.5624
Ni				
Cu				
Zn	28.16	7.64	0.0296	0.0859
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.2.2.19. Relative element concentrations by stage from DRUM impactor.

Stage 4: 1.15 - 2.5 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	284.04	70.18		0.0266
S				
Cl	256.87	77.45		0.4778
K				
Ca				
Ti	83.02	25.09		0.7740
V	166.09	34.55		
Cr	53.47	20.55		
Mn				
Fe				
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.2.2.20. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	522.56	102.55	1.9633	
Al				
Si	150.85	46.18	0.5668	0.0141
S				
Cl	307.15	49.64	1.1540	0.5713
K	266.16	44.18	1.0000	0.1991
Ca				
Ti				
V				
Cr				
Mn	63.04	18.91	0.2368	0.2788
Fe				
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.2.2.21. Relative element concentrations by stage from DRUM impactor.

Stage 6: 0.34 - 0.56 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	5,020.16	387.27	0.2896	
Na				
Mg				
Al				
Si	155.78	39.09	0.0090	0.0146
S				
Cl	14,818.00	793.09	0.8548	27.5642
K	17,335.24	930.55	1.0000	12.9675
Ca				
Ti				
V	109.69	59.45	0.0063	
Cr				
Mn				
Fe				
Ni	28.27	10.18	0.0016	1.5787
Cu				
Zn	45.80	12.00	0.0026	0.1397
As				
Se				
Br				
Rb				
Sr				
Pb	101.24	38.55	0.0058	

Table 3.2.2.22. Relative element concentrations by stage from DRUM impactor.

Stage 7: 0.24 - 0.34 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				0.0164
Si	175.25	28.18		
S	174.36	38.36		0.8712
Cl				
K				
Ca				
Ti				
V	93.53	24.73		
Cr				
Mn	44.56	13.64		0.1971
Fe				
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.2.2.23. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	13-Aug-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	5,094.45	768.00	0.4221	
Na				
Mg				
Al				
Si	124.24	49.64	0.0103	0.0116
S				
Cl	8,637.65	480.73	0.7157	16.0676
K	12,068.62	658.55	1.0000	9.0279
Ca				
Ti				
V	70.29	28.73	0.0058	
Cr				
Mn				
Fe	99.78	30.18	0.0083	0.0541
Ni				
Cu	907.11	87.27	0.0752	3.6502
Zn	692.25	106.18	0.0574	2.1111
As				
Se				
Br				
Rb	43.04	17.82	0.0036	
Sr				
Pb				

Table 3.2.2.24
VOC Concentrations (ppbv)

Date	13-Aug-92	13-Aug-92	13-Aug-92
Fuel	Wheat Straw	Wheat Straw	Wheat Straw
Traverse	Traverse 1	Traverse 2	Traverse 3
Acetic acid			
Propanone (acetone)			
Methyl ester acetic acid (methylacetate)			
Butane			
Dimethyloxirane			
Pentene			
Methylbutanone (isopropylmethyl ketone)			
Furancarboxaldehyde (furfural)			
Benzene	21.7	20.7	34.3
Dimethylbutane			
Hexane			
Phenol	4.7	8.1	9.3
Dimethylfuran			
2-methyl 2-cyclopenten-1-one			
2-chloro phenol			
Toluene	5	7.6	11.2
Benzonitrile			
Benzaldehyde	2.7	5.7	6.1
Methylphenol (hydroxy toluene)			
Styrene	7.8	13.5	11.2
Xylene		1.4	2.7
Trimethylpentane			
Benzofuran			
Methoxymethylphenol (creosol)			
Naphthalene	5.8	4	5.7
C10H12			
Alpha-pinene			
Camphene			
Δ3-Carene			
Limonene			
No match r.t. (6.7)			
No match r.t. (8.51)	11.2	8.7	9.1
No match r.t. (8.71)			
No match r.t. (8.73)			
No match r.t.(6.4)			
No match r.t.(8.5)			

Table 3.2.2.25
VOC Emission Factors (mg/kg)

Date	13-Aug-92	13-Aug-92	13-Aug-92
Fuel	Wheat Straw	Wheat Straw	Wheat Straw
Traverse	Traverse 1	Traverse 2	Traverse 3
Fuel Consumption Rate (g/s d.b)	1.78	2.25	2.02
Stack Gas Mass Flow Rate (kg/s)	5.30	4.62	4.96
Acetic acid			
Propanone (acetone)			
Methyl ester acetic acid (methylacetate)			
Butane			
Dimethyloxirane			
Pentene			
Methylbutanone (isopropylmethyl ketone)			
Furancarboxaldehyde (furfural)			
Benzene	174	115	228
Dimethylbutane			
Hexane			
Phenol	45	54	74
Dimethylfuran			
2-methyl 2-cyclopenten-1-one			
2-chloro phenol			
Toluene	47	50	88
Benzonitrile			
Benzaldehyde	29	43	55
Methylphenol (hydroxy toluene)			
Styrene	83	100	99
Xylene		11	24
Trimethylpentane			
Benzofuran			
Methoxymethylphenol (creosol)			
Naphthalene	76	36	62
Unknown			
Alpha-pinene			
Camphene			
Δ3-Carene			
Limonene			

Table 3.2.2.26. PAH emission factors, wheat straw, 13 August 1992 (zero indicates not detected).

	Traverse 1 Filter	Traverse 2 Filter	Trap/Tubing	Traverse 1 Sorbent	Traverse 2 Sorbent	Impinger Rinsate	Total Traverse 1	Total Traverse 2	Total Average
					µg/kg dry fuel				
Naphthalene	2,350	76	0	41,713	43,306	674	44,736	44,056	44,396
2-Methyl-naphthalene	82	19	0	443	1,997	132	657	2,148	1,402
Acenaphthylene	35	20	0	295	732	372	702	1,124	913
Acenaphthene	0	0	0	107	241	153	260	393	326
Fluorene	33	17	0	153	56	174	360	246	303
Phenanthrene	1,116	546	71	3,617	3,298	849	5,653	4,764	5,208
Anthracene	332	164	0	876	952	114	1,322	1,230	1,276
Fluoranthene	3,102	1,889	0	983	873	3,231	7,316	5,992	6,654
Pyrene	3,277	2,271	0	984	783	213	4,474	3,267	3,870
Benz[a]-anthracene	2,225	1,993	0	133	189	5	2,364	2,188	2,276
Chrysene	2,395	1,899	0	134	197	13	2,542	2,109	2,326
Benzo[b]-fluoranthene	2,881	963	0	28	27	0	2,908	989	1,949
Benzo[k]-fluoranthene	790	484	0	0	50	0	790	533	662
Benzo[a]pyrene	1,043	237	0	0	39	0	1,043	276	659
Benzo[e]pyrene	1,521	441	0	0	43	0	1,521	484	1,003
Perylene	302	996	0	0	0	0	302	996	649
Benzo[ghi]-perylene	1,070	1,021	0	0	0	0	1,070	1,021	1,046
Indeno[1,2,3-cd]-pyrene	1,160	186	0	0	0	0	1,160	186	673
Dibenz[a,h]-anthracene	0	0	0	0	0	0	0	0	0
Total	23,715	13,222	71	49,467	52,783	5,928	79,180	72,004	75,592

Figure 3.2.2.1. Ambient air conditions, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

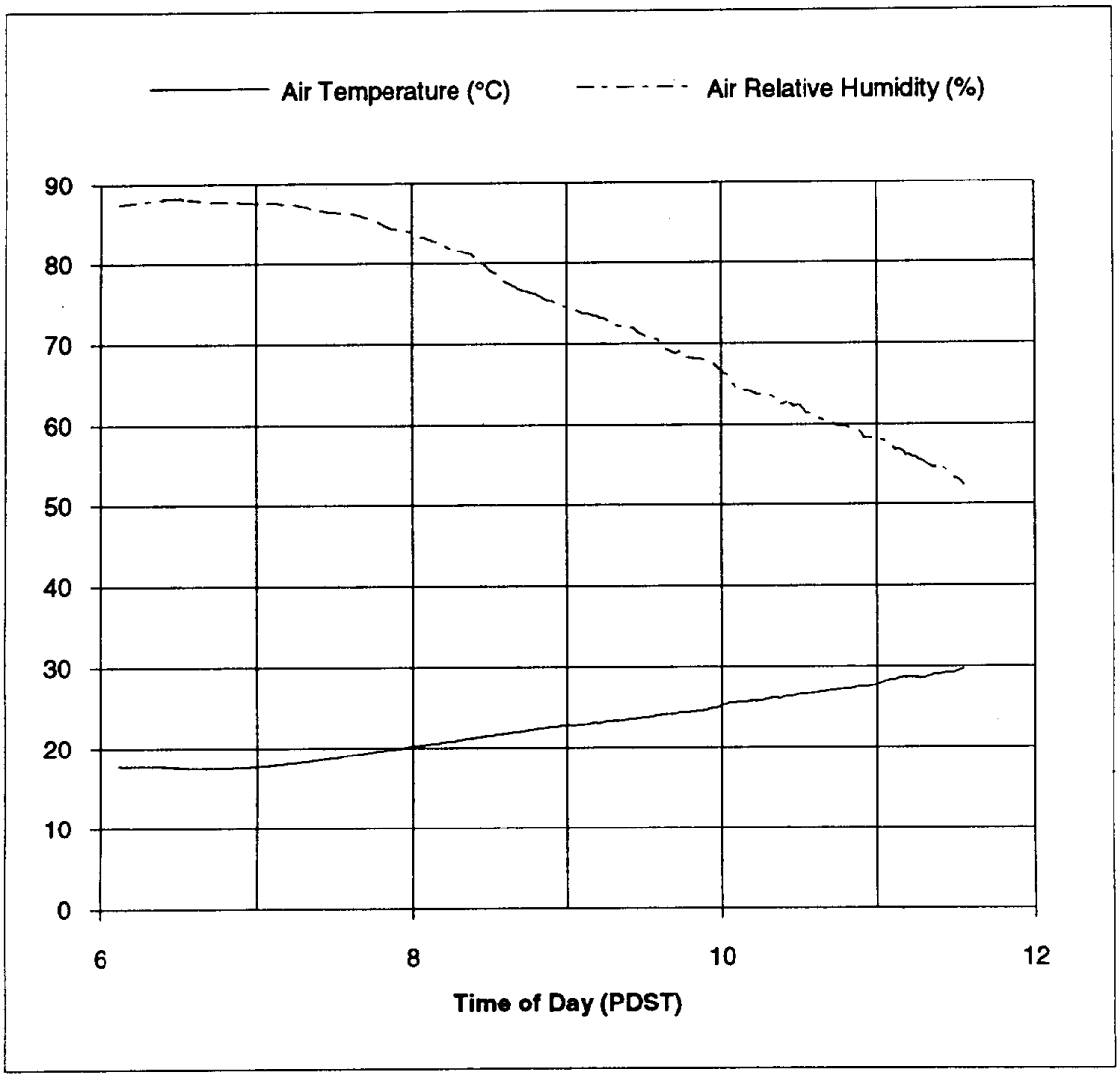

Figure 3.2.2.2. Air temperature and relative humidity from CIMIS station.

Fuel: Wheat Straw Date of Test: 13-Aug-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

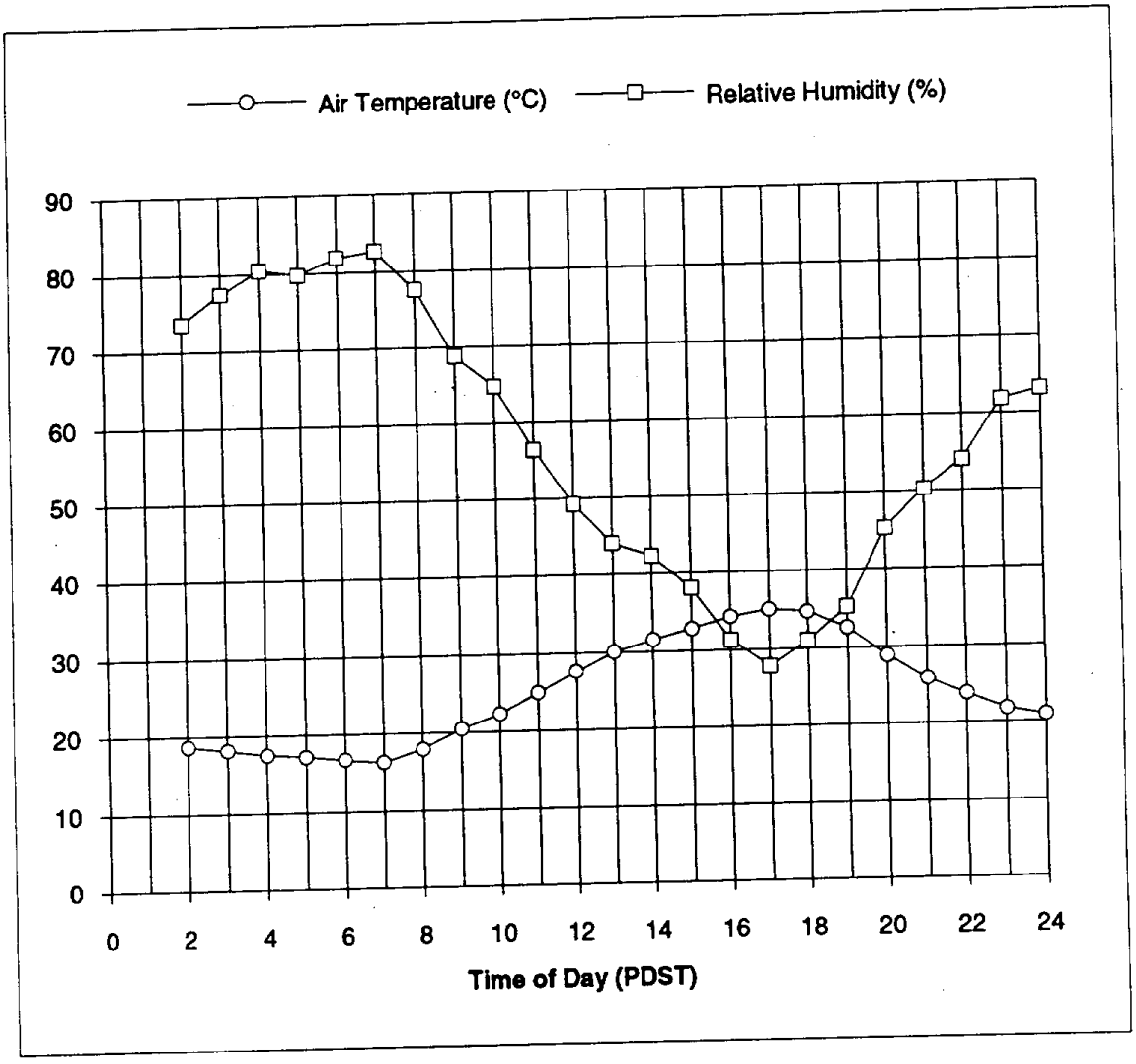

Figure 3.2.2.3. Wind speed from CIMIS station.

Fuel: Wheat Straw Date of Test: 13-Aug-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

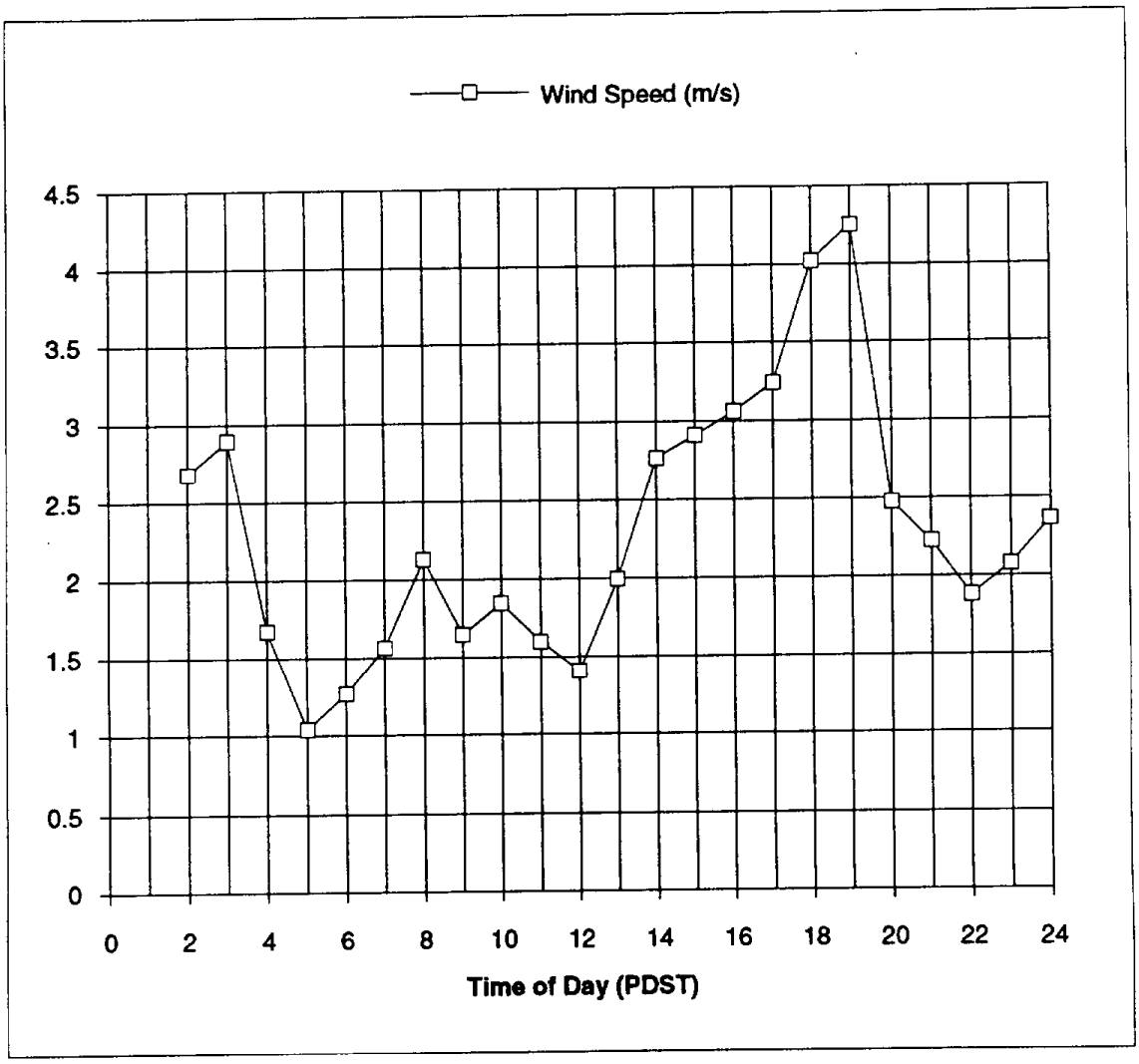

Figure 3.2.2.4. Wind direction and solar radiation from CIMIS station.

Fuel: Wheat Straw Date of Test: 13-Aug-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

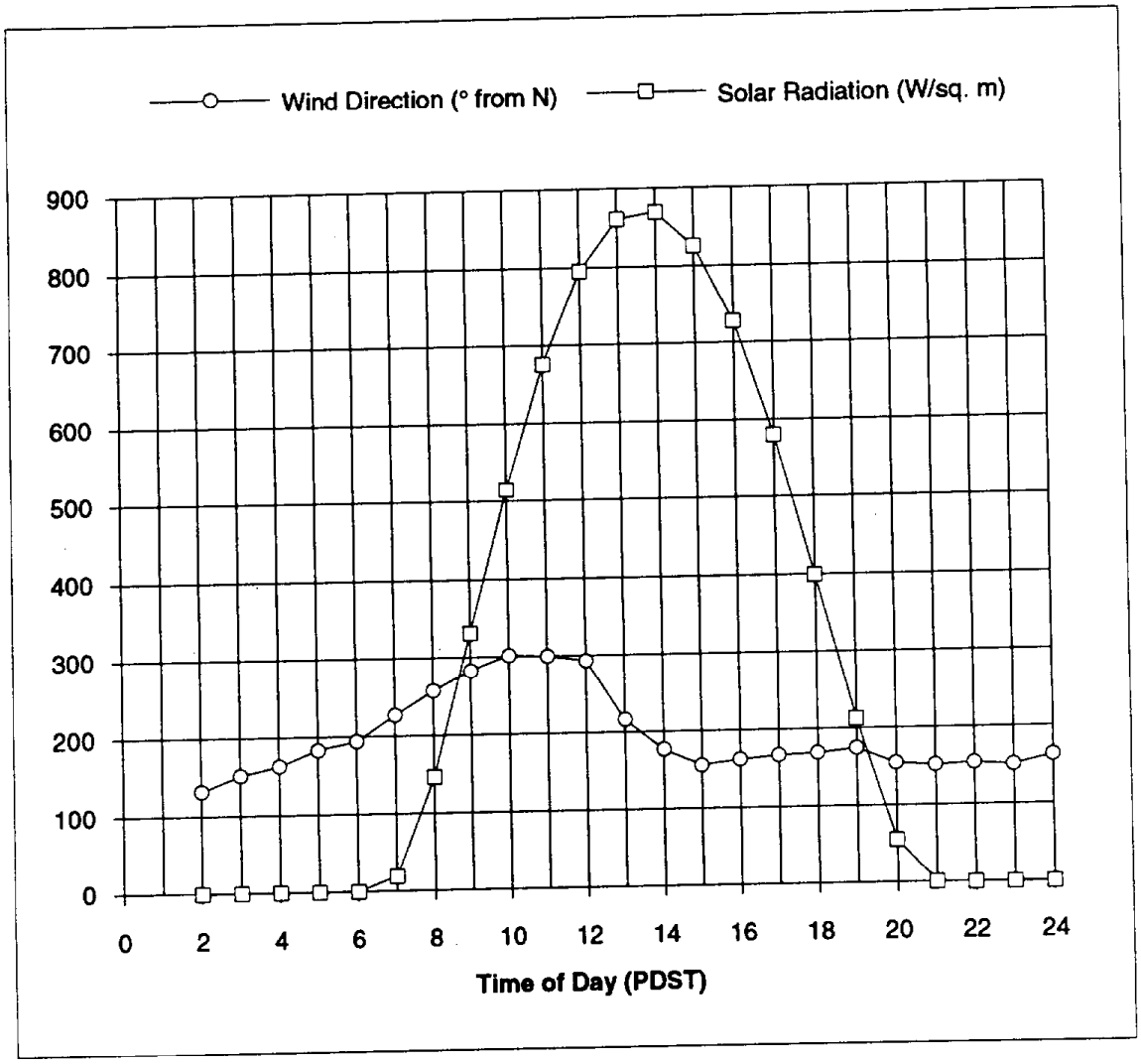

Figure 3.2.2.5. Inlet air, stack gas, and impinger temperatures, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF
Test Date 13-Aug-92

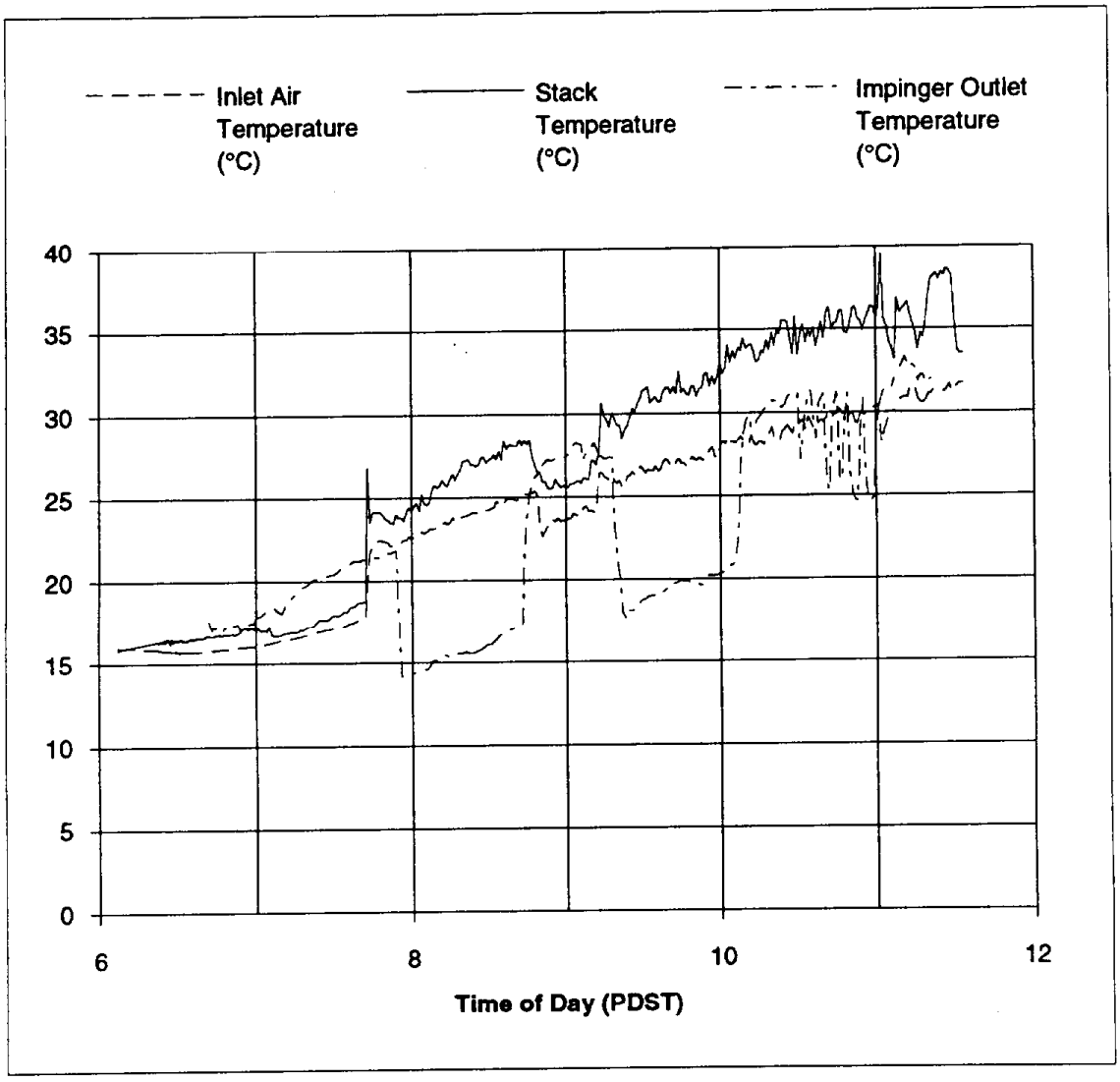

Figure 3.2.2.6. Conveyor speed and stack gas velocity, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

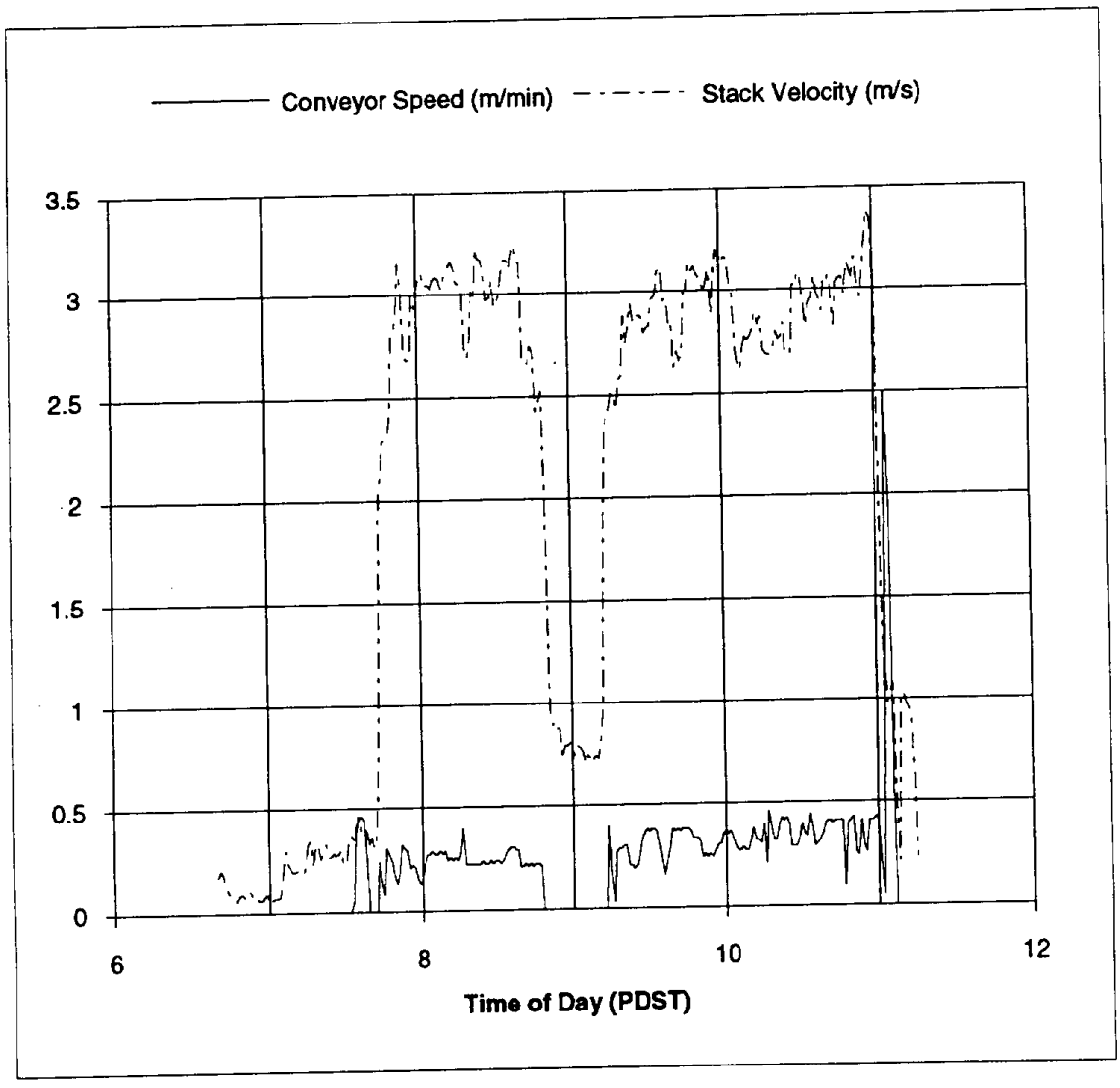

Figure 3.2.2.7. Conveyor speed with 10 min moving average, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

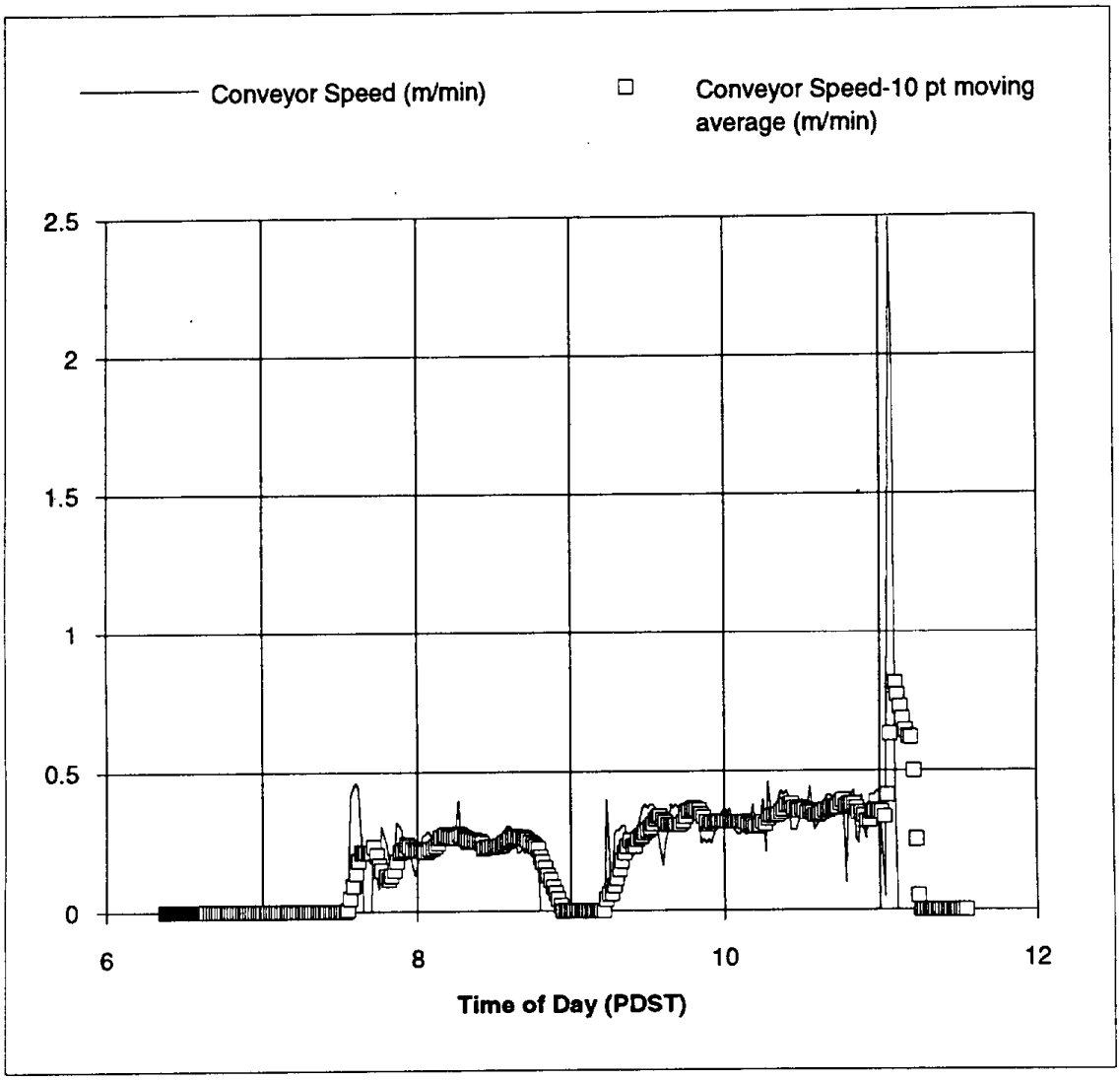

Figure 3.2.2.8. Conveyor travel, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

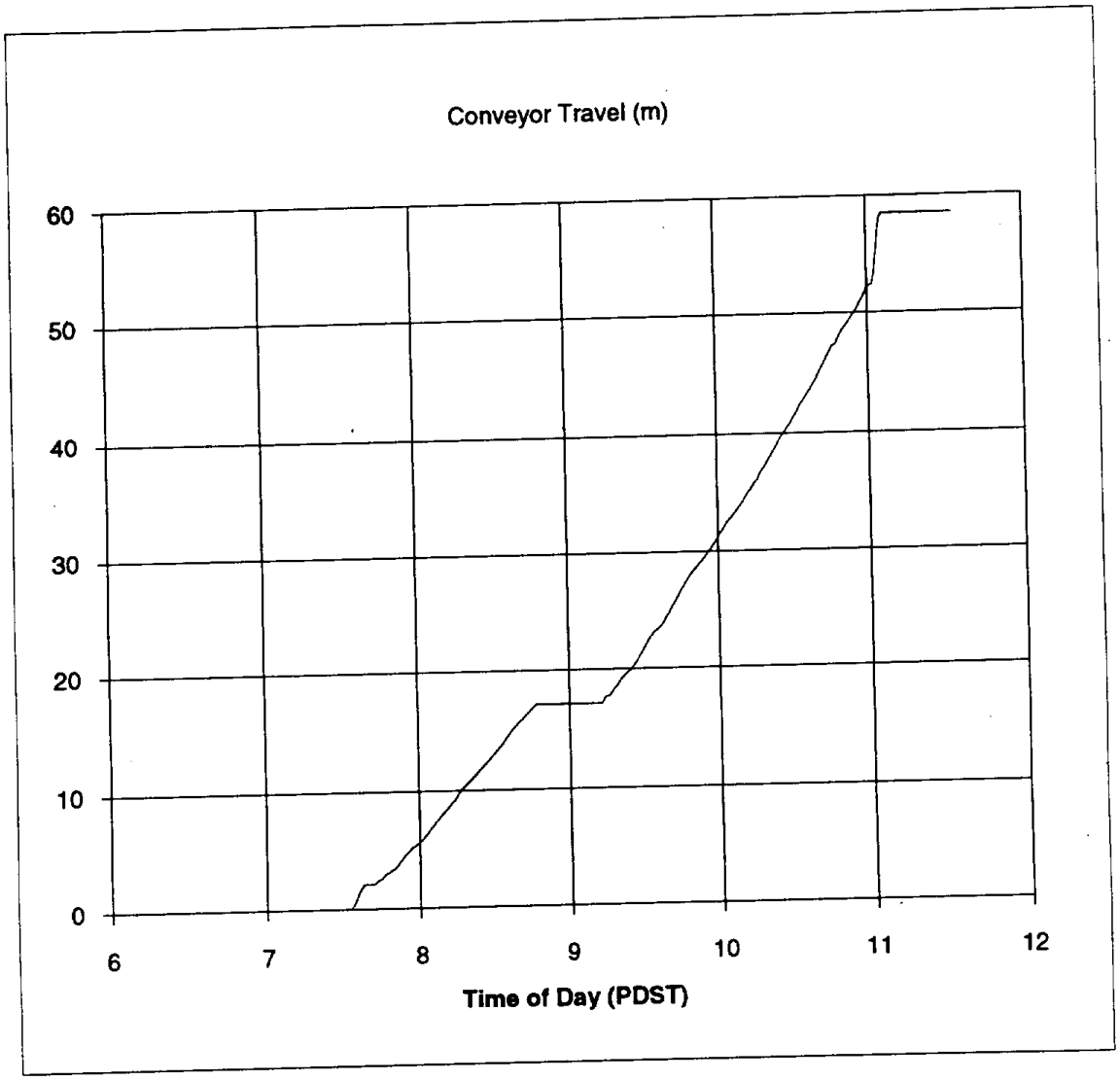

Figure 3.2.2.9. CO concentration in stack gas, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

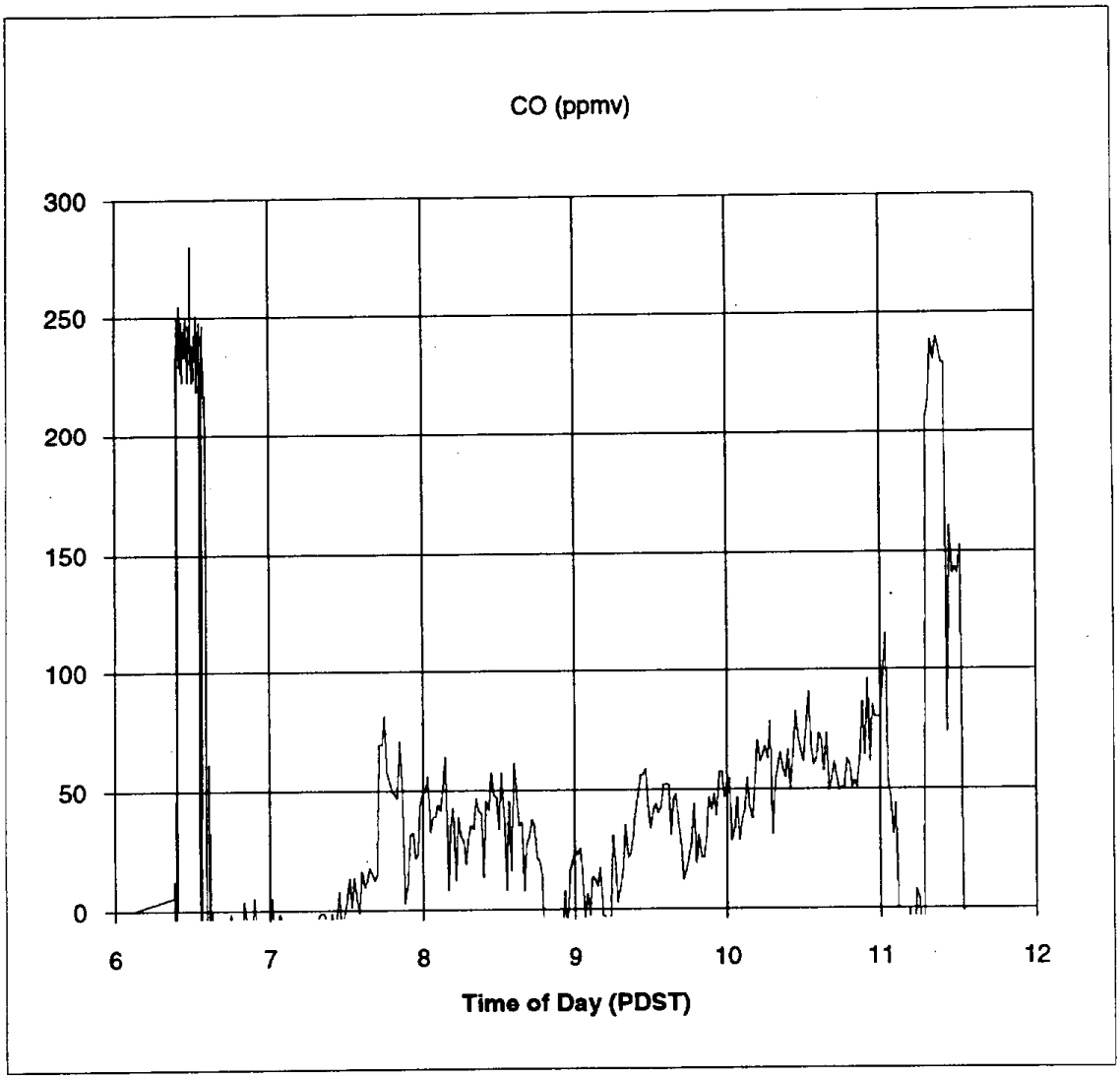

Figure 3.2.2.10. NO and NOx concentrations in stack gas, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF
Test Date 13-Aug-92

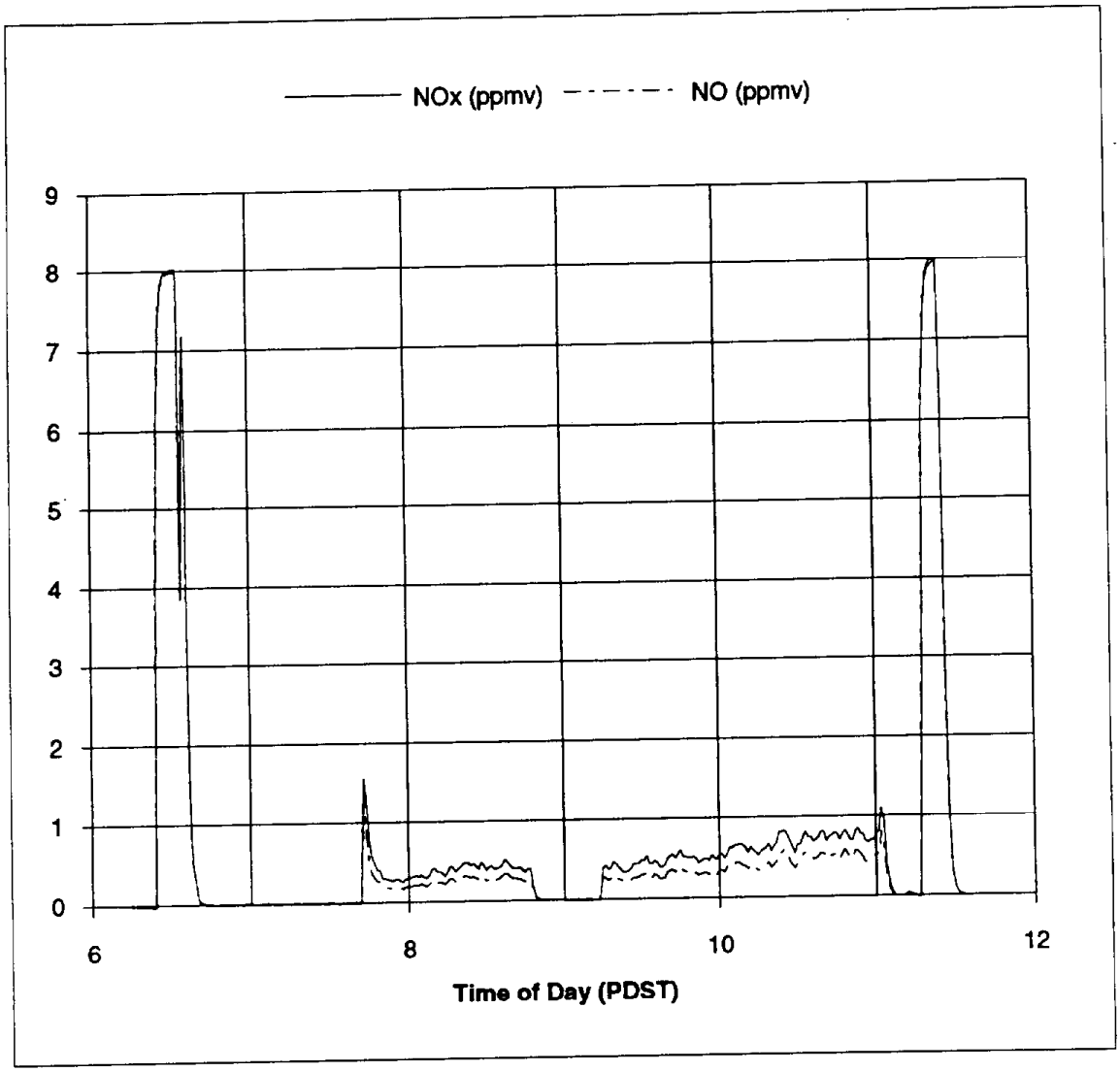

Figure 3.2.2.11. SO2 concentration in stack gas, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF
Test Date 13-Aug-92

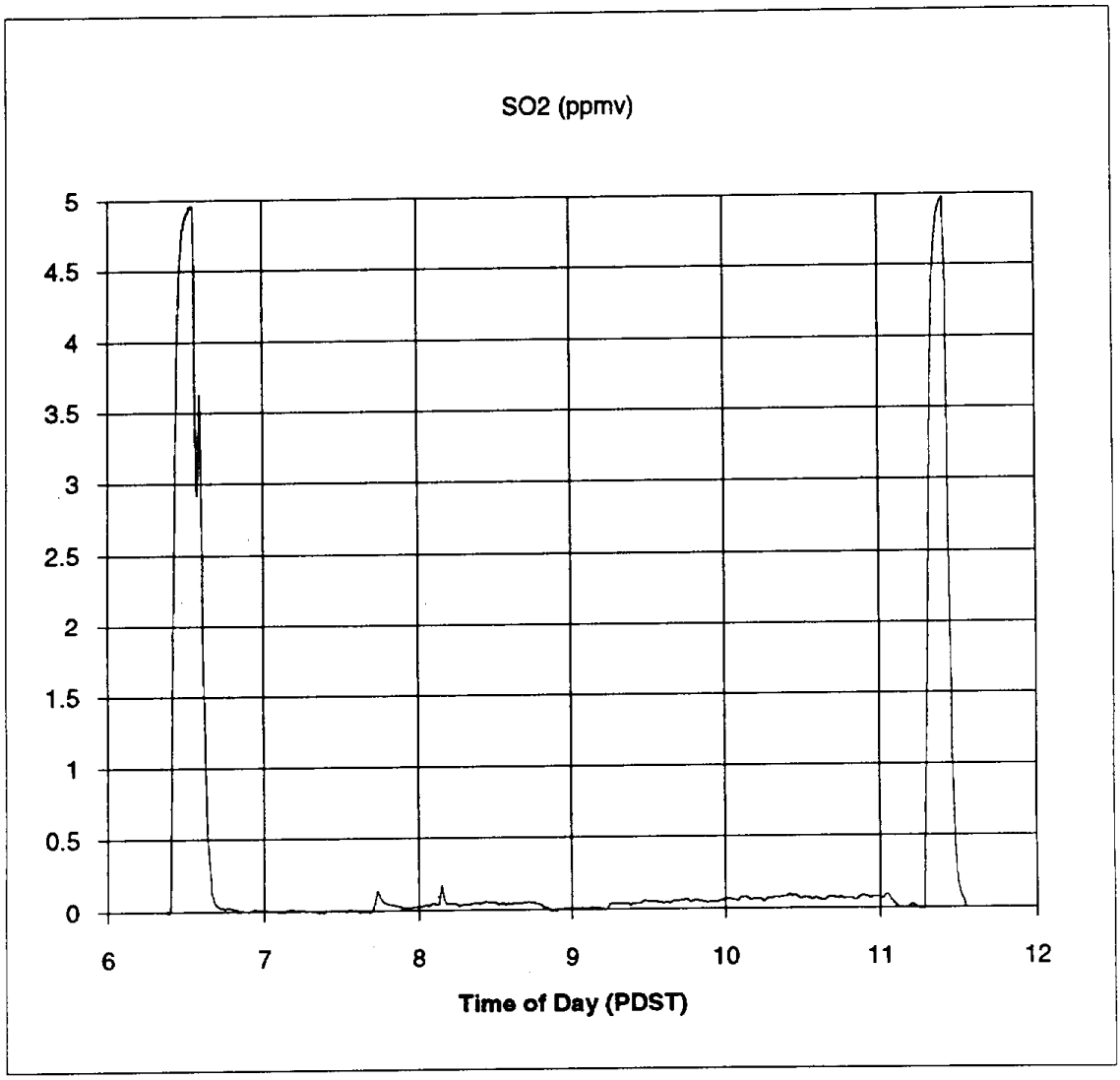

Figure 3.2.2.12. Total sulfur concentration in stack gas, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

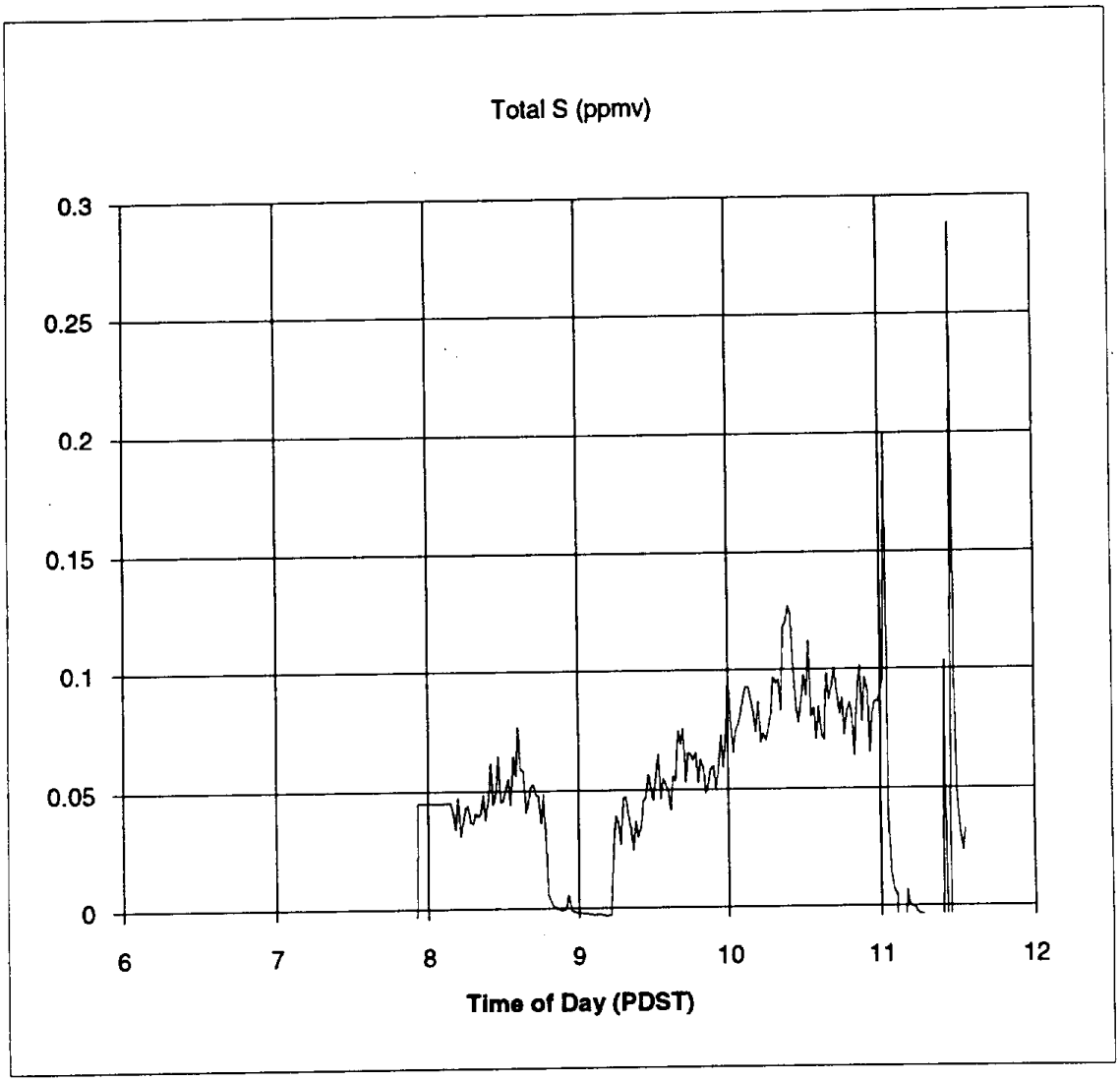

Figure 3.2.2.13. THC concentration in stack gas, 13 August 92.

Fuel Type: Wheat Straw
Configuration: CEWF

Test Date 13-Aug-92

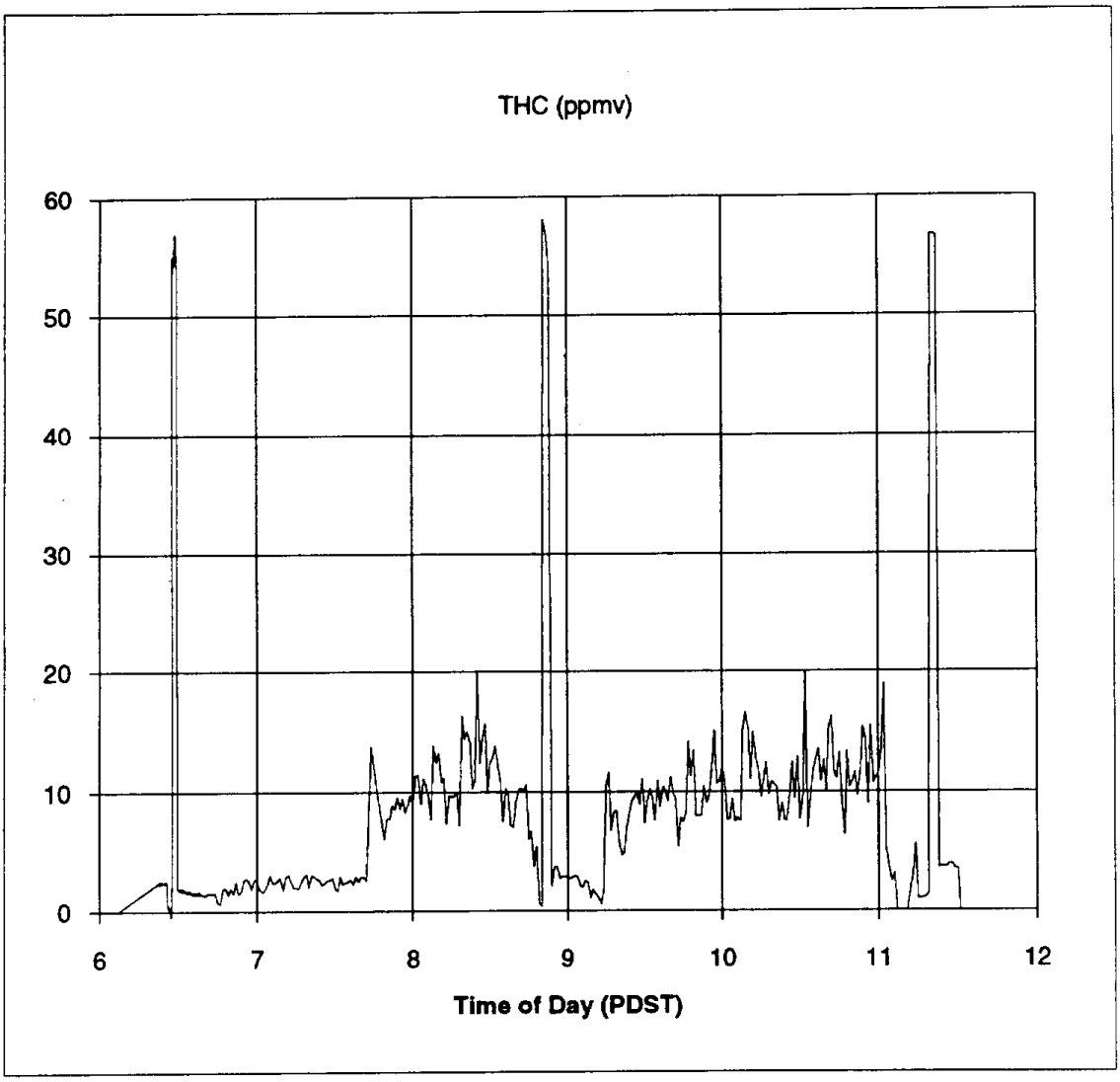

Figure 3.2.2.14. Particle size distribution, traverse 1, 13 August 92.

Fuel: Wheat Straw

Date of Test: 13-Aug-92
Configuration: CEWF

Particle Size Distribution
Traverse 1:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	14.00	0.05	3.15	1.000
2	7.84	0.1	3.10	0.984
3	4.18	0.1	3.00	0.952
4	2.21	0.1	2.90	0.921
5	1.27	0.2	2.80	0.889
6	0.75	0.3	2.60	0.825
7	0.39	0.4	2.30	0.730
filter	0.00	1.9	1.90	0.603

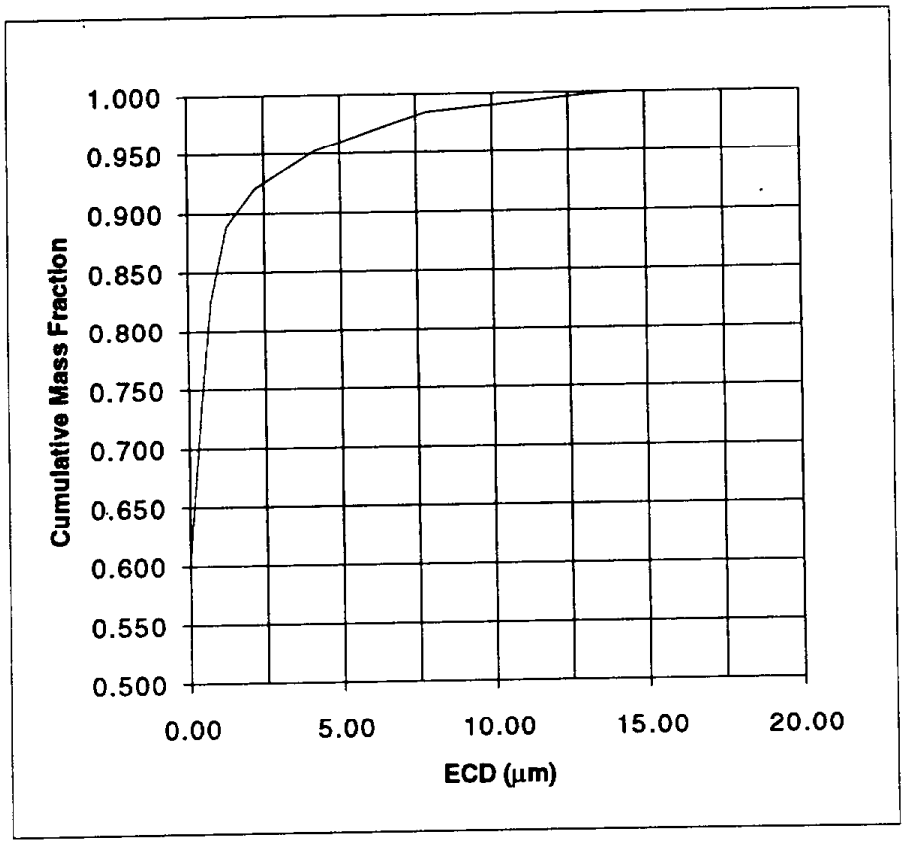

Figure 3.2.2.15. Particle size distribution, traverse 2, 13 August 92.

Fuel: Wheat Straw

Date of Test: 13-Aug-92
Configuration: CEWF

Particle Size Distribution
Traverse 2:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.85	0.1	3.10	1.000
2	7.76	0.1	3.00	0.968
3	4.14	0.0	2.90	0.935
4	2.19	0.1	2.90	0.935
5	1.26	0.1	2.80	0.903
6	0.74	0.4	2.70	0.871
7	0.39	0.4	2.30	0.742
filter	0.00	1.9	1.90	0.613

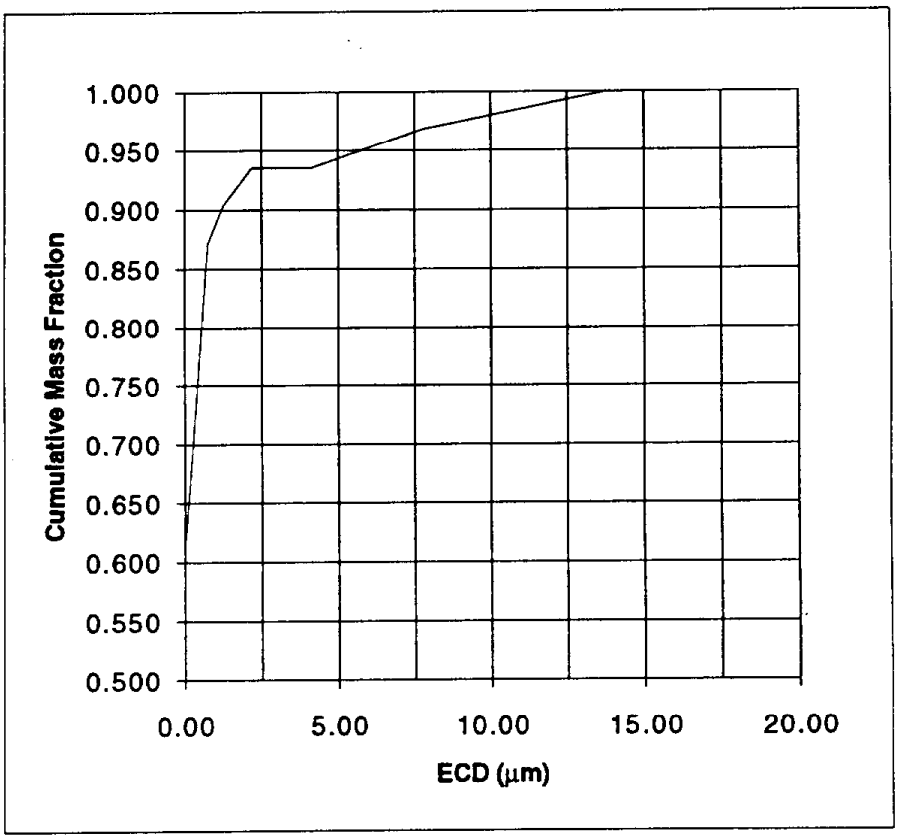

Figure 3.2.2.16. Nitrogen balance.
Date of Test: 13-Aug-92
Fuel Wheat Straw

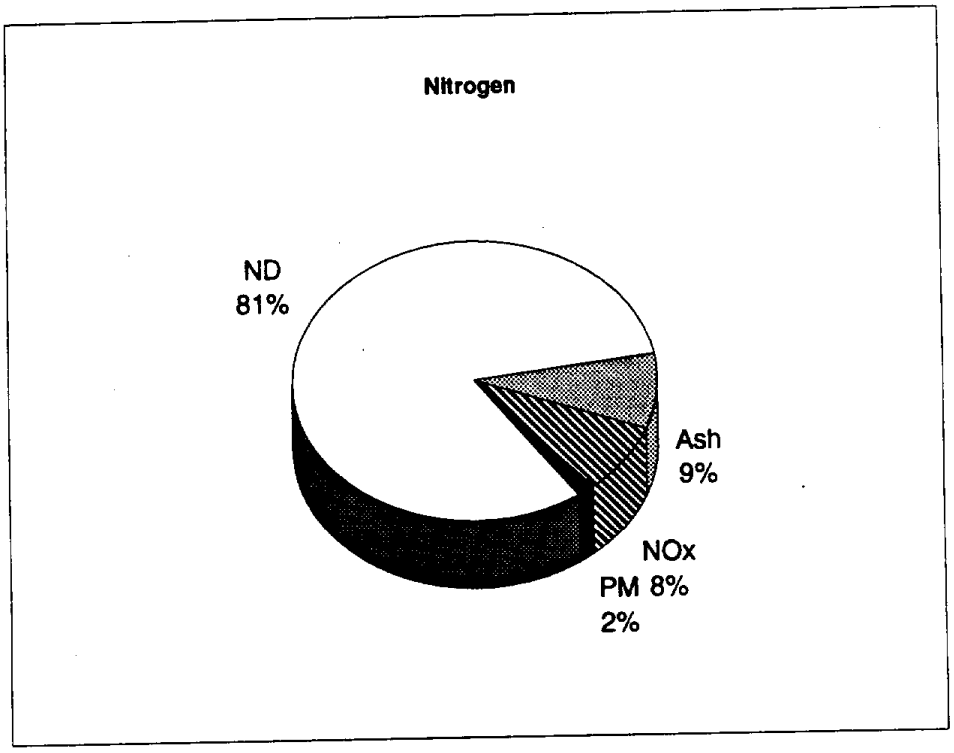

Figure 3.2.2.17. Sulfur balance.
Date of Test: 13-Aug-92
Fuel Wheat Straw

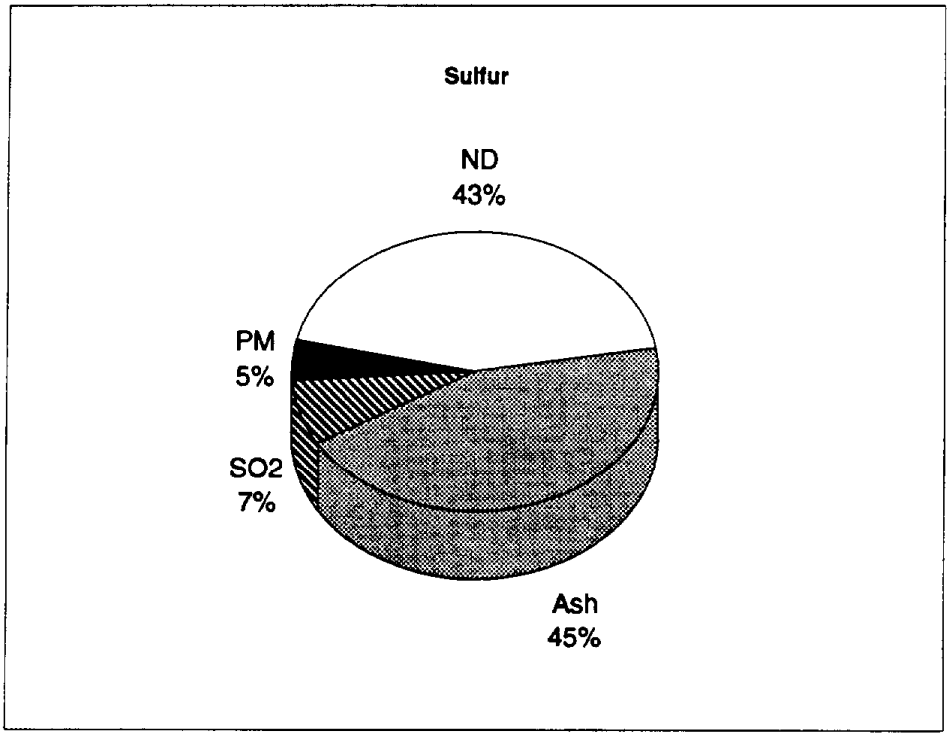

Figure 3.2.2.18. Relative abundance of major elements from DRUM impactor, Wheat Straw, 13 August 92, (CEWF).

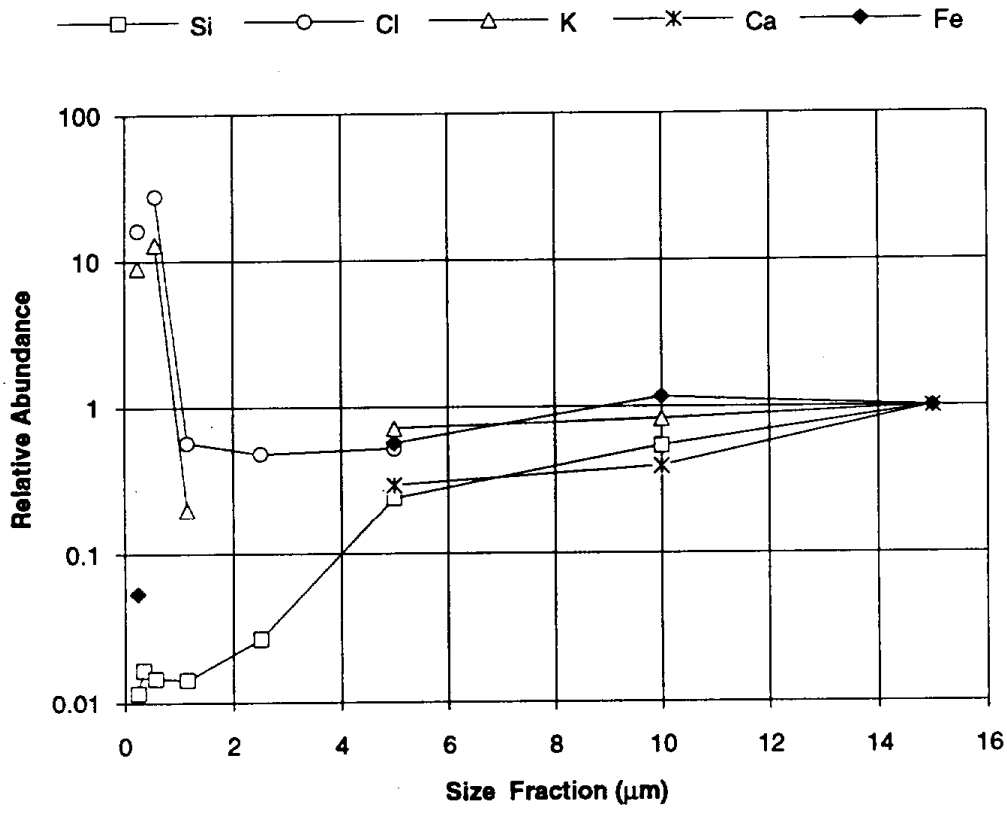

Figure 3.2.2.19. Mass fraction of PAH on primary filter samples, 13 August 1992, wheat straw.

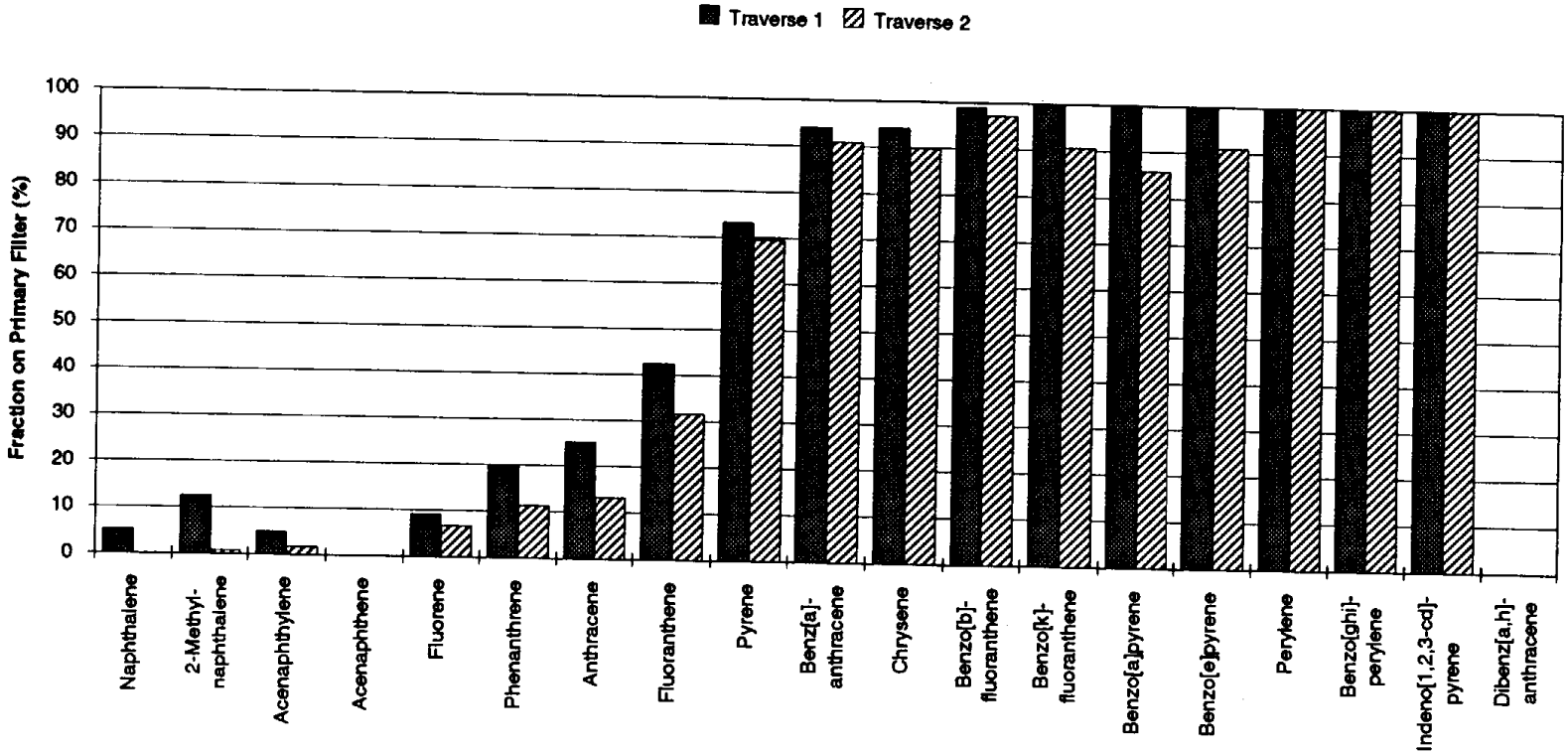

Table 3.3.1.1

Fuel and Ash Analyses

Run Date	15-Sep-92	15-Sep-92
Fuel Type	Barley Straw	Barley Straw
Sample Type	Fuel	Ash
Ultimate Analysis		
(% dry weight)		
C	44.81	24.42
H	5.89	1.31
N	0.63	0.91
Elemental Analysis		
(% by weight dry basis)		
N	0.81	0.94
P	0.11	1.08
K	2.25	20.48
Ca	0.31	1.72
Mg	0.14	0.72
Na	0.18	2.23
Cl	0.18	0.79
(mg/kg dry weight)		
S	1,330	7,730
B	6	29
Zn	13	92
Mn	93	743
Fe	175	721
Cu	4	19
Si		
Total (% dry weight)	54.84	54.62
Proximate Analysis		
(% dry weight)		
Ash	7.79	64.18
Volatiles	76.63	23.36
Fixed Carbon	15.57	12.46
Higher Heating Value		
(MJ/kg dry weight)	17.8139	8.1423

Table 3.3.1.2. Operating conditions and concentrations, 15 September 92.

Fuel:	Barley Straw	Date of Test:	15-Sep-92
		Configuration:	CEWF

Fuel Loading Rate (g/sq.m w.b.):	501
Total Fuel Consumption (kg w.b.)	27.2
Total Ash Recovered (kg w.b.)	2.7
Ash Fraction (w.b.)	0.10

	Traverse 1	Traverse 2
Mean Values		
Air Temperature (°C)	17.46	20.80
Air Relative Humidity (%)	71.51	57.60
Inlet Air Temperature (°C)	21.84	25.75
Stack Temperature (°C)	28.53	35.48
Impinger Outlet Temperature (°C)	14.03	17.59
Fire Spreading Rate (m/min)	0.35	0.47
Stack Gas Velocity (m/s)	2.22	2.17
Gas and PM Concentrations (less background)		
CO (ppmv)	96.51	118.07
NO (ppmv)	0.85	1.22
NOx (ppmv)	1.47	1.81
SO2 (ppmv)	0.01	0.02
THC (ppmv as CH4)	34.28	36.63
HC (ppmv as CH4 by GC)	13.41	13.88
CH4 (ppmv)	5.54	5.96
NMHC (ppmv as CH4)	28.75	30.67
NMHC (ppmv as CH4 by GC)	7.87	7.92
CO2 (ppmv by GC)	553	909
Total S (ppmv as SO2)	0.02	0.03
PM (mg/cu.m)	11.11	10.17
PM10 (mg/cu.m)	11.00	10.07
PM2.5 (mg/cu.m)	10.72	9.76

Table 3.3.1.3. Mass balance, barley straw, 15 September 92.

Fuel: Barley Straw

Date of Test: 15-Sep-92

Configuration: CEWF

Mass Balance

	Traverse 1	Traverse 2
Total Conveyor Travel (m)	16.68	11.22
Fuel Moisture Content (% w.b.)	7.2	6.4
Fuel Loading Rate (g/sq.m d.b.)	465	469
Total Fuel Consumption (g w.b.)	10,184	6,851
Total Fuel Consumption (g d.b.)	9,451	6,412
Residual Ash (g w.b.)	1,010	679
Fuel Vaporized (g w.b.)	9,174	6,171
Fuel Consumption Rate (g/s w.b.)	3.54	4.76
Fuel Consumption Rate (g/s d.b.)	3.28	4.45
Ash Generation Rate (g/s w.b.)	0.35	0.47
Fuel Vaporization Rate (g/s w.b.)	3.19	4.29
Stack Gas Density (kg/cu.m)	1.1716	1.1451
Stack Gas Flow Rate (cu.m/s)	3.30	3.22
Stack Gas Mass Flow Rate (kg/s)	3.87	3.69
Inlet Air Mass Flow Rate (kg/s)	3.86	3.69
Overall Air-Fuel Ratio (w.b.)	1092.57	775.03
Overall Air-Fuel Ratio (d.b.)	1177.34	828.02

Table 3.3.1.4. Emission factors, barley straw, 15 September 92 (integrated basis).

Fuel:	Barley Straw	Date of Test:	15-Sep-92
		Configuration:	CEWF

Emission Factors (% fuel dry weight)

Integrated Basis	Traverse 1	Traverse 2	Average
CO	11.032	9.403	10.217
NO	0.103	0.105	0.104
NOx (as NO2)	0.275	0.239	0.257
SO2	0.004	0.005	0.004
THC (as CH4)	2.222	1.672	1.947
HC (as CH4 by GC)	0.872	0.635	0.753
CH4 (by GC)	0.360	0.273	0.316
NMHC (as CH4)	1.862	1.399	1.631
NMHC (as CH4 by GC)	0.512	0.362	0.437
CO2 (by GC)	98.859	114.322	106.591
Total S (as SO2)	0.006	0.006	0.006
SO2/Total S	0.61	0.82	0.71
PM	1.064	0.694	0.879
PM10	1.053	0.687	0.870
PM2.5	1.026	0.666	0.846
MMAD (μm)	0.347	0.239	0.293
σ	3.030	3.057	

Table 3.3.1.5. Emission factors, barley straw, 15 September 92 (average basis).

Fuel:	Barley Straw	Date of Test:	15-Sep-92
		Configuration:	CEWF

Emission Factors (% fuel dry weight)

Average Basis

	Traverse 1	Traverse 2	Average
CO	10.979	9.450	10.215
NO	0.103	0.105	0.104
NOx (as NO2)	0.275	0.238	0.257
SO2	0.004	0.005	0.004
THC (as CH4)	2.229	1.675	1.952
HC (as CH4 by GC)	0.872	0.635	0.753
CH4 (by GC)	0.360	0.273	0.316
NMHC (as CH4)	1.869	1.403	1.636
NMHC (as CH4 by GC)	0.512	0.362	0.437
CO2 (by GC)	98.859	114.322	106.591
Total S (as SO2)	0.006	0.006	0.006
SO2/Total S	0.60	0.80	0.70
PM	1.064	0.694	0.879
PM10	1.053	0.687	0.870
PM2.5	1.026	0.666	0.846
MMAD (μm)	0.347	0.239	0.293
σ	3.030	3.057	

Table 3.3.1.6. Carbon balance.

Date of Test:	15-Sep-92	15-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Carbon Balance		
Dry Fuel Consumption Rate (g/s)	3.28	4.45
Ash Generation Rate (g/s)	0.35	0.47
Ash Fraction (% dry basis)	10.67	10.56
Fuel Carbon Concentration (%)	44.81	44.81
Residual Ash Carbon Concentration (%)	24.42	24.42
Carbon released to stack (g/s)	1.38	1.88
Maximum CO2 emission factor (%)	154.75	154.85
Stack Gas Density (kg/cubic meter)	1.17	1.15
Average CO2 concentration (ppmv)	553	909
Average CO concentration (ppmv)	96.51	118.07
Average THC concentration (ppmv as CH4)	34.28	36.63
PM Concentration (mg/cubic meter)	11.11	10.17
PM Carbon Concentration (%)	63.91	63.91
PM Carbon (mg/cubic meter)	7.10	6.50
Stack Gas Temperature (°C)	28.53	35.48
Impinger Temperature (°C)	14.03	17.59
PM molar concentration (ppm)	13.94	12.92
Estimated Average Stack Gas Velocity (m/s)	2.75	2.48
Emission Factors (% Average Basis):		
CO2	98.859	114.322
CO	10.979	9.450
THC (as CH4)	2.229	1.675
PM	1.064	0.694
Emission Factors (% Integrated Basis):		
CO2	98.859	114.322
CO	11.032	9.403
THC (as CH4)	2.222	1.672
PM	1.064	0.694
Closure (% Average Basis)	81	87
Closure (% Integrated Basis)	79	86

Table 3.3.1.7. Nitrogen balance

Date of Test:	15-Sep-92	15-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Nitrogen Balance		
Fuel Nitrogen Concentration (% dry weight)	0.81	0.81
Ash Nitrogen Concentration (% weight)	0.94	0.94
Emission Factors (% Average Basis):		
NOx (as NO2)	0.275	0.238
PM	1.064	0.694
Emission Factors (% Integrated Basis):		
NOx (as NO2)	0.275	0.239
NO3- Concentration of PM (% weight)	0.273	0.273
NH4+ Concentration of PM (% weight)	0.113	0.113
Nitrogen Concentration of PM (%)	0.149	0.149
Fuel Nitrogen (mg/s)	26.57	36.05
Ash Nitrogen (mg/s)	3.29	4.42
Nitrogen as NOx (mg/s Average Basis)	2.75	3.22
Nitrogen as NOx (mg/s Integrated Basis)	2.75	3.24
Nitrogen as PM (mg/s Average Basis)	0.05	0.05
Nitrogen as NOx+PM (mg/s Average Basis)	2.80	3.27
Nitrogen as NOx+PM (mg/s Integrated Basis)	2.80	3.28
NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.105	0.091
NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.105	0.091
Ash Nitrogen/Fuel Nitrogen	0.124	0.123
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.229	0.213
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.229	0.214

Table 3.3.1.8. Sulfur balance.

Date of Test:	15-Sep-92	15-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Sulfur Balance		
Fuel Sulfur Concentration (mg/kg dry weight)	1,330	1,330
Ash Sulfur Concentration (mg/kg weight)	7,730	7,730
Emission Factors (% Average Basis)		
SO2	0.004	0.005
PM	1.064	0.694
Emission Factors (% Integrated Basis)		
SO2	0.004	0.005
Sulfur Concentration of PM (% weight)	3.408	3.408
Fuel Sulfur (mg/s)	4.36	5.92
Ash Sulfur (mg/s)	2.71	3.63
Sulfur as SO2 (mg/s Average Basis)	0.07	0.11
Sulfur as SO2 (mg/s Integrated Basis)	0.07	0.11
Sulfur as PM (mg/s Average Basis)	1.19	1.05
Sulfur as SO2+PM (mg/s Average Basis)	1.25	1.16
Sulfur as SO2+PM (mg/s Integrated Basis)	1.25	1.16
SO2+PM Sulfur/Fuel Sulfur (Average Basis)	0.288	0.197
SO2+PM Sulfur/Fuel Sulfur (Integrated Basis)	0.288	0.197
Ash Sulfur/Fuel Sulfur	0.620	0.614
Closure (% Average Basis)	91	81
Closure (% Integrated Basis)	91	81

Table 3.3.1.9. Water balance.

Estimated Stack Humidity

Fuel	Barley Straw
Configuration	CEWF
Date of Test	15-Sep-92

	Traverse 1	Traverse 2
Ambient Air Temperature °C)	17	21
Ambient Air Relative Humidity (%)	72	58
Air Temperature (K)	291	294
Saturation Pressure (Pa)	1,995	2,457
Vapor Pressure (Pa)	1,427	1,415
Air Dew Point Temperature (°C)	12.3	12.2
Ambient Volume Fraction Water Vapor	0.0141	0.0140
Ambient Mass Fraction Water Vapor	0.0087	0.0087
Fuel Burning Rate (g/s wet basis)	3.54	4.76
Fuel Moisture Content (%)	7.2	6.4
Ash Fraction (wet basis)	0.10	0.10
Fuel Hydrogen Content (%)	5.89	5.89
Ash Hydrogen Content (%)	1.31	1.31
Moisture Evaporated (g/s)	0.25	0.30
Water of Combustion (g/s)	1.70	2.31
Total Fuel Water Added (g/s)	1.95	2.61
Inlet Air Mass Flowrate (g/s)	3,860	3,690
Inlet Air Water Vapor Flowrate (g/s)	34	32
Total Stack Water Vapor Flowrate (g/s)	36	35
Stack Gas Mass Flowrate (g/s)	3,863	3,694
Mass Fraction Water Vapor in Stack	0.0092	0.0094
Volume Fraction Water Vapor in Stack	0.0149	0.0151
Stack Vapor Pressure (Pa)	1,508	1,529
Stack Temperature (°C)	29	35
Stack Temperature (K)	302	309
Stack Saturation Pressure (Pa)	3,901	5,779
Stack Relative Humidity (%)	39	26
Stack Dew Point Temperature (°C)	13.1	13.3
Impinger Outlet Temperature (°C)	14.0	17.6
Volume Stack Gas Sampled for PM (L)	468	246
Estimated Impinger/Desiccant Weight Gain (g)	5.3	2.8

Totals:

	Estimated	Measured
Total Impinger/Desiccant Weight Gain (g)	8.1	12.6
Estimated/Measured Weight Gain	0.64	

Table 3.3.1.10. Power balance.

Date of Test: Fuel	15-Sep-92 Barley Straw Traverse 1	15-Sep-92 Barley Straw Traverse 2
Power Balance		
Fuel Heating Value (MJ/kg dry weight)	17.8139	17.8139
Ash Heating Value (MJ/kg dry weight)	8.1423	8.1423
Average Energy Release Rate (kW)	55.6	75.4
Products of Incomplete Combustion (kW)		
CO	3.6	4.3
THC (as CH4)	4.1	4.1
PM	0.7	0.6
Heat Release Rate (kW)	47.1	66.4
Fireline Intensity (kW/m)	38.7	54.5
Stack Gas Flow (kg/s)	3.87	3.69
Stack Gas Temperature (°C)	28.53	35.48
Inlet Temperature (°C)	21.84	25.75
Sensible Power at Top of Stack (kW)	26.0	36.1
Tunnel Dissipation (kW)	21.1	30.3

Table 3.3.1.11. Mass concentrations (%) from DRI filter samples

Date	15-Sep-92		15-Sep-92		
Fuel	Barley Straw CEWF		Barley Straw CEWF		
Size Fraction	PM2.5		PM10		
Teflon Filter ID	ABTT028		ABTT029		
Quartz Filter ID	ABTQ028		ABTQ029		
Teflon Field Sample Flag					
Quartz field sample field					
Teflon mass sample flag					
Quartz mass sample flag					
Anions sample flag					
Ammonium analysis flag					
Sodium ion analysis flag					
Magnesium ion analysis flag					
Potassium ion analysis flag					
Carbon analysis flag					
XRF analysis flag	i4				
		±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)	0.20	0.01	0.20	0.01	
Quartz sample volume (m^3)	0.20	0.01	0.20	0.01	
Teflon mass concentration (µg/m^3)	10,530	532	10,510	531	
	Concentration (%)	±Uncertainty	Concentration (%)	±Uncertainty	PM2.5/PM10
Cl-	1.8672	0.1574	1.8508	0.1560	1.01
NO3-	0.2764	0.0389	0.2726	0.0388	1.01
SO4=	6.2005	0.4586	6.4407	0.4764	0.96
NH4+	0.0908	0.0342	0.1128	0.0346	0.80
Na+	0.6321	0.0560	0.6411	0.0567	0.99
K+	10.1523	0.7663	10.6347	0.8028	0.95
C(org)	44.4898	4.3147	47.9475	4.6431	0.93
C(oht)	39.2153	5.9871	42.9056	6.5386	0.91
C(e)	16.6619	1.5806	15.9657	1.5134	1.04
C(eht)	1.3438	0.8198	1.4795	0.9026	0.91
C	61.1517		63.9132		0.96
Al	0.0790	0.0205	0.0912	0.0210	0.87
Si	0.0646	0.0802	0.1383	0.0368	0.47
P	0.0297	0.0909	0.0313	0.0910	0.95
S	3.4139	0.2432	3.4080	0.2428	1.00
Cl	1.5504	0.1168	1.6364	0.1228	0.95
K	11.0002	0.7825	11.2607	0.8011	0.98
Ca	0.0209	0.1579	0.0558	0.1617	0.37
Ti	0.0000	0.0316	0.0010	0.0323	0.00
V	0.0000	0.0137	0.0000	0.0140	
Cr	0.0000	0.0030	0.0011	0.0031	0.00
Mn	0.0007	0.0021	0.0024	0.0015	0.29
Fe	0.0029	0.0055	0.0254	0.0059	0.11
Co	0.0000	0.0012	0.0000	0.0014	
Ni	0.0000	0.0014	0.0000	0.0014	
Cu	0.0000	0.0014	0.0000	0.0015	
Zn	0.0033	0.0011	0.0051	0.0011	0.65
Ga	0.0000	0.0026	0.0000	0.0026	
As	0.0000	0.0030	0.0000	0.0031	
Se	0.0000	0.0016	0.0000	0.0017	
Br	0.0531	0.0040	0.0547	0.0041	0.97
Rb	0.0046	0.0012	0.0042	0.0012	1.10
Sr	0.0000	0.0015	0.0004	0.0016	0.00
Y	0.0006	0.0019	0.0006	0.0019	1.00
Zr	0.0000	0.0023	0.0000	0.0023	
Mo	0.0000	0.0039	0.0000	0.0040	
Pd	0.0007	0.0138	0.0000	0.0141	
Ag	0.0070	0.0157	0.0027	0.0161	2.59
Cd	0.0040	0.0168	0.0035	0.0173	1.14
In	0.0000	0.0188	0.0000	0.0193	
Sn	0.0061	0.0239	0.0014	0.0245	4.36
Sb	0.0129	0.0272	0.0031	0.0279	4.16
Ba	0.0215	0.0951	0.0069	0.0971	3.12
La	0.0000	0.1269	0.0000	0.1298	
Au	0.0000	0.0043	0.0000	0.0044	
Hg	0.0000	0.0035	0.0000	0.0036	
Tl	0.0000	0.0034	0.0000	0.0034	
Pb	0.0000	0.0044	0.0000	0.0045	
U	0.0000	0.0036	0.0000	0.0037	
Sum of measured species	78.4272	4.6771	81.6739	4.9635	0.96

Table 3.3.1.12. Element ratios from DRI filter samples.

Date	15-Sep-92	15-Sep-92	
Fuel	Barley Straw	Barley Straw	
Configuration	CEWF	CEWF	
Size Fraction	PM2.5	PM10	PM2.5/PM10
Teflon Filter ID	ABTT028	ABTT029	
Quartz Filter ID	ABTQ028	ABTQ029	
Cl-/Cl	1.20	1.13	1.06
K+/K	0.92	0.94	0.98
Sulfate S/Total S	0.61	0.63	0.96
C(org)/C	0.73	0.75	0.97
Cl/K	0.14	0.15	0.97
Cl-/K+	0.18	0.17	1.06
Cl-/Na+	2.95	2.89	1.02
S/K	0.31	0.30	1.03
S/Na+	5.40	5.32	1.02
Al/Si	1.22	0.66	1.85

Table 3.3.1.13. Emission factors (mg/kg) from DRI filter samples.

Date		15-Sep-92		15-Sep-92		
Fuel		Barley Straw CEWF		Barley Straw CEWF		
Size Fraction		PM2.5		PM10		
Teflon Filter ID		ABTT028		ABTT029		
Quartz Filter ID		ABTQ028		ABTQ029		
Start Time		10:47				
Stop Time		11:07				
Start Time						
End Time						
Elapsed Time (minutes)		20				Traverse 2
PM (mg/m^3 by total filter)						10.170
PM10 (by total filter/impactor)						10.070
PM2.5 (by total filter/impactor)						9.760
PM emission factor (%)						0.694
PM10 emission factor (%)						0.687
PM2.5 emission factor (%)						0.666
			±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)		0.20	0.01	0.20	0.01	
Quartz sample volume (m^3)		0.20	0.01	0.20	0.01	
Teflon mass concentration (mg/m^3)		10.530	0.532	10.510	0.531	
Teflon mass/Total mass		1.079		1.044		
		Emission (mg/kg)	±Uncertainty	Emission (mg/kg)	±Uncertainty	PM2.5/PM10
Cl-		158.5617	10.4828	155.6800	10.7172	1.02
NO3-		23.4718	2.5907	22.9297	2.6656	1.02
SO4=		526.5435	30.5428	541.7595	32.7287	0.97
NH4+		7.7107	2.2777	9.4882	2.3770	0.81
Na+		53.6776	3.7296	53.9261	3.8953	1.00
K+		862.1284	51.0356	894.5378	55.1524	0.96
C(org)		3778.0524	287.3590	4033.1039	318.9810	0.94
C(oht)		3330.1444	398.7409	3609.0045	449.2018	0.92
C(e)		1414.9205	105.2680	1342.9548	103.9706	1.05
C(eht)		114.1148	54.5987	124.4481	62.0086	0.92
C		5192.9729	0.0000	5376.0587	0.0000	0.97
Al		6.7086	1.3653	7.6713	1.4427	0.87
Si		5.4858	5.3413	11.6331	2.5282	0.47
P		2.5221	6.0539	2.6328	6.2517	0.96
S		289.9067	16.1971	286.6639	16.6804	1.01
Cl		131.6592	7.7789	137.6458	8.4364	0.96
K		934.1317	52.1145	947.1938	55.0356	0.99
Ca		1.7748	10.5161	4.6936	11.1088	0.38
Ti		0.0000	2.1046	0.0841	2.2190	0.00
V		0.0000	0.9124	0.0000	0.9618	
Cr		0.0000	0.1998	0.0925	0.2130	0.00
Mn		0.0594	0.1399	0.2019	0.1031	0.29
Fe		0.2463	0.3663	2.1365	0.4053	0.12
Co		0.0000	0.0799	0.0000	0.0962	
Ni		0.0000	0.0932	0.0000	0.0962	
Cu		0.0000	0.0932	0.0000	0.1031	
Zn		0.2802	0.0733	0.4290	0.0756	0.65
Ga		0.0000	0.1732	0.0000	0.1786	
As		0.0000	0.1998	0.0000	0.2130	
Se		0.0000	0.1066	0.0000	0.1168	
Br		4.5092	0.2664	4.6011	0.2817	0.98
Rb		0.3906	0.0799	0.3533	0.0824	1.11
Sr		0.0000	0.0999	0.0336	0.1099	0.00
Y		0.0510	0.1265	0.0505	0.1305	1.01
Zr		0.0000	0.1532	0.0000	0.1580	
Mo		0.0000	0.2597	0.0000	0.2748	
Pd		0.0594	0.9191	0.0000	0.9687	
Ag		0.5944	1.0456	0.2271	1.1061	2.62
Cd		0.3397	1.1189	0.2944	1.1885	1.15
In		0.0000	1.2521	0.0000	1.3259	
Sn		0.5180	1.5917	0.1178	1.6832	4.40
Sb		1.0955	1.8115	0.2608	1.9167	4.20
Ba		1.8258	6.3337	0.5804	6.6708	3.15
La		0.0000	8.4515	0.0000	8.9173	
Au		0.0000	0.2864	0.0000	0.3023	
Hg		0.0000	0.2331	0.0000	0.2473	
Tl		0.0000	0.2264	0.0000	0.2336	
Pb		0.0000	0.2930	0.0000	0.3092	
U		0.0000	0.2398	0.0000	0.2542	
Sum of measured species		6,660	311	6,870	331	0.97

Table 3.3.1.14. Element concentrations (ng/m^3) from CNL filter samples.

Fuel:	Barley
Date:	15-Sep-92
Time:	
Filter ID:	AG-34

Element	Concentration	±Uncertainty
	ng/m^3	
H	300,840	23,700
Na	242,250	31,600
Mg		
Al	10,620	2,700
Si	48,210	3,900
P		
S	176,300	9,600
Cl	151,170	8,800
K	1,166,100	58,900
Ca		
Ti	870	400
V		
Cr		
Mn	830	300
Fe	9,560	600
Ni		
Cu	760	200
Zn		
As		
Pb		
Se		
Br	6,960	500
Rb		
Sr		
Zr		

Table 3.3.1.15. Element emission factors (mg/kg) from CNL filter samples.

Fuel:	Barley	
Date:	15-Sep-92	
Time:		
Filter ID:	AG-34	
Fuel rate (g/s)		3.28
Stack gas flow rate (m^3/s)		3.30
Stack Temperature (°C)		28.53
Ambient Temperature (°C)		17.46

Element	Emission factor (mg/kg)	±Uncertainty (mg/kg)
H	291.6	23.0
Na	234.8	30.6
Mg		
Al	10.3	2.6
Si	46.7	3.8
P		
S	170.9	9.3
Cl	146.5	8.5
K	1,130.2	57.1
Ca		
Ti	0.8	0.4
V		
Cr		
Mn	0.8	0.3
Fe	9.3	0.6
Ni		
Cu	0.7	0.2
Zn		
As		
Pb		
Se		
Br	6.7	0.5
Rb		
Sr		
Zr		

Table 3.3.1.16. Relative element concentrations by stage from DRUM impactor.

Stage 1: 10 - 15 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	715.46	203.20	0.6103	1
Al				
Si	4,936.34	288.00	4.2107	1
S	377.78	69.00	0.3222	1
Cl	295.02	99.00	0.2517	1
K	1,172.32	124.20	1.0000	1
Ca	875.24	107.20	0.7466	1
Ti				
V				
Cr				
Mn	116.06	25.60	0.0990	1
Fe	1,248.00	77.60	1.0646	1
Ni				
Cu	239.48	25.40	0.2043	1
Zn	284.06	61.40	0.2423	1
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.1.17. Relative element concentrations by stage from DRUM impactor.

Stage 2: 5 - 10 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	722.90	155.40	0.7067	1.0104
Al				
Si	1,695.84	129.40	1.6579	0.3435
S	525.82	63.40	0.5141	1.3919
Cl				
K	1,022.86	90.00	1.0000	0.8725
Ca				
Ti	95.82	32.40	0.0937	
V				
Cr	82.84	20.20	0.0810	
Mn	54.84	16.80	0.0536	0.4725
Fe	486.50	40.20	0.4756	0.3898
Ni	57.78	13.00	0.0565	
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.1.18. Relative element concentrations by stage from DRUM impactor.

Stage 3: 2.5 - 5 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	882.96	96.20	0.8586	0.1789
S	286.80	70.60	0.2789	0.7592
Cl	180.32	47.80	0.1753	0.6112
K	1,028.38	93.40	1.0000	0.8772
Ca				
Ti	63.48	26.20	0.0617	
V				
Cr	44.56	16.80	0.0433	
Mn	82.86	18.40	0.0806	0.7139
Fe	471.64	47.20	0.4586	0.3779
Ni	37.32	8.60	0.0363	#DIV/0!
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.1.19. Relative element concentrations by stage from DRUM impactor.

Stage 4: 1.15 - 2.5 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	901.84	122.80	0.8380	
Na				
Mg	778.90	125.40	0.7238	1.0887
Al				
Si	277.28	64.60	0.2577	0.0562
S	456.10	65.20	0.4238	1.2073
Cl	165.22	45.00	0.1535	0.5600
K	1,076.14	104.80	1.0000	0.9180
Ca				
Ti				
V				
Cr	93.76	23.20	0.0871	
Mn	42.72	18.40	0.0397	0.3681
Fe	115.16	24.00	0.1070	0.0923
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb	23.86	12.80	0.0222	
Sr				
Pb				

Table 3.3.1.20. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	524.42	107.00	0.5703	
Na				
Mg	719.82	113.80	0.7828	1.0061
Al				
Si				
S				
Cl	445.30	61.40	0.4843	1.5094
K	919.50	83.00	1.0000	0.7843
Ca				
Ti				
V	143.00	40.20	0.1555	
Cr				
Mn				
Fe				
Ni				
Cu	20.00	8.00	0.0218	0.0835
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.1.21. Relative element concentrations by stage from DRUM impactor.

Stage 6: 0.34 - 0.56 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	19,766.28	2,050.20	0.2159	
Na				
Mg				
Al	475.30	133.20	0.0052	
Si				
S	10,643.82	730.80	0.1163	28.1747
Cl	9,485.22	796.20	0.1036	32.1511
K	91,555.42	4,668.20	1.0000	78.0976
Ca				
Ti				
V				
Cr				
Mn	133.08	34.60	0.0015	1.1466
Fe				
Ni				
Cu				
Zn	79.30	18.00	0.0009	0.2792
As				
Se				
Br	917.94	177.80	0.0100	
Rb				
Sr				
Pb				

Table 3.3.1.22. Relative element concentrations by stage from DRUM impactor.

Stage 7: 0.24 - 0.34 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	207.74	63.20	0.1986	0.2904
Al	390.14	76.40	0.3730	
Si				
S				
Cl	461.24	86.40	0.4410	1.5634
K	1,045.94	88.80	1.0000	0.8922
Ca	160.54	37.40	0.1535	0.1834
Ti	145.36	34.20	0.1390	
V				
Cr				
Mn	33.68	12.80	0.0322	0.2902
Fe	81.76	28.00	0.0782	0.0655
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb	55.94	16.00	0.0535	
Sr				
Pb				

Table 3.3.1.23. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	15-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	3679.2	275.2	0.1802	
Na				
Mg				
Al	335.30	126.20	0.0164	
Si				
S	4,648.86	496.20	0.2277	12.3057
Cl	2,649.92	507.00	0.1298	8.9822
K	20,417.02	1,083.40	1.0000	17.4159
Ca				
Ti				
V				
Cr				
Mn	82.68	21.40	0.0040	0.7124
Fe	188.92	46.80	0.0093	0.1514
Ni				
Cu	61.92	13.60	0.0030	0.2586
Zn	85.44	14.80	0.0042	0.3008
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.1.24
VOC Concentrations (ppbv)

Date	15-Sep-92	15-Sep-92
Fuel	Barley Straw	Barley Straw
Traverse	Traverse 1	Traverse 2
Acetic acid		
Propanone (acetone)		
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	47.2	78
Dimethylbutane		
Hexane	53.8	67.4
Phenol		
Dimethylfuran	15.6	15.9
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	28.5	36.5
Benzonitrile		
Benzaldehyde	11.9	14.5
Methylphenol (hydroxy toluene)		
Styrene	255.7	281.1
Xylene	4	5
Trimethylpentane	14.8	23.1
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	6.2	7.1
C10H12		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		
No match r.t. (6.7)		
No match r.t. (8.51)		
No match r.t. (8.71)		
No match r.t. (8.73)		
No match r.t.(6.4)		
No match r.t.(8.5)		

Table 3.3.1.25
VOC Emission Factors (mg/kg)

Date	15-Sep-92	15-Sep-92
Fuel	Barley Straw	Barley Straw
Traverse	Traverse 1	Traverse 2
Fuel Consumption Rate (g/s d.b)	3.28	4.45
Stack Gas Mass Flow Rate (kg/s)	3.87	3.69
Acetic acid		
Propanone (acetone)		
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	150	174
Dimethylbutane		
Hexane	188	166
Phenol		
Dimethylfuran	61	44
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	107	96
Benzonitrile		
Benzaldehyde	51	44
Methylphenol (hydroxy toluene)		
Styrene	1,083	837
Xylene	17	15
Trimethylpentane	69	75
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	32	26
Unknown		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		

Table 3.3.1.26. PAH emission factors, barley straw, 15 September 1992 (zero indicates not detected).

	Traverse 1 Filter	Traverse 2 Filter	Trap	Traverse 1 Sorbent	Traverse 2 Sorbent	Impinger Rinsate	Total Traverse 1	Total Traverse 2	Total Average
					µg/kg dry fuel				
Naphthalene	3,001	2,078	0	133,854	159,729	211	137,066	162,018	149,542
2-Methyl-naphthalene	972	570	0	3,199	2,071	55	4,226	2,696	3,461
Acenaphthylene	1,844	956	0	17,702	23,625	16	19,562	24,598	22,080
Acenaphthene	76	151	0	227	842	42	345	1,035	690
Fluorene	81	104	0	4,540	1,807	11	4,632	1,922	3,277
Phenanthrene	2,893	2,097	0	19,464	17,298	47	22,403	19,442	20,923
Anthracene	561	358	0	4,791	2,226	9	5,362	2,593	3,977
Fluoranthene	1,959	1,889	0	1,328	462	31	3,318	2,382	2,850
Pyrene	1,640	1,524	0	775	269	19	2,433	1,812	2,122
Benz[a]-anthracene	1,332	845	0	43	0	5	1,380	850	1,115
Chrysene	1,638	1,076	0	55	0	10	1,702	1,086	1,394
Benzo[b]-fluoranthene	2,619	1,955	0	0	0	35	2,653	1,989	2,321
Benzo[k]-fluoranthene	681	679	0	0	0	3	684	681	683
Benzo[a]pyrene	825	605	0	0	0	27	852	632	742
Benzo[e]pyrene	1,207	703	0	0	0	3	1,210	706	958
Perylene	214	217	0	0	0	15	229	232	231
Benzo[ghi]-perylene	682	361	0	0	0	0	682	361	522
Indeno[1,2,3-cd]-pyrene	809	375	0	0	0	0	809	375	592
Dibenz[a,h]-anthracene	0	0	0	0	0	10	10	10	10
Total	23,035	16,543	0	185,979	208,329	548	209,561	225,420	217,490

Figure 3.3.1.1. Ambient air conditions, 15 September 92.

Fuel Type: Barley Straw Test Date 15-Sep-92
Configuration: CEWF

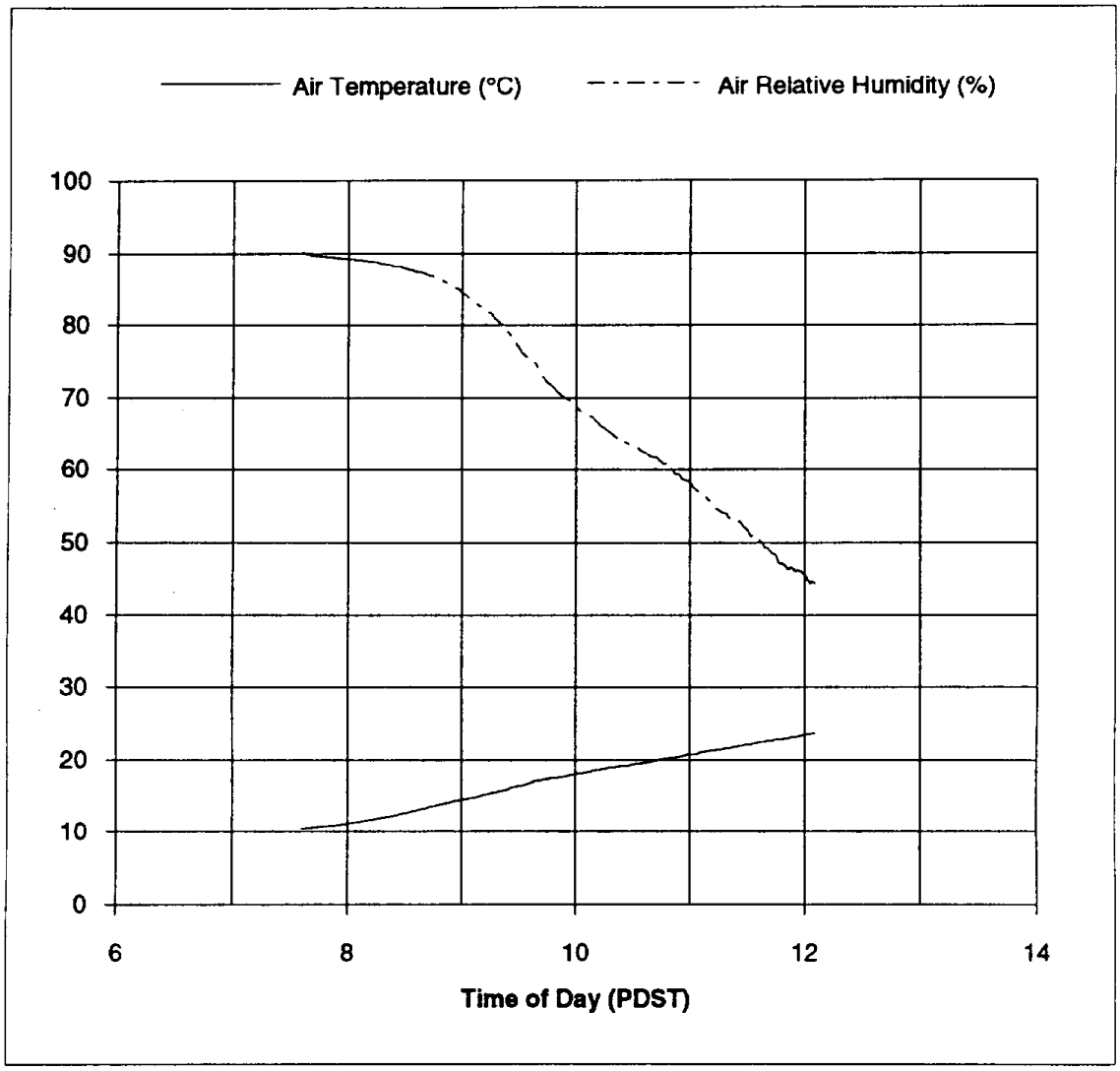

Figure 3.3.1.2. Air temperature and relative humidity from CIMIS station.

Fuel: Barley Straw Date of Test: 15-Sep-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

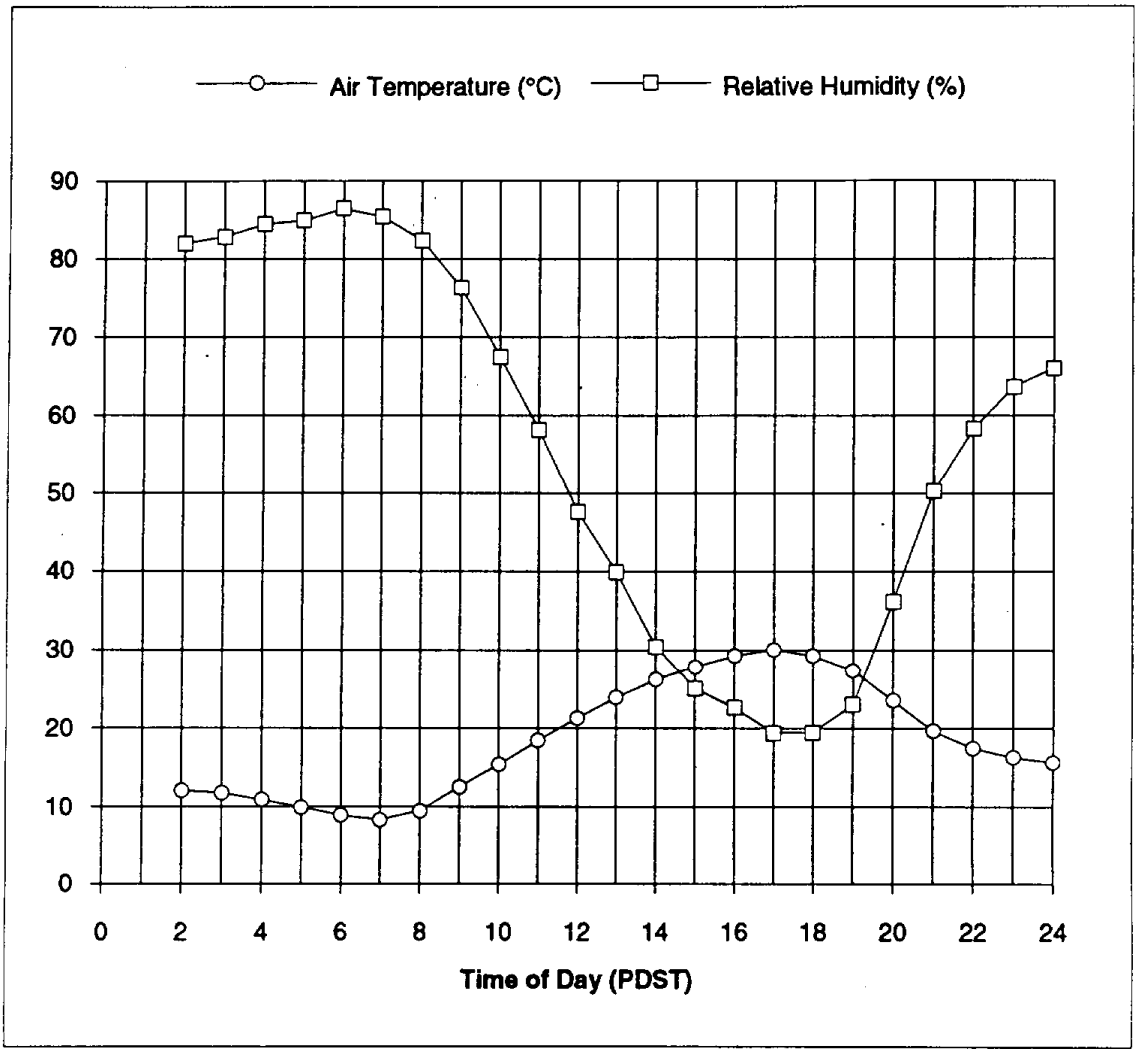

Figure 3.3.1.3. Wind speed from CIMIS station.

Fuel: Barley Straw Date of Test: 15-Sep-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

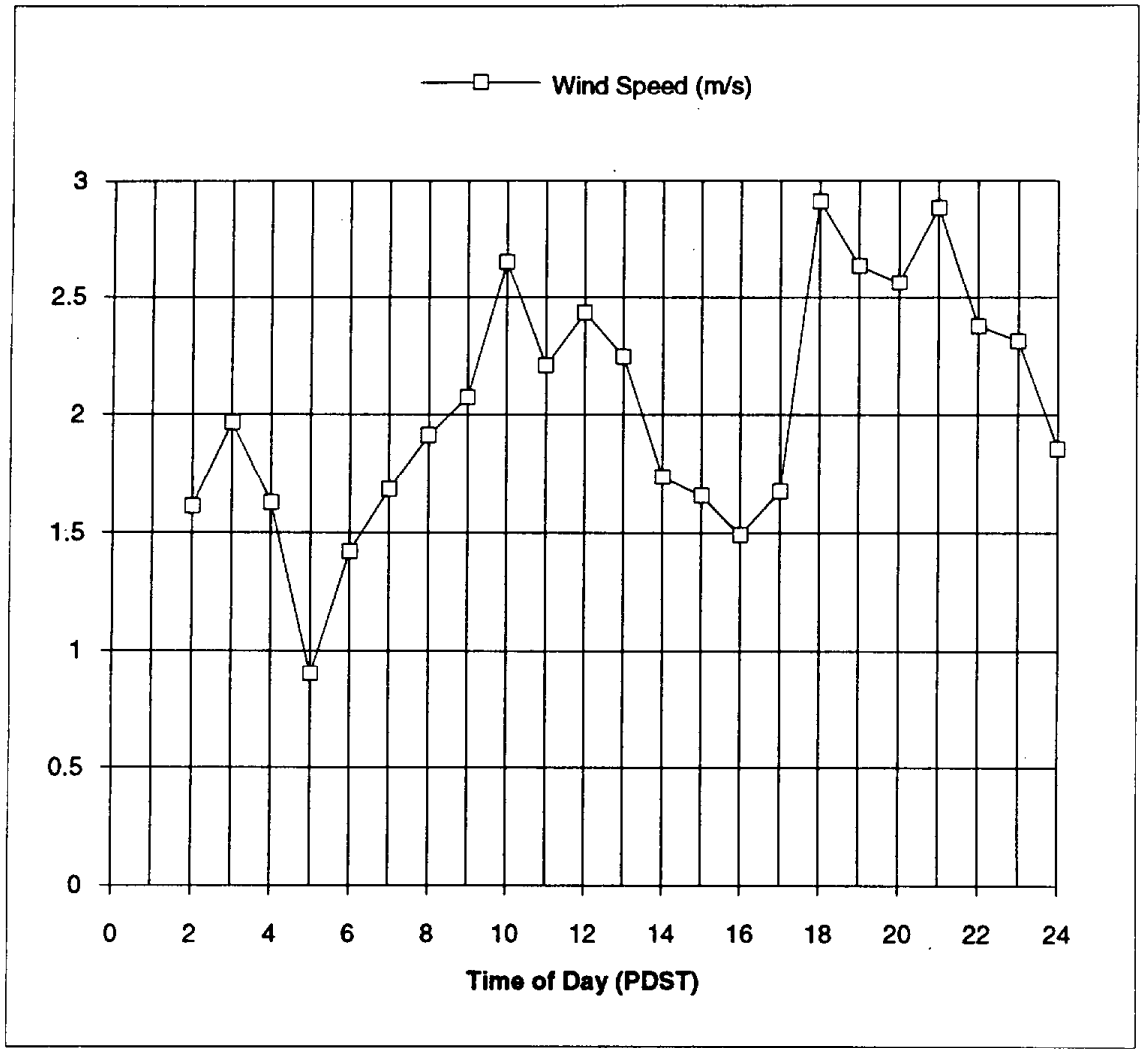

Figure 3.3.1.4. Wind direction and solar radiation from CIMIS station.

Fuel: Barley Straw Date of Test: 15-Sep-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

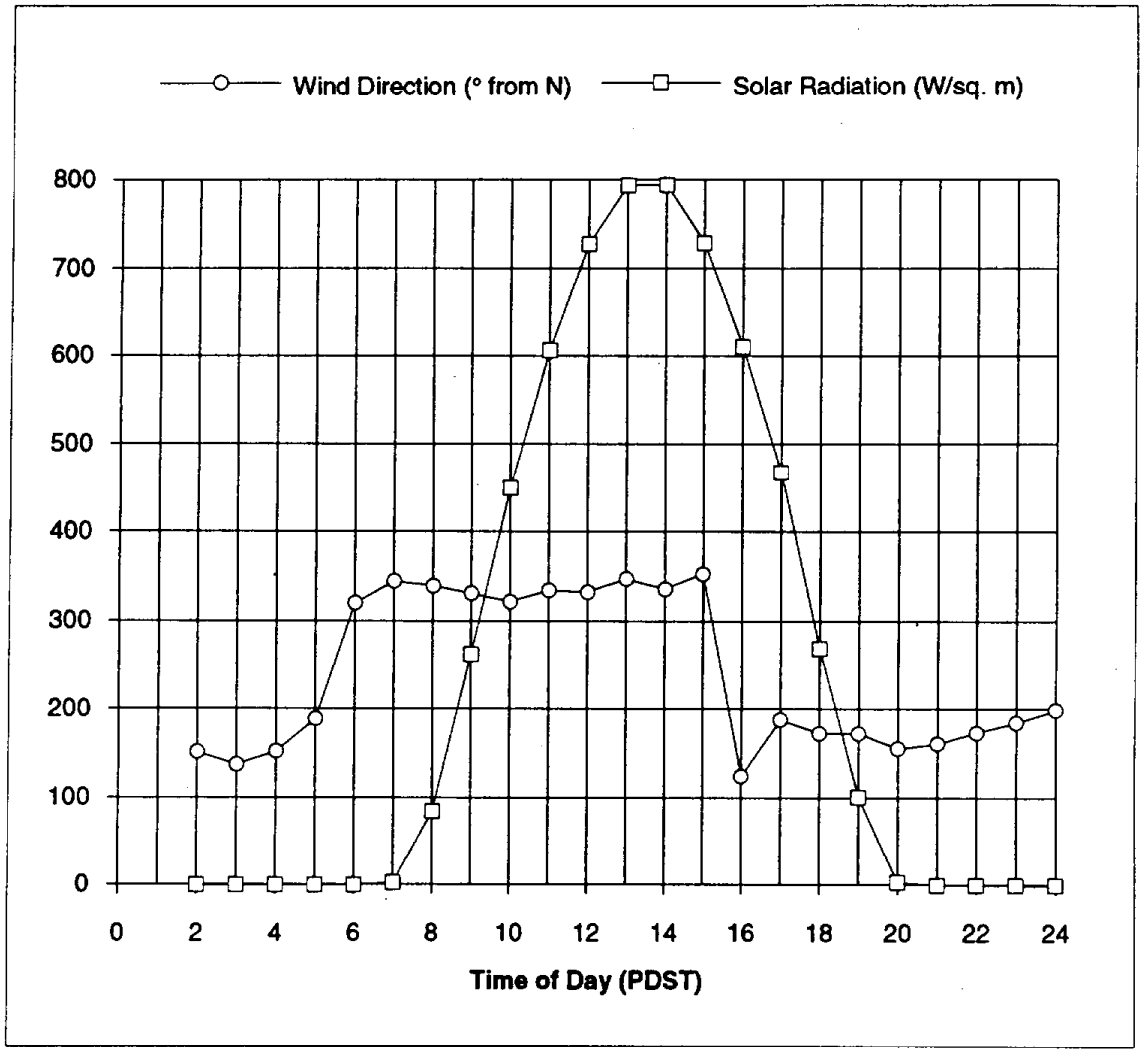

Figure 3.3.1.5. Inlet air, stack gas, and impinger temperatures, 15 September 92.

Fuel Type: Barley Straw Test Date 15-Sep-92
Configuration: CEWF

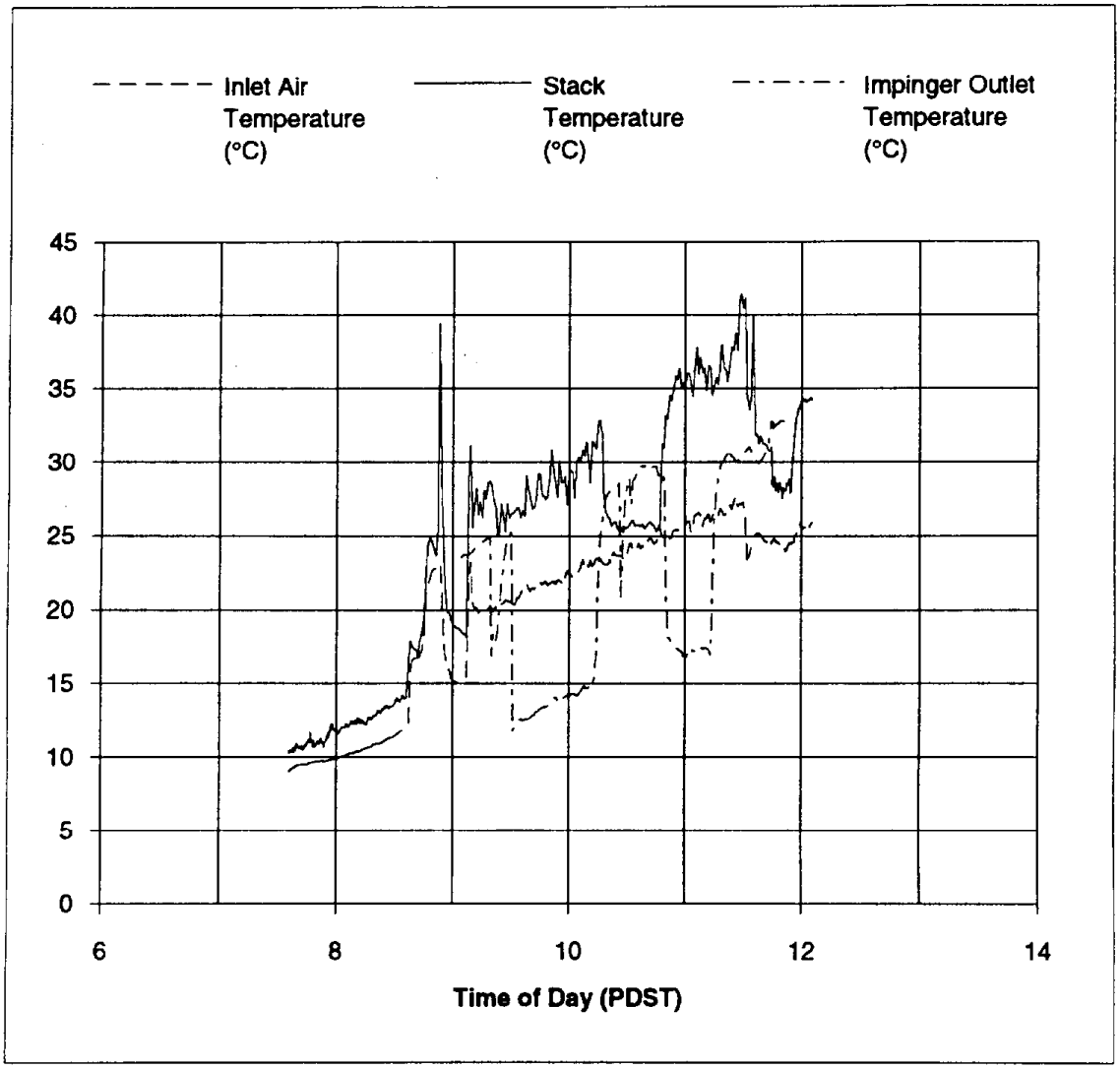

Figure 3.3.1.6. Conveyor speed and stack gas velocity, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

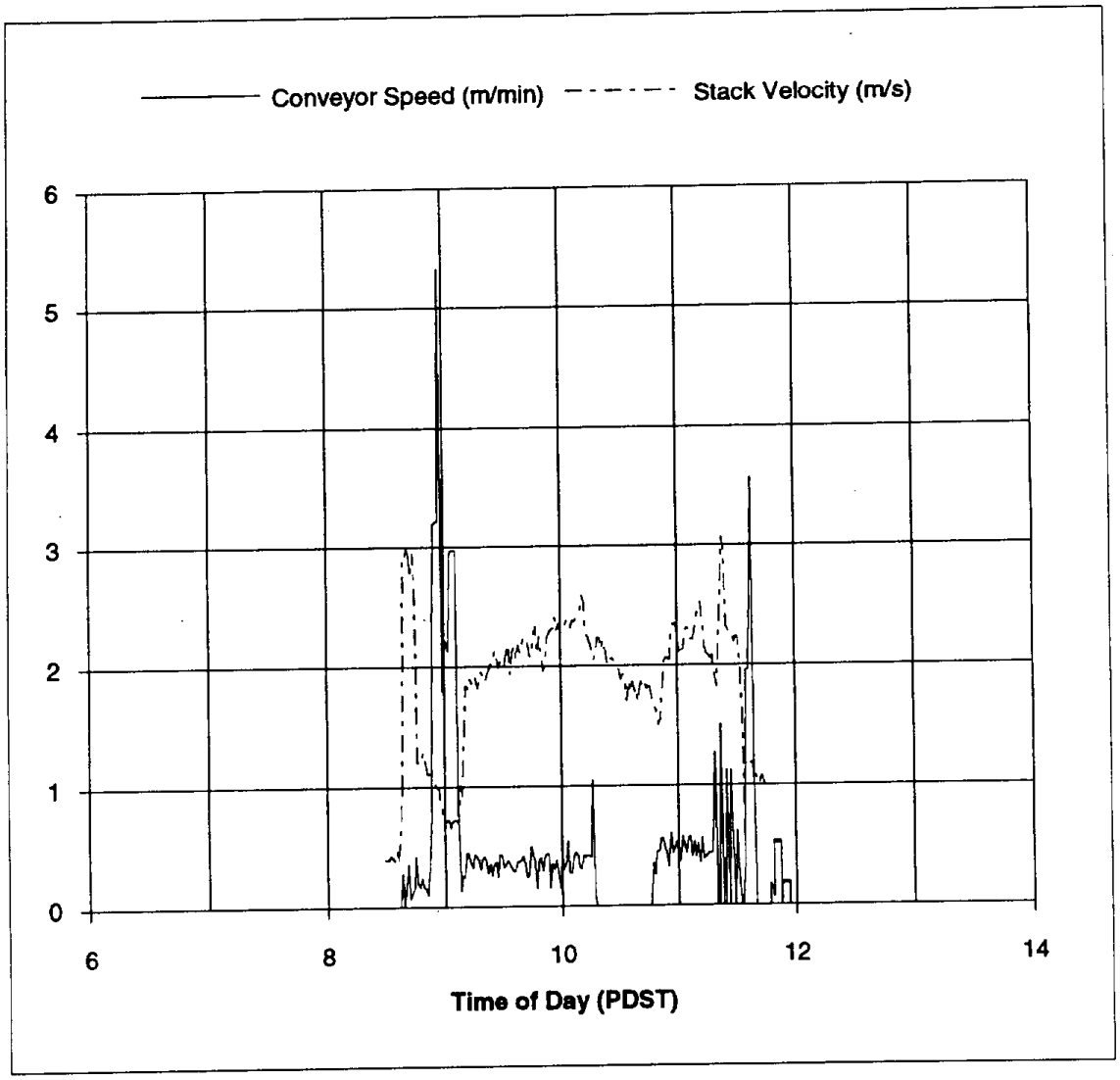

Figure 3.3.1.7. Conveyor speed with 10 min moving average, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

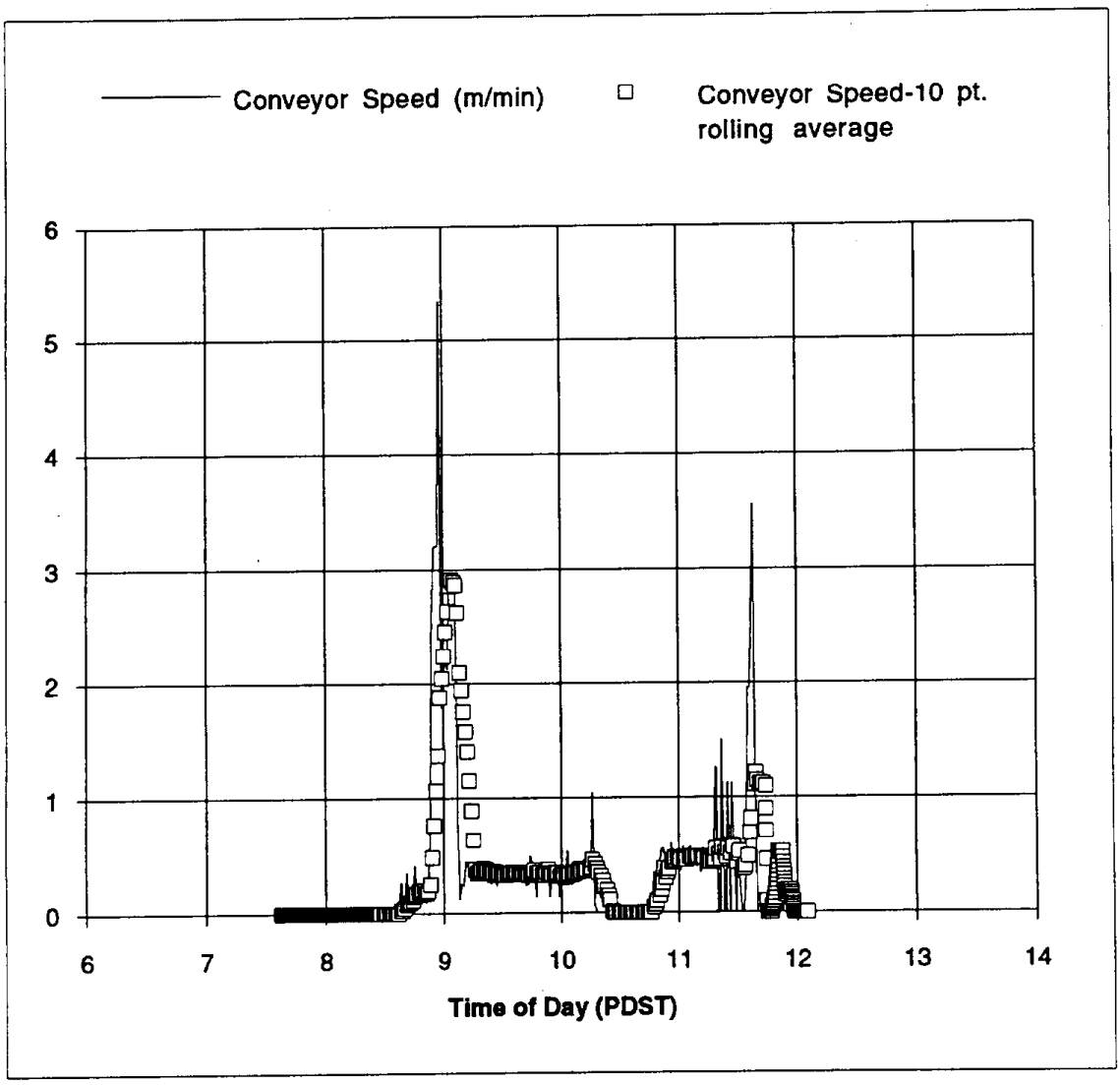

Figure 3.3.1.8. Conveyor travel, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

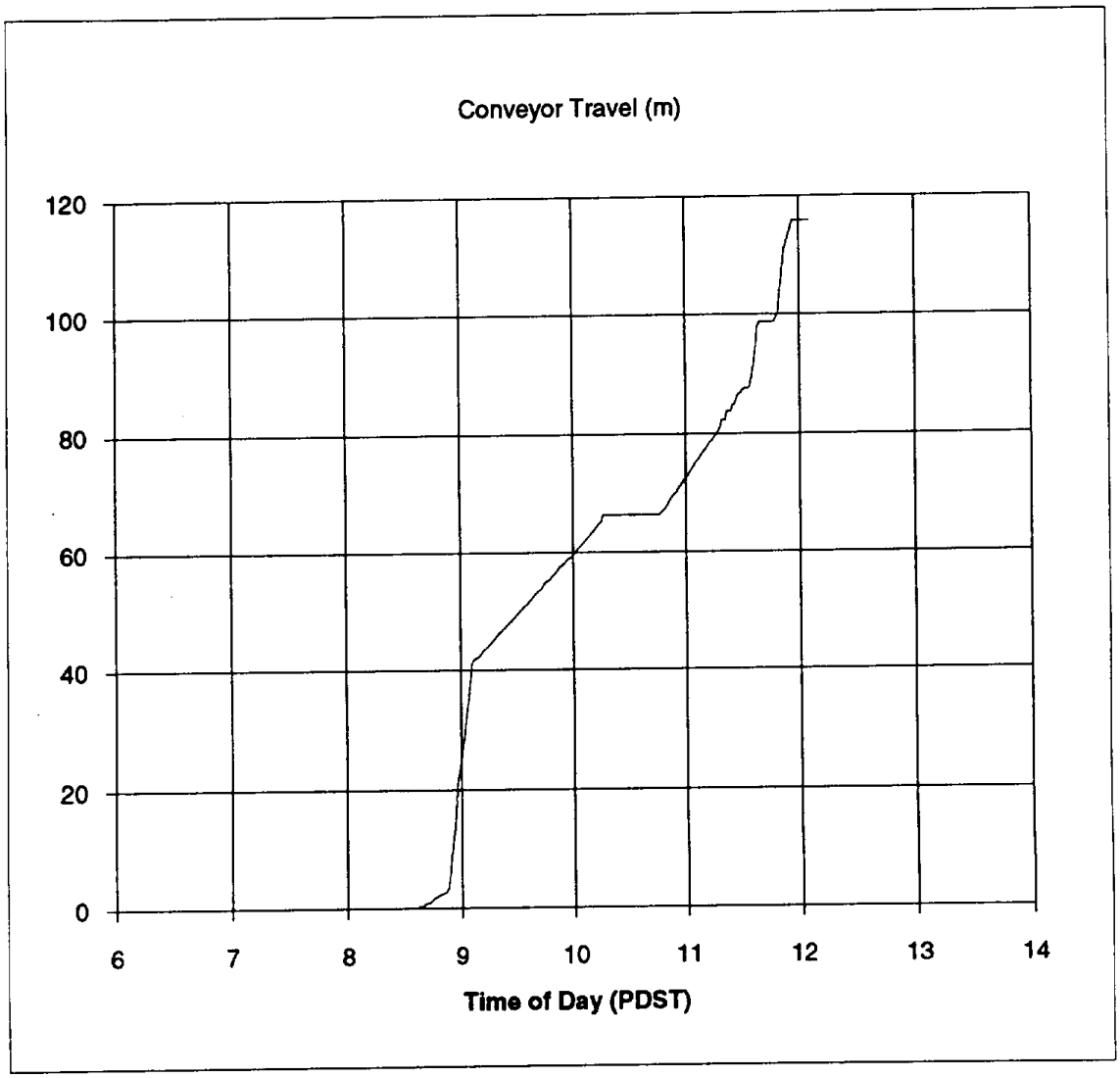

Figure 3.3.1.9. CO concentration in stack gas, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

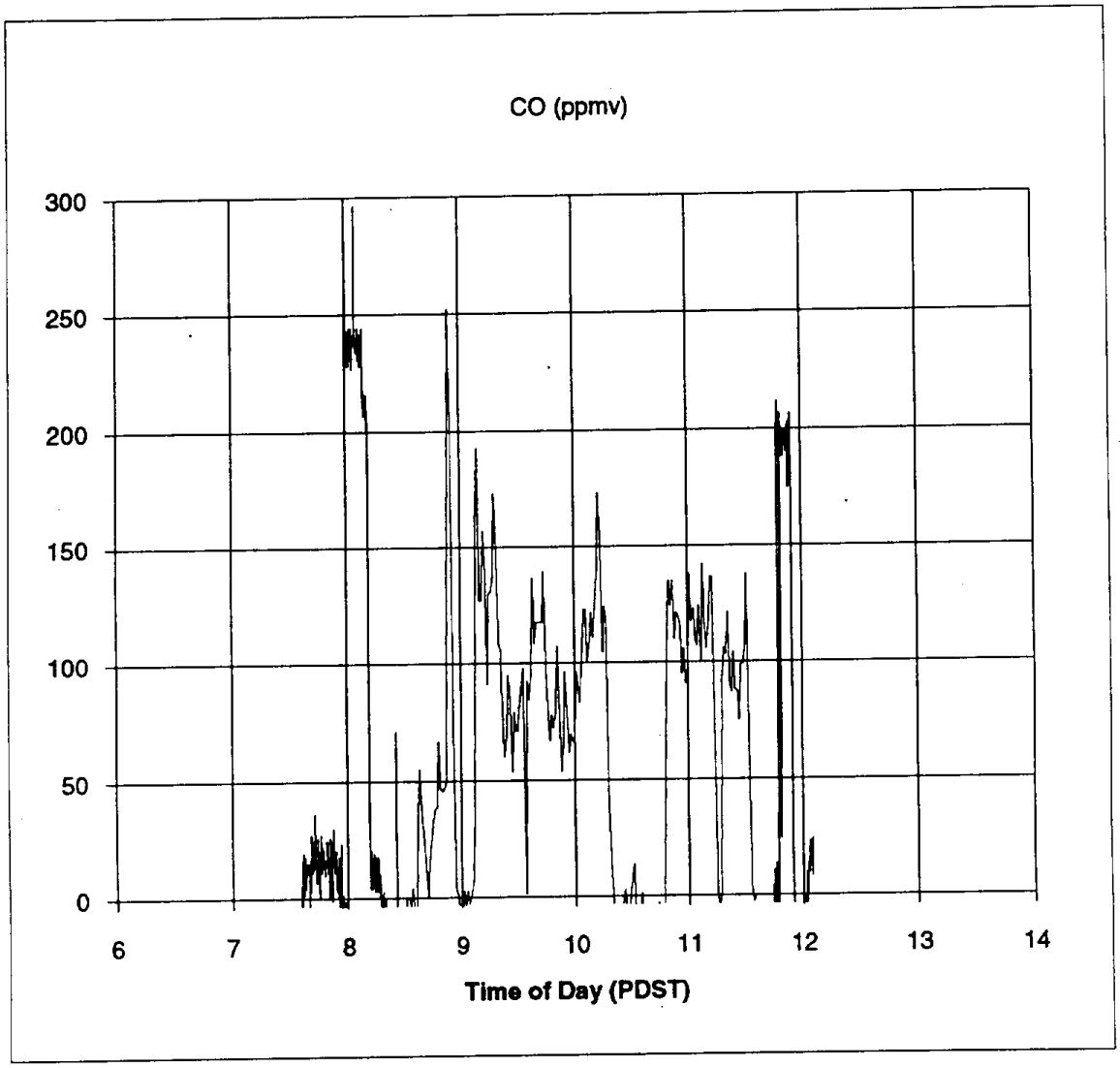

Figure 3.3.1.10. NO and NOx concentrations in stack gas, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF
Test Date 15-Sep-92

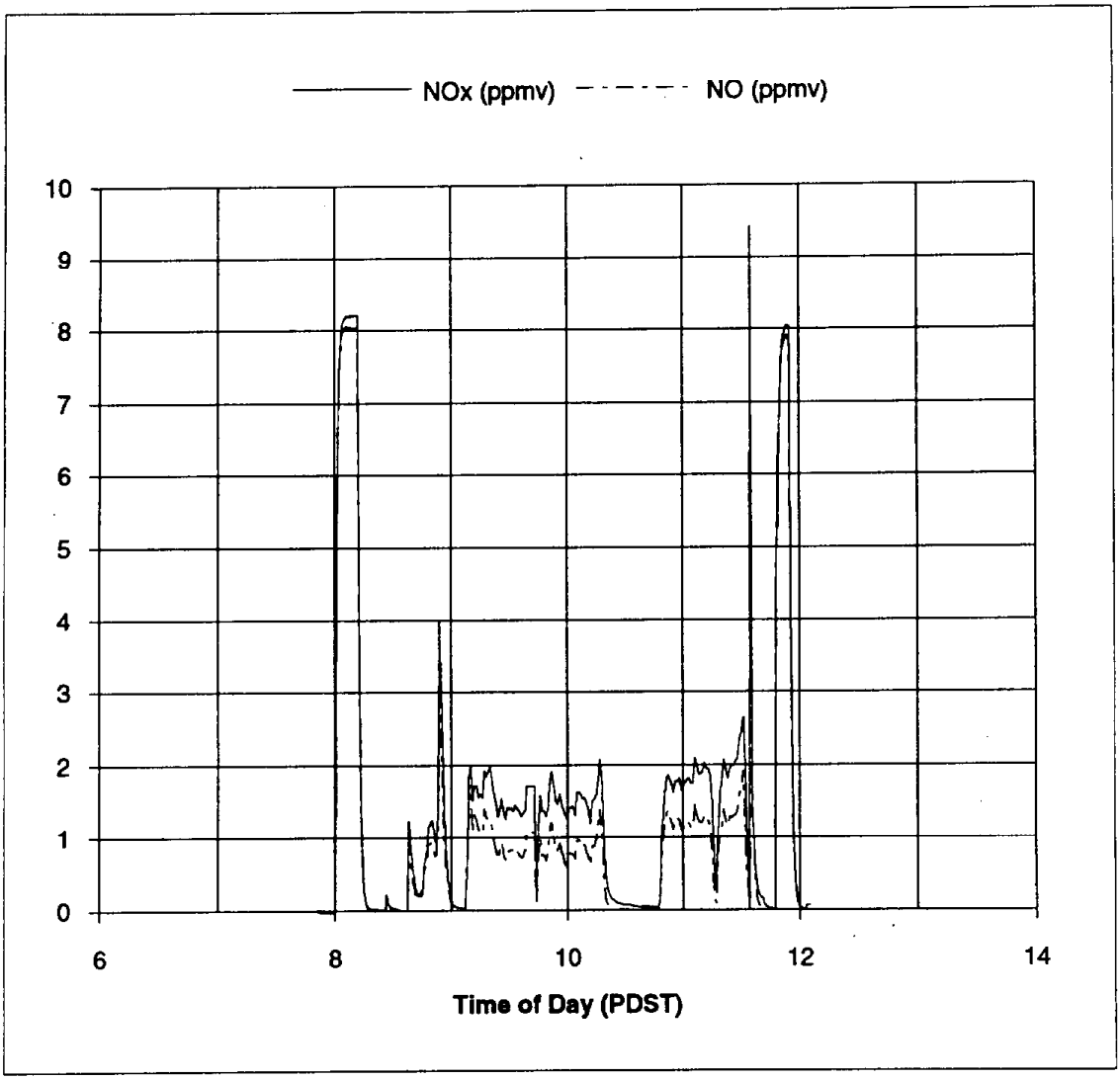

Figure 3.3.1.11. SO2 concentration in stack gas, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

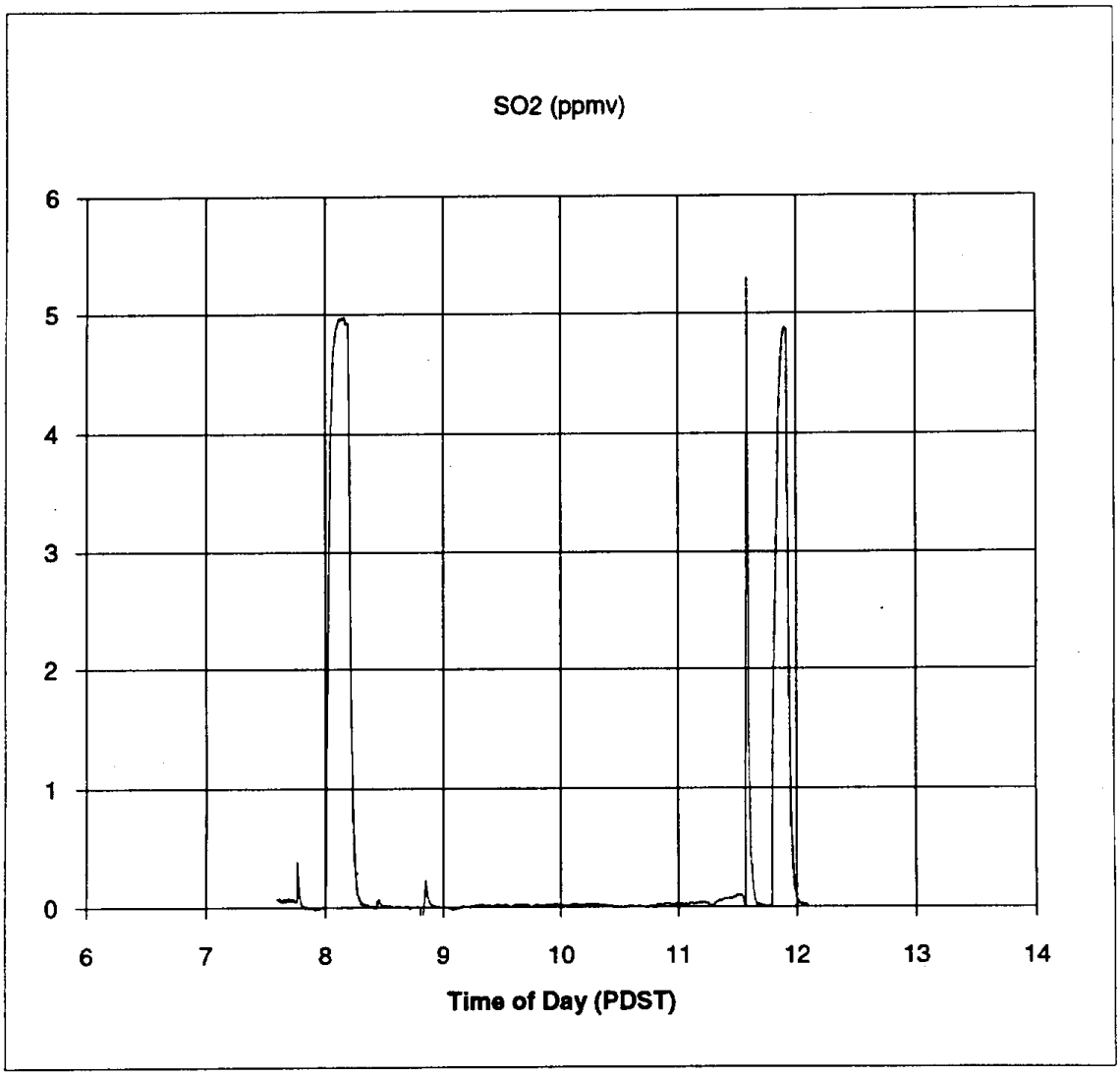

Figure 3.3.1.12. Total sulfur concentration in stack gas, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

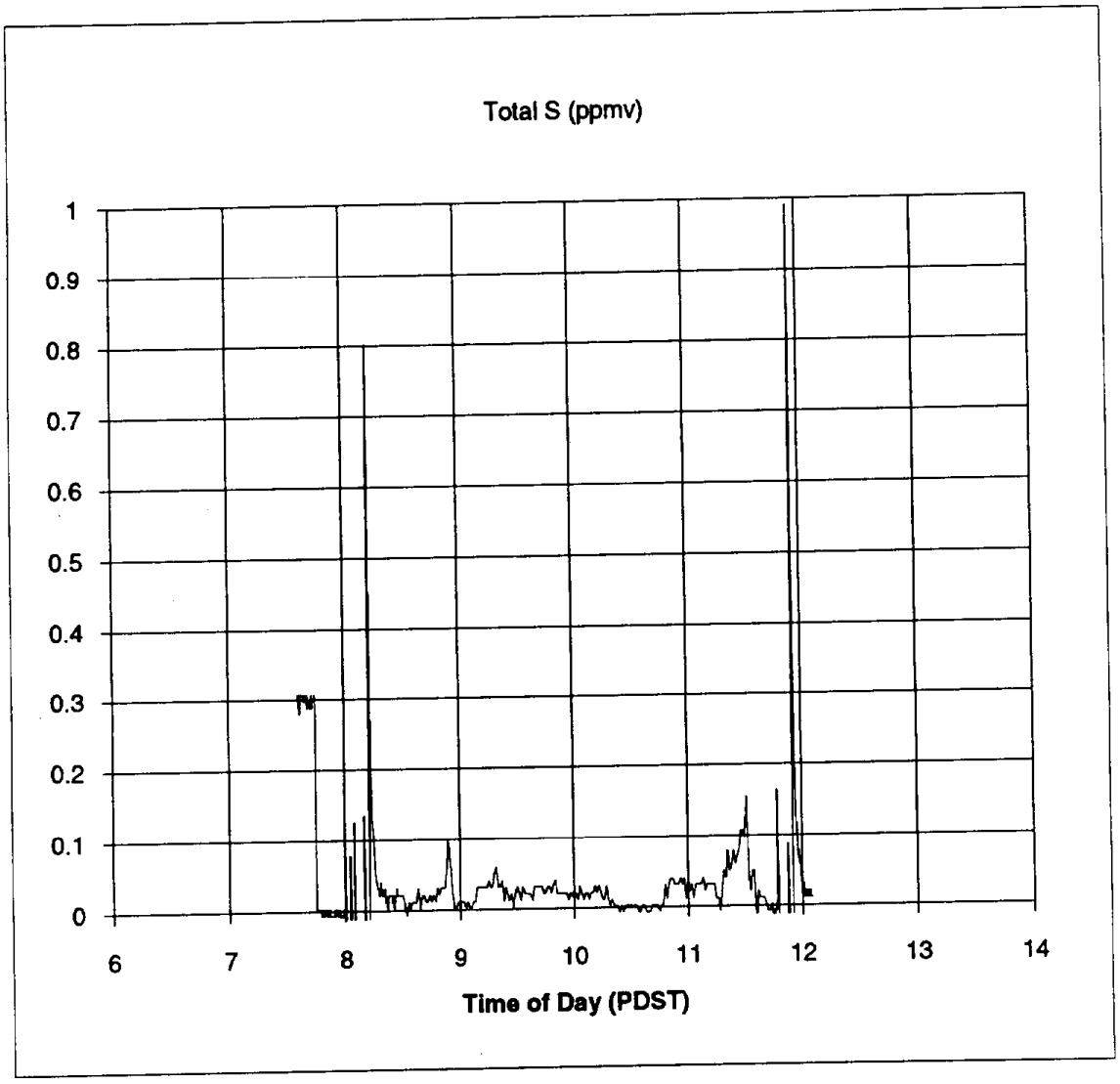

Figure 3.3.1.13. THC concentration in stack gas, 15 September 92.

Fuel Type: Barley Straw
Configuration: CEWF

Test Date 15-Sep-92

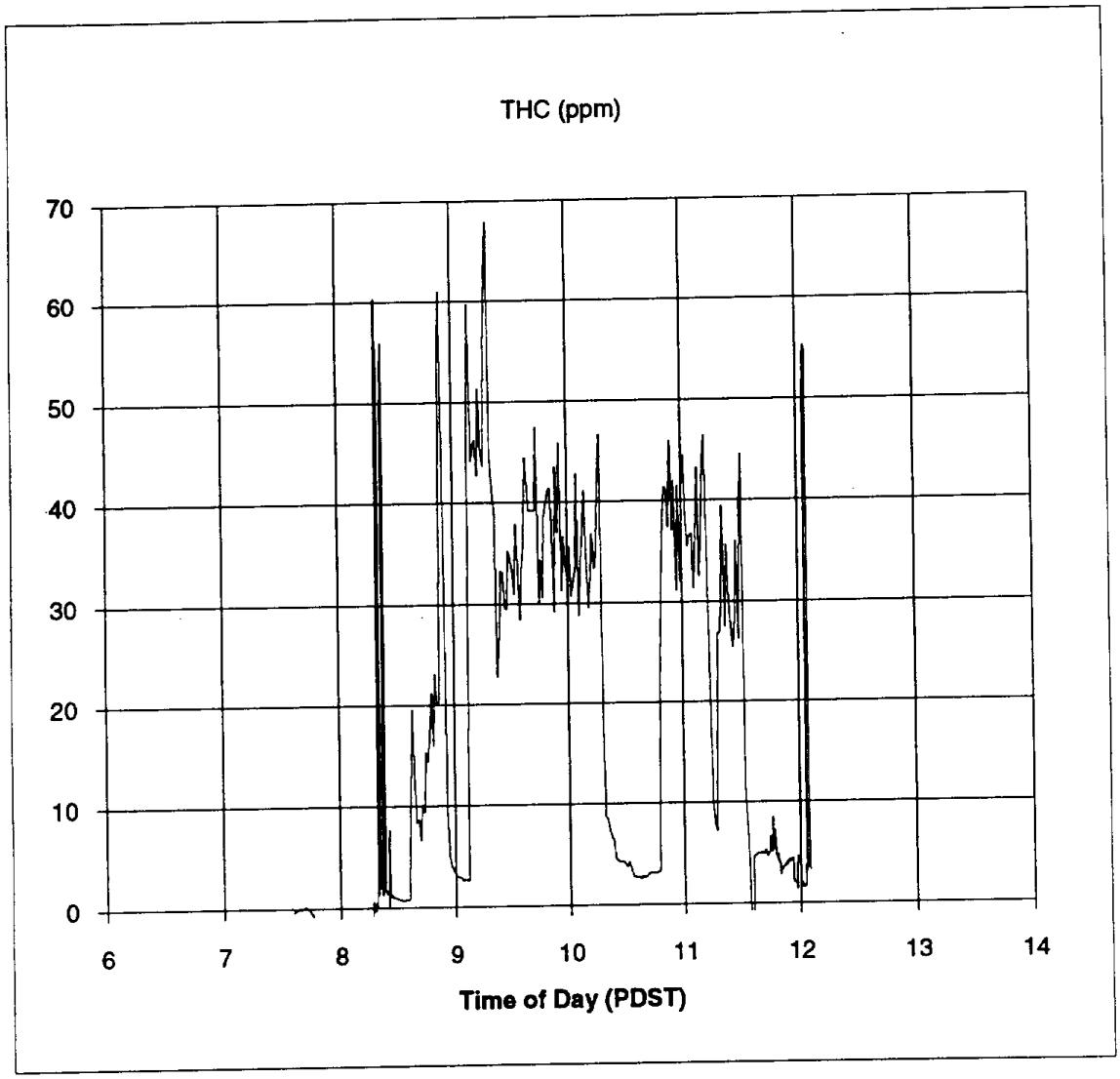

Figure 3.3.1.14. Particle size distribution, traverse 1, 15 September 92.

Fuel: Barley Straw

Date of Test: 15-Sep-92
Configuration: CEWF

Particle Size Distribution
Traverse 1:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.64	0.1	7.86	1.000
2	7.64	0.09	7.76	0.987
3	4.07	0.1	7.67	0.976
4	2.16	0.14	7.57	0.963
5	1.24	0.34	7.43	0.945
6	0.73	1.19	7.09	0.902
7	0.38	1.04	5.9	0.751
filter	0.00	4.86	4.86	0.618

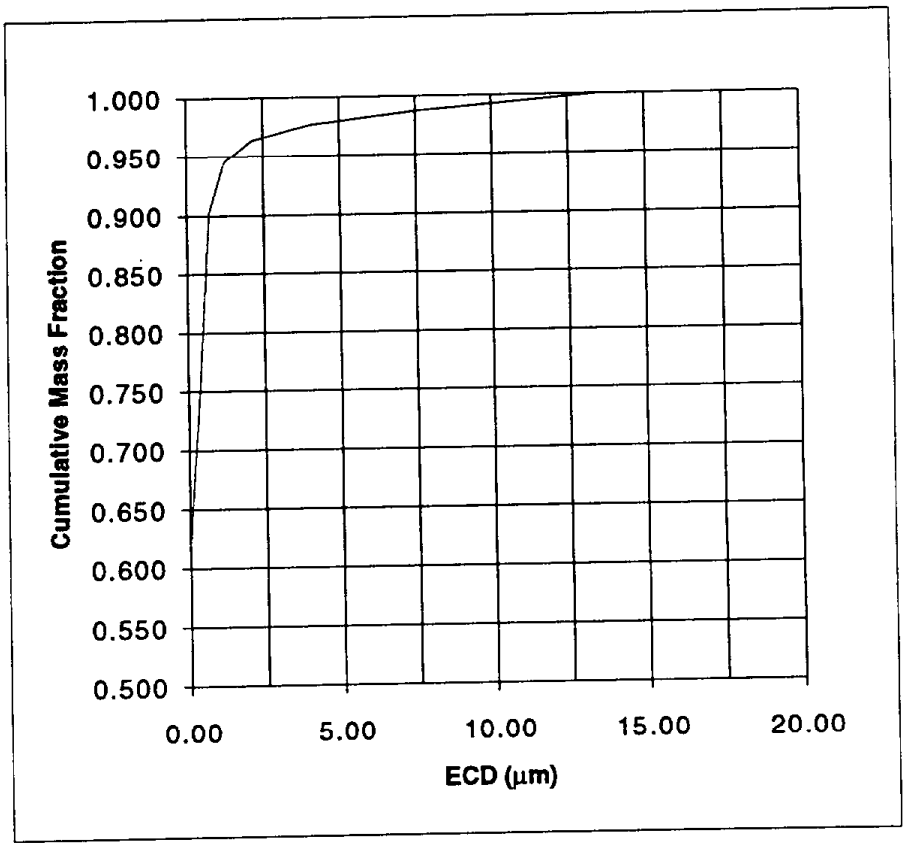

Figure 3.3.1.15. Particle size distribution, traverse 2, 15 September 92.

Fuel: Barley Straw

Date of Test: 15-Sep-92
Configuration: CEWF

Particle Size Distribution
Traverse 2:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.85	0.07	5.55	1.000
2	7.76	0.09	5.48	0.987
3	4.14	0.09	5.39	0.971
4	2.19	0.13	5.3	0.955
5	1.26	0.28	5.17	0.932
6	0.74	1.14	4.89	0.881
7	0.39	0.93	3.75	0.676
filter	0.00	2.82	2.82	0.508

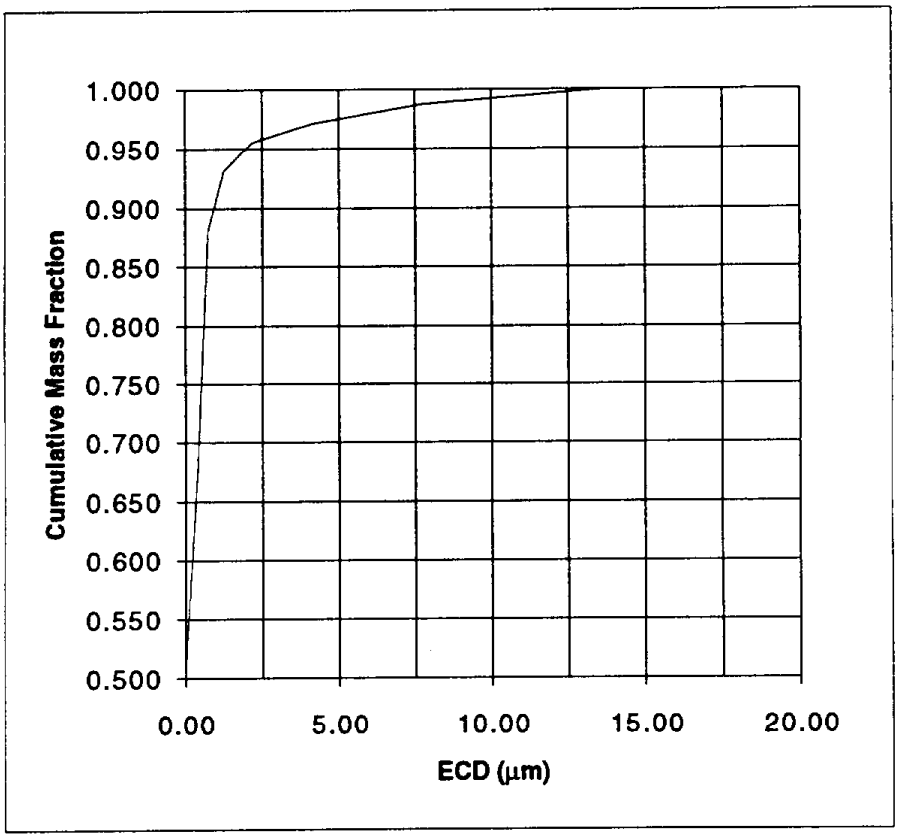

Figure 3.3.1.16. Nitrogen balance.
Date of Test: 15-Sep-92
Fuel Barley Straw

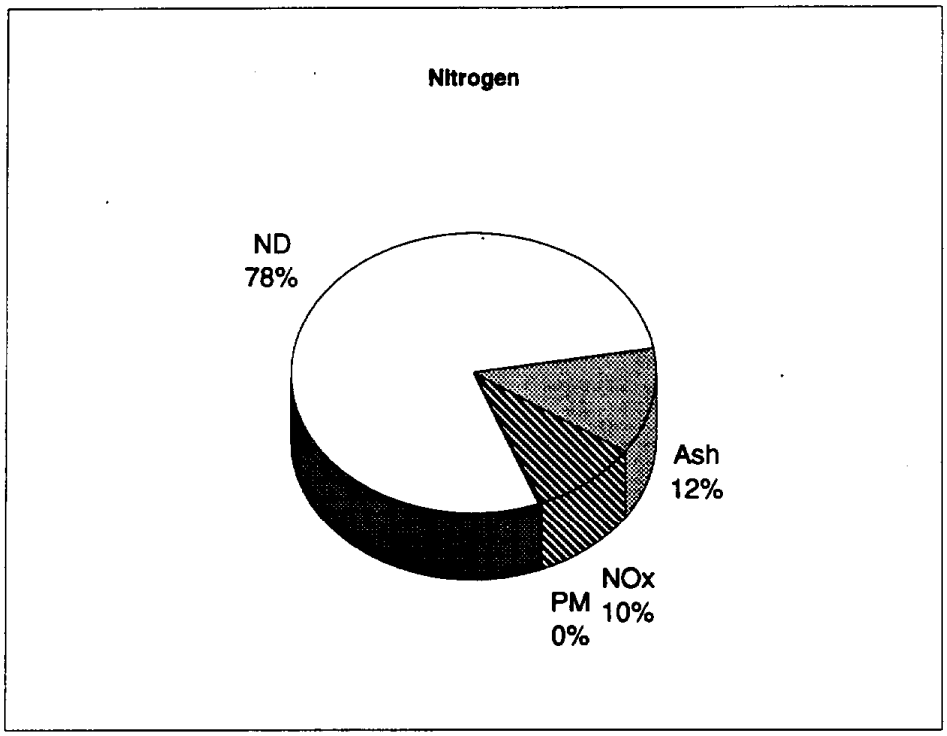

Figure 3.3.1.17. Sulfur balance.
Date of Test: 15-Sep-92
Fuel Barley Straw

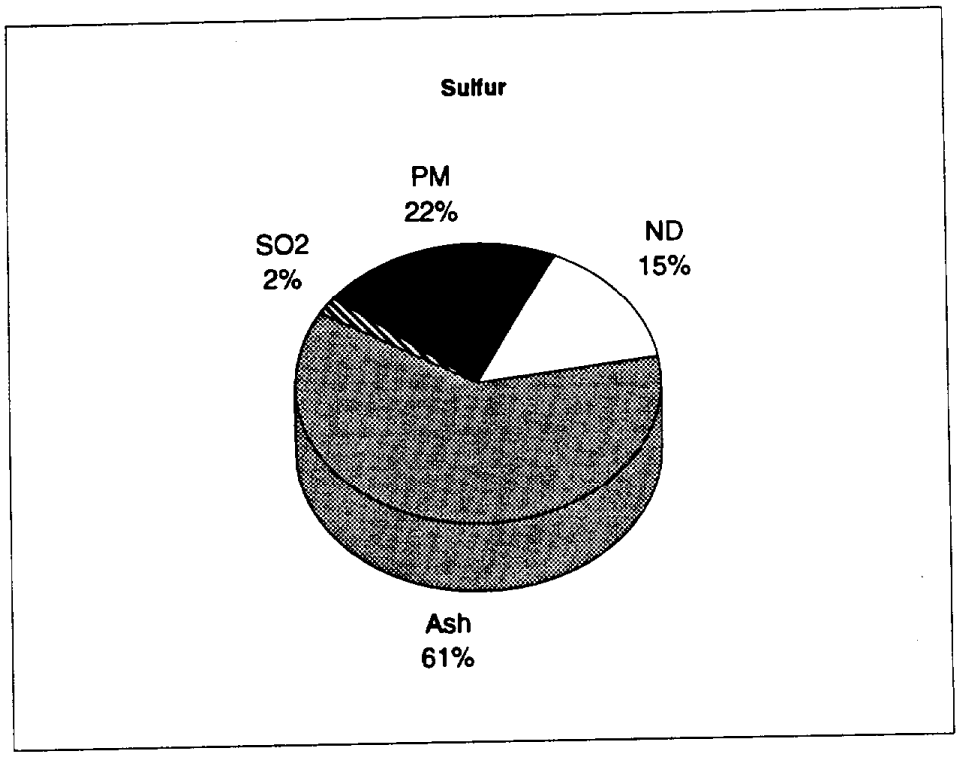

Figure 3.3.1.18. Relative abundance of major elements from DRUM impactor, Barley Straw,15 September 92, (CEWF).

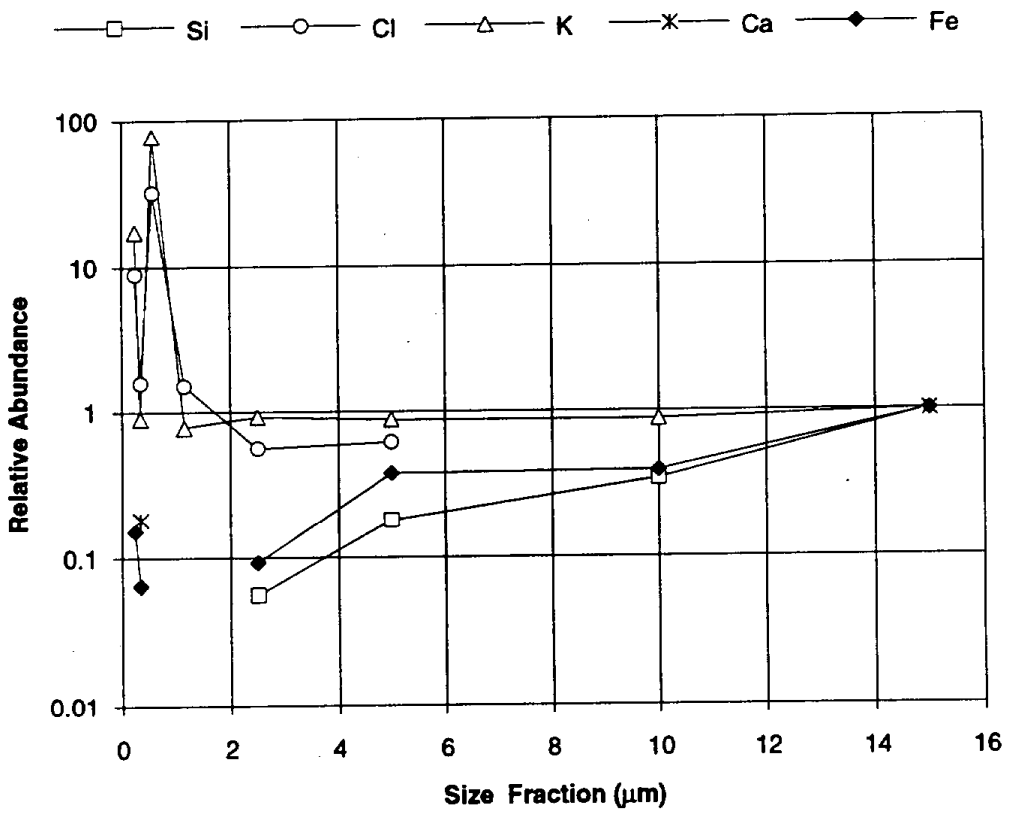

Figure 3.3.1.19. Mass fraction of PAH on primary filter samples, 15 September 1992, barley straw.

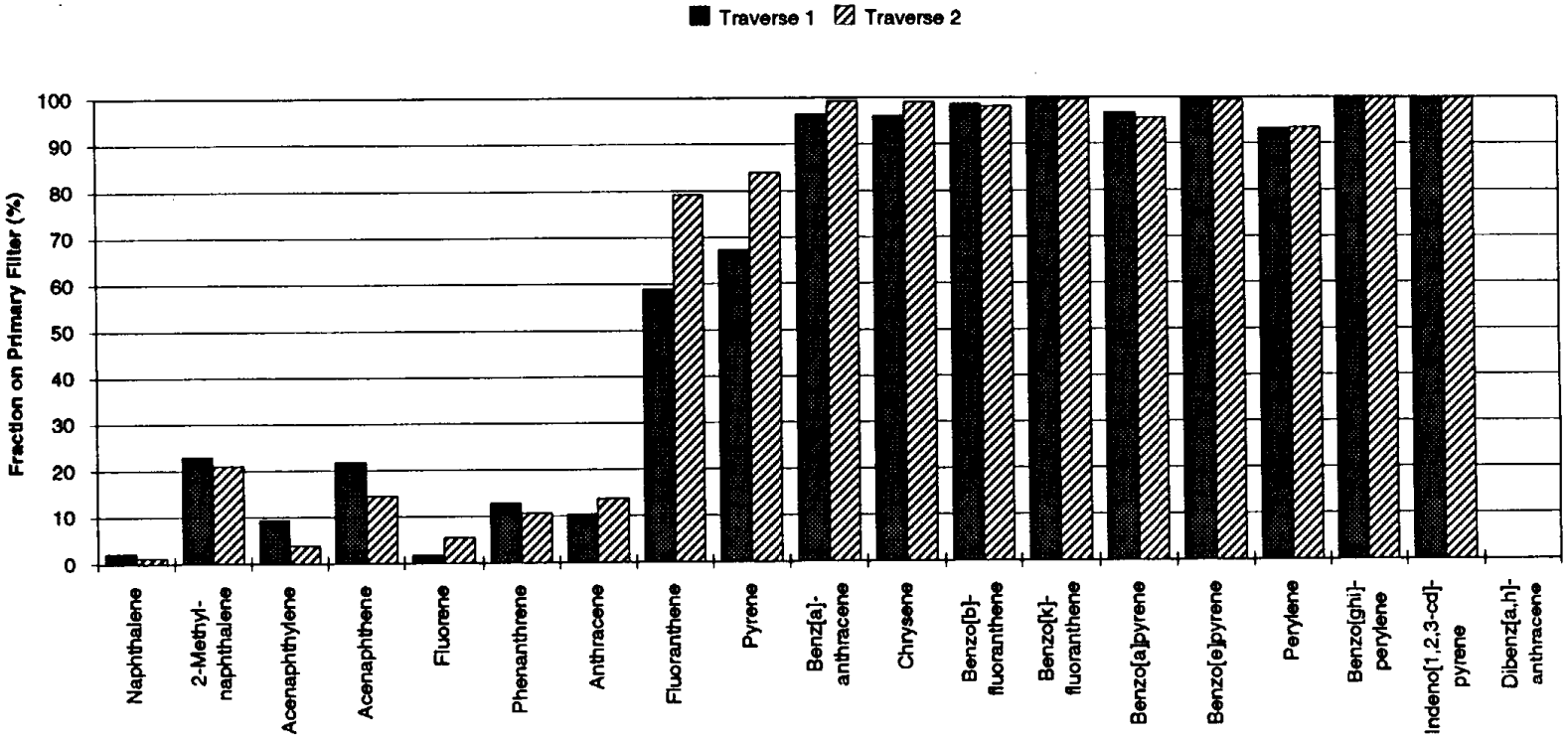

Table 3.3.2.1

Fuel and Ash Analyses

Run Date	17-Sep-92	17-Sep-92
Fuel Type	Barley Straw	Barley Straw
Sample Type	Fuel	Ash
Ultimate Analysis		
(% dry weight)		
C	44.88	22.34
H	5.81	1.97
N	0.59	1.01
Elemental Analysis		
(% by weight dry basis)		
N	0.73	1.09
P	0.12	1.66
K	2.75	26.38
Ca	0.20	0.81
Mg	0.08	0.37
Na	0.16	0.67
Cl	0.21	1.33
(mg/kg dry weight)		
S	1,270	7,420
B	7	67
Zn	10	45
Mn	38	154
Fe	81	230
Cu	4	13
Si		
Total (% dry weight)	55.08	57.41
Proximate Analysis		
(% dry weight)		
Ash	7.43	68.70
Volatiles	79.49	20.58
Fixed Carbon	13.08	10.72
Higher Heating Value		
(MJ/kg dry weight)	17.7927	7.6404

Table 3.3.2.2. Operating conditions and concentrations, 17 September 92.

Fuel:	Barley Straw	Date of Test:	17-Sep-92
		Configuration:	CRNF

Fuel Loading Rate (g/sq.m w.b.):	503
Total Fuel Consumption (kg w.b.)	28.0
Total Ash Recovered (kg w.b.)	2.7
Ash Fraction (w.b.)	0.10

	Traverse 1	Traverse 2
Mean Values		
Air Temperature (°C)	17.91	21.17
Air Relative Humidity (%)	76.20	61.35
Inlet Air Temperature (°C)	23.08	25.88
Stack Temperature (°C)	32.33	36.54
Impinger Outlet Temperature (°C)	15.78	18.82
Fire Spreading Rate (m/min)	0.38	0.43
Stack Gas Velocity (m/s)	2.23	2.17
Gas and PM Concentrations (less background)		
CO (ppmv)	103.54	97.07
NO (ppmv)	1.40	1.50
NOx (ppmv)	1.77	1.93
SO2 (ppmv)	0.02	0.01
THC (ppmv as CH4)	19.82	16.07
HC (ppmv as CH4 by GC)	7.21	6.87
CH4 (ppmv)	3.36	3.19
NMHC (ppmv as CH4)	16.46	12.88
NMHC (ppmv as CH4 by GC)	3.85	3.68
CO2 (ppmv by GC)	701	1,037
Total S (ppmv as SO2)	0.03	0.02
PM (mg/cu.m)	8.17	8.51
PM10 (mg/cu.m)	8.01	8.50
PM2.5 (mg/cu.m)	7.76	8.08

Table 3.3.2.3. Mass balance, barley straw, 17 September 92.

Fuel: Barley Straw

Date of Test: 17-Sep-92

Configuration: CRNF

Mass Balance

	Traverse 1	Traverse 2
Total Conveyor Travel (m)	9.06	10.26
Fuel Moisture Content (% w.b.)	6.7	7.1
Fuel Loading Rate (g/sq.m d.b.)	469	467
Total Fuel Consumption (g w.b.)	5,558	6,288
Total Fuel Consumption (g d.b.)	5,186	5,841
Residual Ash (g w.b.)	529	599
Fuel Vaporized (g w.b.)	5,029	5,689
Fuel Consumption Rate (g/s w.b.)	3.86	4.37
Fuel Consumption Rate (g/s d.b.)	3.60	4.06
Ash Generation Rate (g/s w.b.)	0.37	0.42
Fuel Vaporization Rate (g/s w.b.)	3.49	3.95
Stack Gas Density (kg/cu.m)	1.1570	1.1413
Stack Gas Flow Rate (cu.m/s)	3.32	3.22
Stack Gas Mass Flow Rate (kg/s)	3.84	3.67
Inlet Air Mass Flow Rate (kg/s)	3.83	3.67
Overall Air-Fuel Ratio (w.b.)	992.88	840.23
Overall Air-Fuel Ratio (d.b.)	1064.18	904.45

Table 3.3.2.4. Emission factors, barley straw, 17 September 92 (integrated basis).

Fuel:	Barley Straw	Date of Test:	17-Sep-92
		Configuration:	CRNF

Emission Factors (% fuel dry weight)

Integrated Basis

	Traverse 1	Traverse 2	Average
CO	10.595	8.438	9.517
NO	0.154	0.140	0.147
NOx (as NO2)	0.298	0.276	0.287
SO2	0.005	0.003	0.004
THC (as CH4)	1.051	0.712	0.882
HC (as CH4 by GC)	0.424	0.343	0.383
CH4 (by GC)	0.197	0.159	0.178
NMHC (as CH4)	0.854	0.553	0.703
NMHC (as CH4 by GC)	0.226	0.184	0.205
CO2 (by GC)	113.218	142.494	127.856
Total S (as SO2)	0.007	0.004	0.005
SO2/Total S	0.81	0.83	0.82
PM	0.711	0.637	0.674
PM10	0.697	0.636	0.667
PM2.5	0.676	0.605	0.640
MMAD (μm)	0.428	0.200	0.314
σ	4.461	4.308	

Table 3.3.2.5. Emission factors, barley straw, 17 September 92 (average basis).

Fuel:	Barley Straw	Date of Test:	17-Sep-92
		Configuration:	CRNF

Emission Factors (% fuel dry weight)

Average Basis

	Traverse 1	Traverse 2	Average
CO	10.648	8.486	9.567
NO	0.155	0.141	0.148
NOx (as NO2)	0.298	0.277	0.288
SO2	0.006	0.003	0.004
THC (as CH4)	1.165	0.803	0.984
HC (as CH4 by GC)	0.424	0.343	0.383
CH4 (by GC)	0.197	0.159	0.178
NMHC (as CH4)	0.967	0.644	0.805
NMHC (as CH4 by GC)	0.226	0.184	0.205
CO2 (by GC)	113.218	142.494	127.856
Total S (as SO2)	0.007	0.004	0.005
SO2/Total S	0.82	0.82	0.82
PM	0.711	0.637	0.674
PM10	0.697	0.636	0.667
PM2.5	0.676	0.605	0.640
MMAD (μm)	0.428	0.200	0.314
σ	4.461	4.308	

Table 3.3.2.6. Carbon balance.

Date of Test:	17-Sep-92	17-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Carbon Balance		
Dry Fuel Consumption Rate (g/s)	3.60	4.06
Ash Generation Rate (g/s)	0.37	0.42
Ash Fraction (% dry basis)	10.28	10.34
Fuel Carbon Concentration (%)	44.88	44.88
Residual Ash Carbon Concentration (%)	22.34	22.34
Carbon released to stack (g/s)	1.53	1.73
Maximum CO2 emission factor (%)	156.14	156.09
Stack Gas Density (kg/cubic meter)	1.16	1.14
Average CO2 concentration (ppmv)	701	1,037
Average CO concentration (ppmv)	103.54	97.07
Average THC concentration (ppmv as CH4)	19.82	16.07
PM Concentration (mg/cubic meter)	8.17	8.51
PM Carbon Concentration (%)	47.42	47.42
PM Carbon (mg/cubic meter)	3.87	4.04
Stack Gas Temperature (°C)	32.33	36.54
Impinger Temperature (°C)	15.78	18.82
PM molar concentration (ppm)	7.65	8.06
Estimated Average Stack Gas Velocity (m/s)	2.59	2.13
Emission Factors (% Average Basis):		
CO2	113.218	142.494
CO	10.648	8.486
THC (as CH4)	1.165	0.803
PM	0.711	0.637
Emission Factors (% Integrated Basis):		
CO2	113.218	142.494
CO	10.595	8.438
THC (as CH4)	1.051	0.712
PM	0.711	0.637
Closure (% Average Basis)	86	102
Closure (% Integrated Basis)	85	101

Table 3.3.2.7. Nitrogen balance

Date of Test:	17-Sep-92	17-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Nitrogen Balance		
Fuel Nitrogen Concentration (% dry weight)	0.73	0.73
Ash Nitrogen Concentration (% weight)	1.09	1.09
Emission Factors (% Average Basis):		
NOx (as NO2)	0.298	0.277
PM	0.711	0.637
Emission Factors (% Integrated Basis):		
NOx (as NO2)	0.298	0.276
NO3- Concentration of PM (% weight)	0.454	0.454
NH4+ Concentration of PM (% weight)	0.629	0.629
Nitrogen Concentration of PM (%)	0.592	0.592
Fuel Nitrogen (mg/s)	26.28	29.64
Ash Nitrogen (mg/s)	4.03	4.58
Nitrogen as NOx (mg/s Average Basis)	3.27	3.42
Nitrogen as NOx (mg/s Integrated Basis)	3.27	3.41
Nitrogen as PM (mg/s Average Basis)	0.15	0.15
Nitrogen as NOx+PM (mg/s Average Basis)	3.42	3.58
Nitrogen as NOx+PM (mg/s Integrated Basis)	3.42	3.56
NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.130	0.121
NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.130	0.120
Ash Nitrogen/Fuel Nitrogen	0.153	0.154
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.283	0.275
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.283	0.275

Table 3.3.2.8. Sulfur balance.

Date of Test:	17-Sep-92	17-Sep-92
Fuel	Barley Straw Traverse 1	Barley Straw Traverse 2
Sulfur Balance		
Fuel Sulfur Concentration (mg/kg dry weight)	1,270	1,270
Ash Sulfur Concentration (mg/kg weight)	7,420	7,420
Emission Factors (% Average Basis)		
SO2	0.006	0.003
PM	0.711	0.637
Emission Factors (% Integrated Basis)		
SO2	0.005	0.003
Sulfur Concentration of PM (% weight)	5.212	5.212
Fuel Sulfur (mg/s)	4.57	5.16
Ash Sulfur (mg/s)	2.75	3.12
Sulfur as SO2 (mg/s Average Basis)	0.11	0.06
Sulfur as SO2 (mg/s Integrated Basis)	0.09	0.06
Sulfur as PM (mg/s Average Basis)	1.33	1.35
Sulfur as SO2+PM (mg/s Average Basis)	1.44	1.41
Sulfur as SO2+PM (mg/s Integrated Basis)	1.42	1.41
SO2+PM Sulfur/Fuel Sulfur (Average Basis)	0.315	0.273
SO2+PM Sulfur/Fuel Sulfur (Integrated Basis)	0.311	0.273
Ash Sulfur/Fuel Sulfur	0.600	0.604
Closure (% Average Basis)	92	88
Closure (% Integrated Basis)	91	88

Table 3.3.2.9. Water balance.

Estimated Stack Humidity

Fuel	Barley Straw
Configuration	CRNF
Date of Test	17-Sep-92

	Traverse 1	Traverse 2
Ambient Air Temperature °C)	18	21
Ambient Air Relative Humidity (%)	76	61
Air Temperature (K)	291	294
Saturation Pressure (Pa)	2,053	2,514
Vapor Pressure (Pa)	1,564	1,542
Air Dew Point Temperature (°C)	13.7	13.5
Ambient Volume Fraction Water Vapor	0.0154	0.0152
Ambient Mass Fraction Water Vapor	0.0096	0.0094
Fuel Burning Rate (g/s wet basis)	3.86	4.37
Fuel Moisture Content (%)	6.7	7.1
Ash Fraction (wet basis)	0.10	0.10
Fuel Hydrogen Content (%)	5.81	5.81
Ash Hydrogen Content (%)	1.97	1.97
Moisture Evaporated (g/s)	0.26	0.31
Water of Combustion (g/s)	1.81	2.05
Total Fuel Water Added (g/s)	2.07	2.36
Inlet Air Mass Flowrate (g/s)	3,830	3,670
Inlet Air Water Vapor Flowrate (g/s)	37	35
Total Stack Water Vapor Flowrate (g/s)	39	37
Stack Gas Mass Flowrate (g/s)	3,833	3,674
Mass Fraction Water Vapor in Stack	0.0101	0.0101
Volume Fraction Water Vapor in Stack	0.0163	0.0162
Stack Vapor Pressure (Pa)	1,651	1,645
Stack Temperature (°C)	32	37
Stack Temperature (K)	305	310
Stack Saturation Pressure (Pa)	4,848	6,125
Stack Relative Humidity (%)	34	27
Stack Dew Point Temperature (°C)	14.5	14.5
Impinger Outlet Temperature (°C)	15.8	18.8
Volume Stack Gas Sampled for PM (L)	245	235
Estimated Impinger/Desiccant Weight Gain (g)	3.0	2.9

Totals:

	Estimated	Measured
Total Impinger/Desiccant Weight Gain (g)	5.9	11.7
Estimated/Measured Weight Gain	0.50	

Table 3.3.2.10. Power balance.

Date of Test: Fuel	17-Sep-92 Barley Straw Traverse 1	17-Sep-92 Barley Straw Traverse 2
Power Balance		
Fuel Heating Value (MJ/kg dry weight)	17.7927	17.7927
Ash Heating Value (MJ/kg dry weight)	7.6404	7.6404
Average Energy Release Rate (kW)	61.2	69.0
Products of Incomplete Combustion (kW)		
CO	3.9	3.5
THC (as CH4)	2.3	1.8
PM	0.4	0.4
Heat Release Rate (kW)	54.6	63.3
Fireline Intensity (kW/m)	44.8	51.9
Stack Gas Flow (kg/s)	3.84	3.67
Stack Gas Temperature (°C)	32.33	36.54
Inlet Temperature (°C)	23.08	25.88
Sensible Power at Top of Stack (kW)	35.7	39.4
Tunnel Dissipation (kW)	18.9	24.0

Table 3.3.2.11. Mass concentrations (%) from DRI filter samples

Date	17-Sep-92	17-Sep-92
Fuel	Barley Straw CRNF	Barley Straw CRNF
Size Fraction	PM2.5	PM10
Teflon Filter ID	ABTT030	ABTT031
Quartz Filter ID	ABTQ030	ABTQ031
Teflon Field Sample Flag		
Quartz field sample field		
Teflon mass sample flag		
Quartz mass sample flag		
Anions sample flag		
Ammonium analysis flag		
Sodium ion analysis flag		
Magnesium ion analysis flag		
Potassium ion analysis flag		
Carbon analysis flag		
XRF analysis flag		

		±Uncertainty		±Uncertainty
Teflon sample volume (m^3)	0.20	0.01	0.20	0.01
Quartz sample volume (m^3)	0.20	0.01	0.20	0.01
Teflon mass concentration (µg/m^3)	6,635	341	6,780	348

	Concentration (%)	±Uncertainty	Concentration (%)	±Uncertainty	PM2.5/PM10
Cl-	8.8074	0.7353	9.0062	0.7514	0.98
NO3-	0.4250	0.0614	0.4535	0.0614	0.94
SO4=	8.8570	0.6633	9.1654	0.6829	0.97
NH4+	0.5818	0.0677	0.6291	0.0689	0.92
Na+	0.8626	0.0778	0.9249	0.0827	0.93
K+	20.6555	1.5704	21.7858	1.6555	0.95
C(org)	32.2122	3.2246	32.0395	3.2058	1.01
C(oht)	31.7540	4.9513	31.6501	4.9289	1.00
C(e)	14.5592	1.3892	15.3761	1.4634	0.95
C(eht)	0.3316	0.2260	0.0590	0.1237	5.62
C	46.7714		47.4156		0.99
Al	0.1424	0.0355	0.1469	0.0358	0.97
Si	0.1219	0.1306	0.2183	0.0589	0.56
P	0.0309	0.1616	0.0574	0.1631	0.54
S	5.1242	0.3700	5.2122	0.3760	0.98
Cl	8.2825	0.5993	8.2122	0.5940	1.01
K	22.1095	1.5854	22.2809	1.5968	0.99
Ca	0.0449	0.3168	0.1533	0.3196	0.29
Ti	0.0025	0.0513	0.0043	0.0491	0.58
V	0.0000	0.0222	0.0001	0.0213	0.00
Cr	0.0003	0.0048	0.0025	0.0047	0.12
Mn	0.0010	0.0033	0.0055	0.0023	0.18
Fe	0.0046	0.0088	0.0376	0.0091	0.12
Co	0.0007	0.0020	0.0005	0.0021	1.40
Ni	0.0000	0.0022	0.0003	0.0021	0.00
Cu	0.0001	0.0023	0.0000	0.0022	
Zn	0.0068	0.0017	0.0075	0.0017	0.91
Ga	0.0000	0.0041	0.0000	0.0040	
As	0.0000	0.0048	0.0000	0.0046	
Se	0.0011	0.0027	0.0000	0.0025	
Br	0.1650	0.0121	0.1656	0.0121	1.00
Rb	0.0068	0.0025	0.0065	0.0025	1.05
Sr	0.0016	0.0024	0.0028	0.0016	0.57
Y	0.0000	0.0031	0.0000	0.0030	
Zr	0.0000	0.0036	0.0000	0.0035	
Mo	0.0000	0.0062	0.0013	0.0059	0.00
Pd	0.0080	0.0229	0.0000	0.0224	
Ag	0.0039	0.0262	0.0046	0.0255	0.85
Cd	0.0000	0.0279	0.0025	0.0272	0.00
In	0.0000	0.0313	0.0090	0.0305	0.00
Sn	0.0020	0.0390	0.0000	0.0378	
Sb	0.0000	0.0443	0.0143	0.0434	0.00
Ba	0.0212	0.1542	0.0000	0.1483	
La	0.0000	0.2045	0.0000	0.1993	
Au	0.0000	0.0068	0.0003	0.0066	0.00
Hg	0.0004	0.0056	0.0026	0.0055	0.15
Tl	0.0000	0.0054	0.0000	0.0052	
Pb	0.0001	0.0071	0.0000	0.0068	
U	0.0000	0.0061	0.0001	0.0060	0.00
Sum of measured species	84.7229	3.9462	85.9724	3.9602	0.99

Table 3.3.2.12. Element ratios from DRI filter samples.

Date	17-Sep-92	17-Sep-92	
Fuel	Barley Straw	Barley Straw	
Configuration	CRNF	CRNF	
Size Fraction	PM2.5	PM10	PM2.5/PM10
Teflon Filter ID	ABTT030	ABTT031	
Quartz Filter ID	ABTQ030	ABTQ031	
Cl-/Cl	1.06	1.10	0.97
K+/K	0.93	0.98	0.96
Sulfate S/Total S	0.58	0.59	0.98
C(org)/C	0.69	0.68	1.02
Cl/K	0.37	0.37	1.02
Cl-/K+	0.43	0.41	1.03
Cl-/Na+	10.21	9.74	1.05
S/K	0.23	0.23	0.99
S/Na+	5.94	5.64	1.05
Al/Si	1.17	0.67	1.74

Table 3.3.2.13. Emission factors (mg/kg) from DRI filter samples.

Date	17-Sep-92		17-Sep-92		
Fuel	Barley Straw CRNF		Barley Straw CRNF		
Size Fraction	PM2.5		PM10		
Teflon Filter ID	ABTT030		ABTT031		
Quartz Filter ID	ABTQ030		ABTQ031		
Start Time	10:01				
Stop Time	10:21				
Start Time					
End Time					
Elapsed Time (minutes)	20				Traverse 2
PM (mg/m^3 by total filter)					8.510
PM10 (by total filter/impactor)					8.500
PM2.5 (by total filter/impactor)					8.080
PM emission factor (%)					0.637
PM10 emission factor (%)					0.636
PM2.5 emission factor (%)					0.605
		±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)	0.20	0.01	0.20	0.01	
Quartz sample volume (m^3)	0.20	0.01	0.20	0.01	
Teflon mass concentration (mg/m^3)	6.635	0.341	6.780	0.348	
Teflon mass/Total mass	0.821		0.798		
	Emission (mg/kg)	±Uncertainty	Emission (mg/kg)	±Uncertainty	PM2.5/PM10
Cl-	628.9300	44.4857	666.2537	47.7890	0.94
NO3-	30.3489	3.7147	33.5487	3.9050	0.90
SO4=	632.4719	40.1297	678.0309	43.4324	0.93
NH4+	41.5459	4.0959	46.5391	4.3820	0.89
Na+	61.5976	4.7069	68.4215	5.2597	0.90
K+	1474.9941	95.0092	1611.6531	105.2898	0.92
C(org)	2300.2495	195.0883	2370.1935	203.8889	0.97
C(oht)	2267.5298	299.5537	2341.3867	313.4780	0.97
C(e)	1039.6618	84.0466	1137.4813	93.0722	0.91
C(eht)	23.6793	13.6730	4.3647	7.8673	5.43
C	3339.9113	0.0000	3507.6747	0.0000	0.95
Al	10.1687	2.1478	10.8673	2.2769	0.94
Si	8.7048	7.9013	16.1492	3.7460	0.54
P	2.2065	9.7768	4.2463	10.3732	0.52
S	365.9154	22.3850	385.5841	23.9136	0.95
Cl	591.4472	36.2577	607.5158	37.7784	0.97
K	1578.8231	95.9167	1648.2793	101.5565	0.96
Ca	3.2063	19.1664	11.3407	20.3266	0.28
Ti	0.1785	3.1037	0.3181	3.1228	0.56
V	0.0000	1.3431	0.0074	1.3547	0.00
Cr	0.0214	0.2904	0.1849	0.2989	0.12
Mn	0.0714	0.1997	0.4069	0.1463	0.18
Fe	0.3285	0.5324	2.7815	0.5788	0.12
Co	0.0500	0.1210	0.0370	0.1336	1.35
Ni	0.0000	0.1331	0.0222	0.1336	0.00
Cu	0.0071	0.1392	0.0000	0.1399	
Zn	0.4856	0.1029	0.5548	0.1081	0.88
Ga	0.0000	0.2481	0.0000	0.2544	
As	0.0000	0.2904	0.0000	0.2926	
Se	0.0786	0.1634	0.0000	0.1590	
Br	11.7825	0.7321	12.2506	0.7696	0.96
Rb	0.4856	0.1513	0.4809	0.1590	1.01
Sr	0.1143	0.1452	0.2071	0.1018	0.55
Y	0.0000	0.1876	0.0000	0.1908	
Zr	0.0000	0.2178	0.0000	0.2226	
Mo	0.0000	0.3751	0.0962	0.3752	0.00
Pd	0.5713	1.3855	0.0000	1.4246	
Ag	0.2785	1.5851	0.3403	1.6218	0.82
Cd	0.0000	1.6880	0.1849	1.7299	0.00
In	0.0000	1.8937	0.6658	1.9398	0.00
Sn	0.1428	2.3595	0.0000	2.4041	
Sb	0.0000	2.6802	1.0579	2.7602	0.00
Ba	1.5139	9.3291	0.0000	9.4319	
La	0.0000	12.3723	0.0000	12.6755	
Au	0.0000	0.4114	0.0222	0.4198	0.00
Hg	0.0286	0.3388	0.1923	0.3498	0.15
Tl	0.0000	0.3267	0.0000	0.3307	
Pb	0.0071	0.4296	0.0000	0.4325	
U	0.0000	0.3691	0.0074	0.3816	0.00
Sum of measured species	6,050	239	6,360	240	0.95

Table 3.3.2.14. Element concentrations (ng/m^3) from CNL filter samples.

Fuel:	Barley
Date:	17-Sep-92
Time:	9:19
Filter ID:	AG-37

Element	Concentration	±Uncertainty
	ng/m^3	
H	188,640	21,000
Na		
Mg	23,350	8,500
Al	72,750	8,300
Si		
P		
S	375,510	20,300
Cl	1,119,510	57,500
K	2,600,150	131,100
Ca		
Ti	1,580	700
V		
Cr		
Mn	1,280	900
Fe	7,430	700
Ni	1,050	200
Cu		
Zn	1,360	300
As		
Pb		
Se		
Br	10,410	800
Rb	1,100	600
Sr		
Zr		

Table 3.3.2.15. Element emission factors (mg/kg) from CNL filter samples.

Fuel:	Barley
Date:	17-Sep-92
Time:	9:19
Filter ID:	AG-37
Fuel rate (g/s)	3.60
Stack gas flow rate (m^3/s)	3.32
Stack Temperature (°C)	32.33
Ambient Temperature (°C)	17.91

Element	Emission factor (mg/kg)	±Uncertainty (mg/kg)
H	165.8	18.5
Na		
Mg	20.5	7.5
Al	63.9	7.3
Si		
P		
S	330.0	17.8
Cl	983.7	50.5
K	2,284.7	115.2
Ca		
Ti	1.4	0.6
V		
Cr		
Mn	1.1	0.8
Fe	6.5	0.6
Ni	0.9	0.2
Cu		
Zn	1.2	0.3
As		
Pb		
Se		
Br	9.1	0.7
Rb	1.0	0.5
Sr		
Zr		

Table 3.3.2.16. Relative element concentrations by stage from DRUM impactor.

Stage 1: 10 - 15 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	1,996.20	150.41	0.4961	1
S	2,156.59	151.24	0.5359	1
Cl				
K	4,024.03	283.45	1.0000	1
Ca	1,759.16	242.90	0.4372	1
Ti				
V	63.85	30.62	0.0159	1
Cr				
Mn	156.35	28.34	0.0389	1
Fe	561.81	42.41	0.1396	1
Ni				
Cu				
Zn	19.61	7.66	0.0049	1
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.17. Relative element concentrations by stage from DRUM impactor.

Stage 2: 5 - 10 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	927.52	98.48	1.0285	0.4646
S	365.44	89.59	0.4052	0.1695
Cl	464.96	121.24	0.5156	
K	901.84	92.07	1.0000	0.2241
Ca	557.17	73.66	0.6178	0.3167
Ti	115.34	33.72	0.1279	
V				
Cr				
Mn	102.19	21.31	0.1133	0.6536
Fe	263.71	28.97	0.2924	0.4694
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.18. Relative element concentrations by stage from DRUM impactor.

Stage 3: 2.5 - 5 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	217.06	88.55	0.0670	
Al				
Si	2,001.85	134.07	0.6184	1.0028
S	910.57	96.00	0.2813	0.4222
Cl	323.26	65.79	0.0999	
K	3,237.35	206.28	1.0000	0.8045
Ca	1,486.34	120.83	0.4591	0.8449
Ti	62.01	28.76	0.0192	
V				
Cr	50.13	20.69	0.0155	
Mn	87.48	18.41	0.0270	0.5595
Fe	571.41	47.17	0.1765	1.0171
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.19. Relative element concentrations by stage from DRUM impactor.

Stage 4: 1.15 - 2.5 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	344.67	94.97	0.0545	
Al	133.06	54.00	0.0211	
Si	283.57	59.59	0.0449	0.1421
S	1,477.26	179.59	0.2338	0.6850
Cl	1,946.57	293.79	0.3081	
K	6,318.58	358.55	1.0000	1.5702
Ca			0.0000	0.0000
Ti			0.0000	
V	64.88	24.21	0.0103	1.0162
Cr	116.61	35.59	0.0185	
Mn	61.82	17.59	0.0098	0.3954
Fe	372.58	38.07	0.0590	0.6632
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb	31.51	14.90	0.0050	
Sr				
Pb				

Table 3.3.2.20. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	2,560.45	302.28	0.1519	
Na				
Mg				
Al				
Si				
S	2,538.14	281.38	0.1506	1.1769
Cl	4,665.35	412.14	0.2769	
K	16,850.75	894.21	1.0000	4.1875
Ca				
Ti				
V	115.55	33.52	0.0069	1.8098
Cr				
Mn				
Fe				
Ni				
Cu				
Zn				
As				
Se				
Br	73.66	16.76	0.0044	
Rb	58.16	18.21	0.0035	
Sr				
Pb				

Table 3.3.2.21. Relative element concentrations by stage from DRUM impactor.

Stage 6: 0.34 - 0.56 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	6,883.66	733.66	0.0363	
Na				
Mg				
Al	1,229.15	183.72	0.0065	
Si				
S	29,906.65	1,835.38	0.1575	13.8676
Cl	66,186.66	3,605.38	0.3486	
K	189,857.54	9,565.45	1.0000	47.1809
Ca				
Ti				
V				
Cr	140.19	36.62	0.0007	
Mn	104.96	50.07	0.0006	0.6713
Fe				
Ni	64.49	16.97	0.0003	
Cu				
Zn	138.74	25.86	0.0007	7.0738
As				
Se				
Br	1,483.14	122.07	0.0078	
Rb				
Sr				
Pb				

Table 3.3.2.22. Relative element concentrations by stage from DRUM impactor.

Stage 7: 0.24 - 0.34 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	1,110.37	145.86	0.1746	
Na				
Mg				
Al				
Si	133.57	33.72	0.0210	0.0669
S				
Cl	3,736.41	268.55	0.5876	
K	6,359.15	362.07	1.0000	1.5803
Ca				
Ti				
V				
Cr				
Mn				
Fe	75.54	15.52	0.0119	0.1345
Ni	38.92	9.93	0.0061	
Cu				
Zn	43.30	11.38	0.0068	2.2078
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.23. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al	201.02	62.07	0.0085	
Si	149.40	50.69	0.0063	0.0748
S	3,770.71	365.38	0.1599	1.7485
Cl	12,148.94	789.52	0.5151	
K	23,583.48	1,246.97	1.0000	5.8607
Ca				
Ti				
V				
Cr				
Mn				
Fe	100.68	23.79	0.0043	0.1792
Ni	47.67	15.52	0.0020	
Cu				
Zn				
As				
Se				
Br				
Rb	75.50	27.93	0.0032	
Sr				
Pb				

Table 3.3.2.24. Relative element concentrations by stage from DRUM impactor.

Stage 1: 10 - 15 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	25,077.20	1,308.62	3.9030	1
S	1,004.15	135.85	0.1563	1
Cl	1,137.48	194.77	0.1770	1
K	6,425.14	399.23	1.0000	1
Ca	12,316.72	706.62	1.9170	1
Ti	2,646.29	171.08	0.4119	1
V				
Cr				
Mn	429.12	44.15	0.0668	1
Fe	7,773.48	418.77	1.2099	1
Ni				
Cu				
Zn	168.12	22.15	0.0262	1
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.25. Relative element concentrations by stage from DRUM impactor.

Stage 2: 5 - 10 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	4,679.71	272.31	1.1038	0.1866
S	1,560.49	134.92	0.3681	1.5540
Cl	829.14	118.00	0.1956	0.7289
K	4,239.68	289.69	1.0000	0.6599
Ca	12,139.63	679.08	2.8633	0.9856
Ti				
V				
Cr	27.74	13.69	0.0065	
Mn	436.06	35.23	0.1029	1.0162
Fe	1,486.98	96.77	0.3507	0.1913
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.26. Relative element concentrations by stage from DRUM impactor.

Stage 3: 2.5 - 5 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	2,402.02	157.08	0.7741	0.0958
S	738.42	119.85	0.2380	0.7354
Cl	2,102.71	276.46	0.6777	1.8486
K	3,102.89	217.85	1.0000	0.4829
Ca	9,782.29	545.69	3.1526	0.7942
Ti				
V	62.46	25.54	0.0201	
Cr				
Mn	520.40	61.08	0.1677	1.2127
Fe	765.75	67.23	0.2468	0.0985
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.27. Relative element concentrations by stage from DRUM impactor.

Stage 4: 1.15 - 2.5 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	2,031.57	284.31	0.5662	
Na				
Mg	198.94	81.85	0.0554	
Al				
Si	365.17	47.69	0.1018	0.0146
S				
Cl	3,164.75	192.77	0.8820	2.7823
K	3,587.97	228.62	1.0000	0.5584
Ca	3,500.63	269.38	0.9757	0.2842
Ti				
V				
Cr	55.91	20.00	0.0156	
Mn	214.08	27.85	0.0597	0.4989
Fe	177.12	26.62	0.0494	0.0228
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.28. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	284.06	86.00	0.1549	
Al				
Si				
S				
Cl	1,925.25	147.85	1.0495	1.6926
K	1,834.37	125.08	1.0000	0.2855
Ca				
Ti				
V				
Cr	93.34	24.31	0.0509	
Mn				
Fe				
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.29. Relative element concentrations by stage from DRUM impactor.

Stage 6: 0.34 - 0.56 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	10,628.12	1,108.31	0.3397	
Na				
Mg				
Al	576.37	102.77	0.0184	
Si				
S				
Cl	31,063.08	1,602.62	0.9929	27.3088
K	31,284.17	1,613.54	1.0000	4.8690
Ca				
Ti				
V				
Cr	53.18	21.54	0.0017	
Mn				
Fe				
Ni				
Cu				
Zn	92.29	14.00	0.0030	0.5490
As				
Se				
Br	1,284.72	112.46	0.0411	
Rb				
Sr				
Pb				

Table 3.3.2.30. Relative element concentrations by stage from DRUM impactor.

Stage 7: 0.24 - 0.34 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	1,779.48	287.69	0.5683	
Na				
Mg				
Al	115.78	39.54	0.0370	
Si	62.66	26.92	0.0200	0.0025
S				
Cl	3,450.89	205.08	1.1021	3.0338
K	3,131.12	196.15	1.0000	0.4873
Ca				
Ti	59.25	23.08	0.0189	0.0224
V				
Cr				
Mn				
Fe	45.15	11.23	0.0144	0.0058
Ni	33.54	10.92	0.0107	
Cu	34.65	8.62	0.0111	
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.3.2.31. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	17-Sep-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	5,062.80	357.69	0.3251	
Na				
Mg				
Al				
Si				
S				
Cl	10,634.72	594.62	0.6828	9.3494
K	15,574.86	838.00	1.0000	2.4241
Ca				
Ti				
V				
Cr				
Mn				
Fe	138.12	55.54	0.0089	0.0178
Ni				
Cu				
Zn	58.98	14.00	0.0038	0.3508
As				
Se				
Br	393.74	57.38	0.0253	
Rb				
Sr				
Pb				

Table 3.3.2.32
VOC Concentrations (ppbv)

Date	17-Sep-92	17-Sep-92
Fuel	Barley Straw	Barley Straw
Traverse	Traverse 1	Traverse 2
Acetic acid		
Propanone (acetone)		
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	50.8	52
Dimethylbutane		
Hexane		
Phenol		
Dimethylfuran		
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	21.8	18.5
Benzonitrile		
Benzaldehyde	6.3	7
Methylphenol (hydroxy toluene)		
Styrene	106.7	86
Xylene	8.1	2.3
Trimethylpentane		
Benzofuran	3.2	3.1
Methoxymethylphenol (creosol)		
Naphthalene	3.8	3.7
C10H12		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		
No match r.t. (6.7)		
No match r.t. (8.51)		
No match r.t. (8.71)		
No match r.t. (8.73)		
No match r.t.(6.4)		
No match r.t.(8.5)		

Table 3.3.2.33
VOC Emission Factors (mg/kg)

Date	17-Sep-92	17-Sep-92
Fuel	Barley Straw	Barley Straw
Traverse	Traverse 1	Traverse 2
Fuel Consumption Rate (g/s d.b)	3.6	4.06
Stack Gas Mass Flow Rate (kg/s)	3.84	3.67
Acetic acid		
Propanone (acetone)		
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	146	127
Dimethylbutane		
Hexane		
Phenol		
Dimethylfuran		
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	74	53
Benzonitrile		
Benzaldehyde	25	23
Methylphenol (hydroxy toluene)		
Styrene	408	279
Xylene	32	8
Trimethylpentane		
Benzofuran	14	11
Methoxymethylphenol (creosol)		
Naphthalene	18	15
Unknown		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		

Table 3.3.2.34. PAH emission factors, barley straw, 17 September 1992 (zero indicates not detected).

	Traverse 1 Filter	Traverse 2 Filter	Trap	Traverse 1 Sorbent	Traverse 2 Sorbent	Impinger Rinsate	Total Traverse 1	Total Traverse 2	Total Average
					µg/kg dry fuel				
Naphthalene	273	131	0	12,299	9,218	92	12,665	9,441	11,053
2-Methyl-naphthalene	131	90	0	1,917	1,546	91	2,138	1,726	1,932
Acenaphthylene	94	38	0	2,349	343	3	2,446	384	1,415
Acenaphthene	10	7	0	19,655	16,201	0	19,665	16,208	17,936
Fluorene	28	30	0	2,260	1,904	16	2,304	1,950	2,127
Phenanthrene	1,092	740	0	13,266	11,978	231	14,589	12,949	13,769
Anthracene	194	153	0	1,888	1,762	24	2,107	1,939	2,023
Fluoranthene	621	1,745	0	415	510	108	1,144	2,362	1,753
Pyrene	7,308	2,050	0	242	319	71	7,622	2,440	5,031
Benz[a]-anthracene	1,050	1,188	0	0	0	26	1,075	1,213	1,144
Chrysene	1,359	1,553	0	0	0	0	1,359	1,553	1,456
Benzo[b]-fluoranthene	2,257	2,718	0	0	0	0	2,257	2,718	2,488
Benzo[k]-fluoranthene	539	491	0	0	0	0	539	491	515
Benzo[a]pyrene	739	903	0	0	0	0	739	903	821
Benzo[e]pyrene	1,076	1,040	0	0	0	0	1,076	1,040	1,058
Perylene	0	0	0	0	0	0	0	0	0
Benzo[ghi]-perylene	0	0	0	0	0	0	0	0	0
Indeno[1,2,3-cd]-pyrene	0	0	0	0	0	0	0	0	0
Dibenz[a,h]-anthracene	0	0	0	0	0	0	0	0	0
Total	16,770	12,876	0	54,293	43,780	662	71,724	57,318	64,521

Figure 3.3.2.1. Ambient air conditions, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

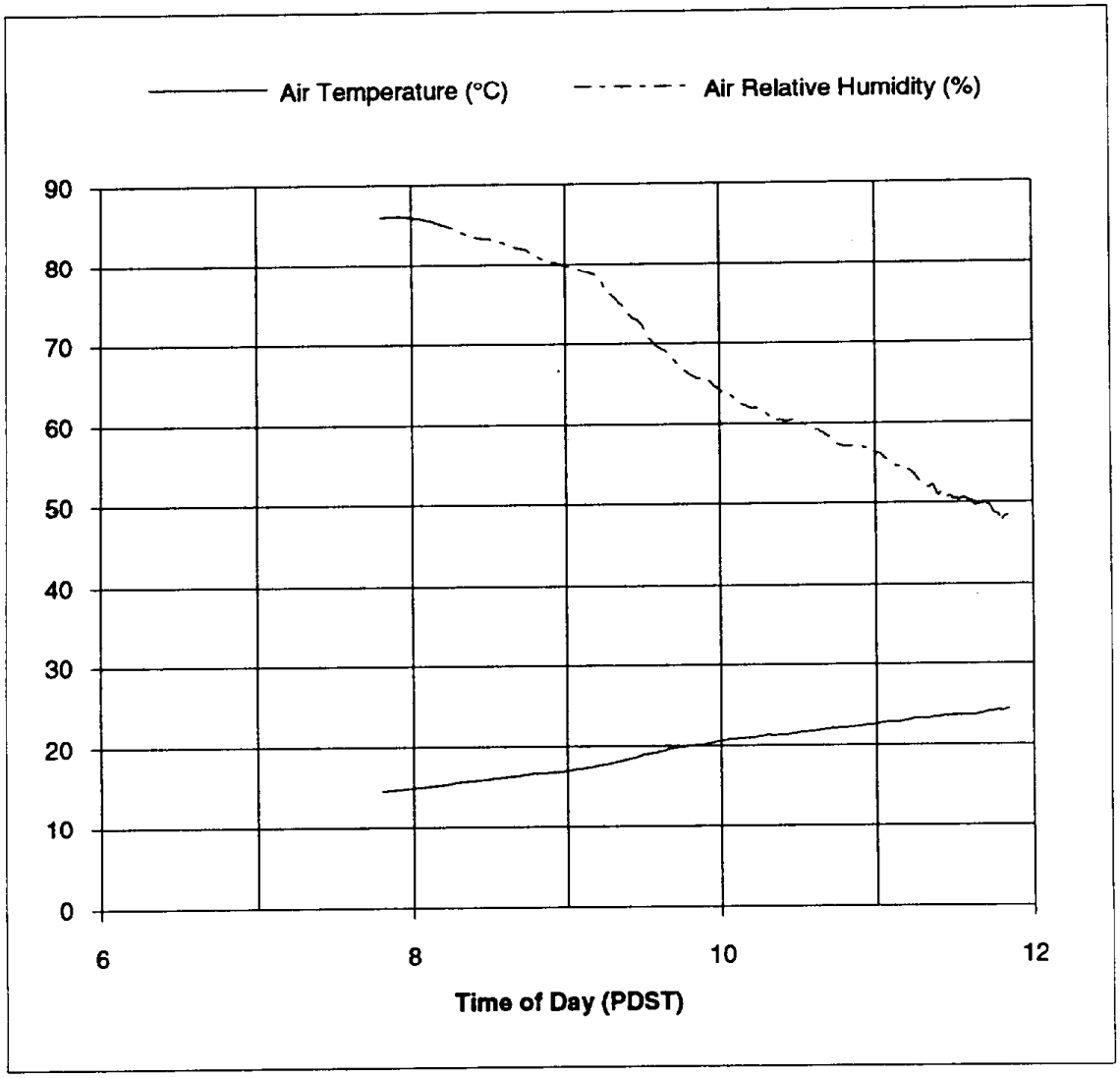

Figure 3.3.2.2. Air temperature and relative humidity from CIMIS station.

Fuel: Barley Straw Date of Test: 17-Sep-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

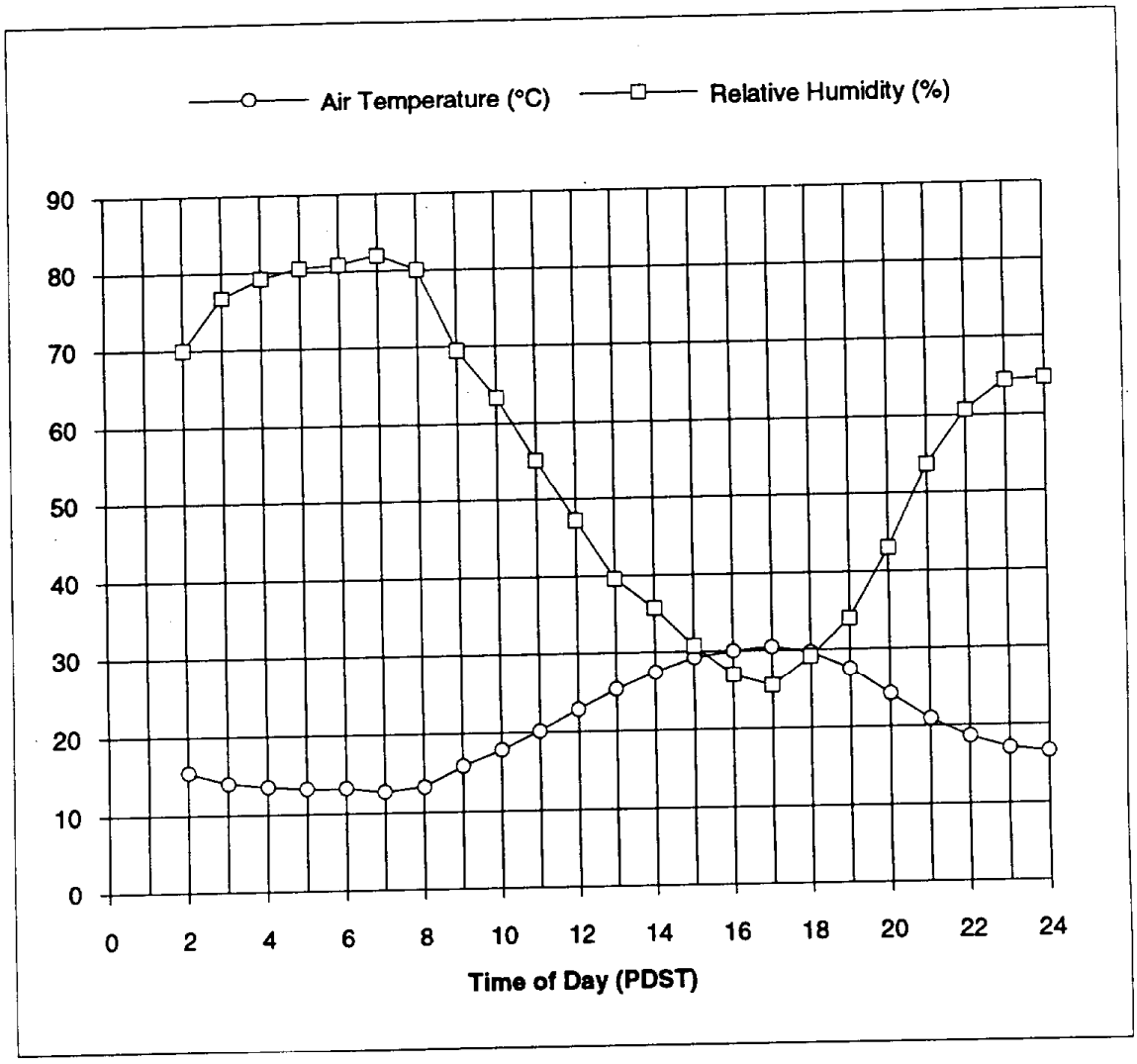

Figure 3.3.2.3. Wind speed from CIMIS station.

Fuel: Barley Straw Date of Test: 17-Sep-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

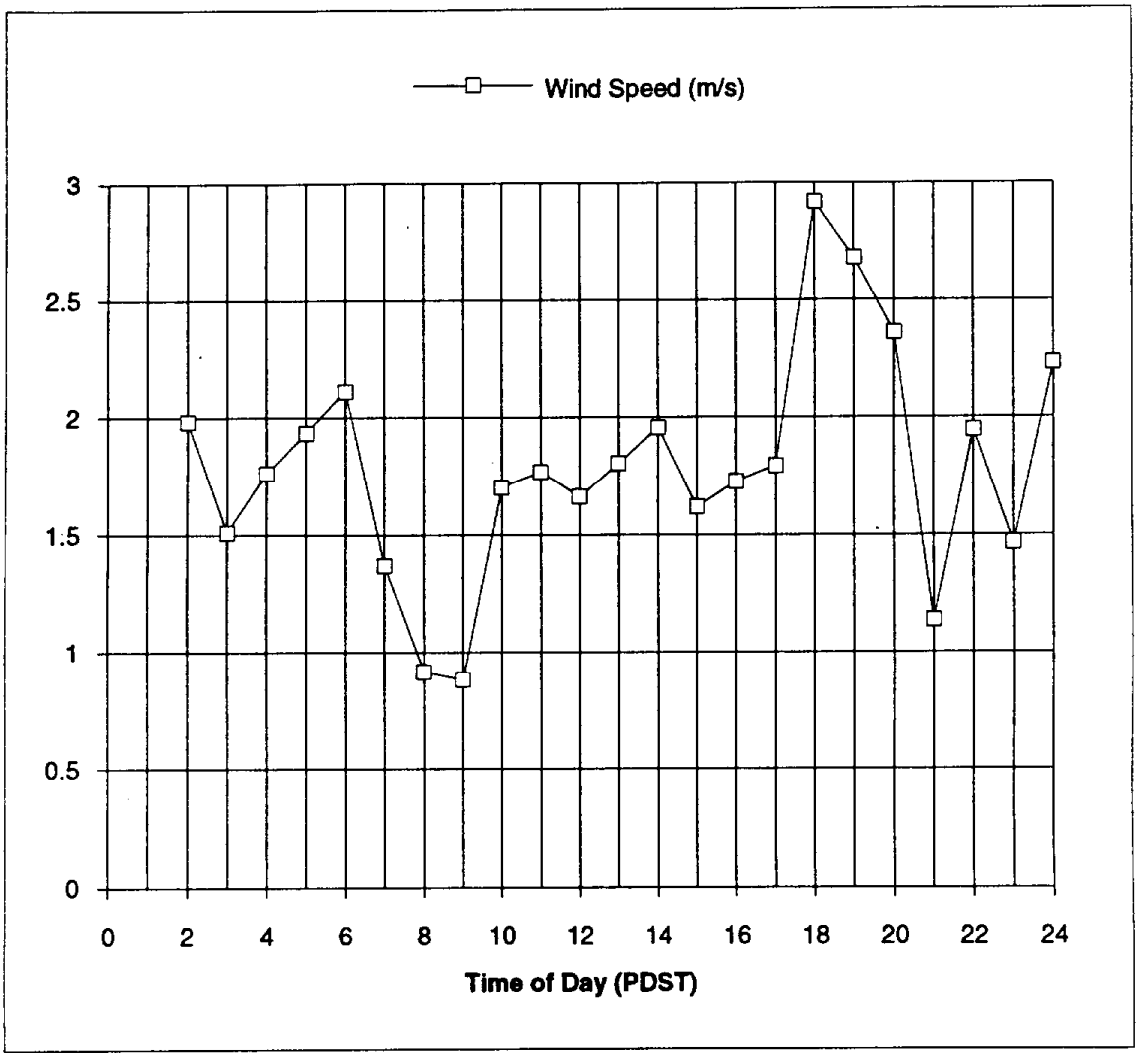

Figure 3.3.2.4. Wind direction and solar radiation from CIMIS station.

Fuel: Barley Straw Date of Test: 17-Sep-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

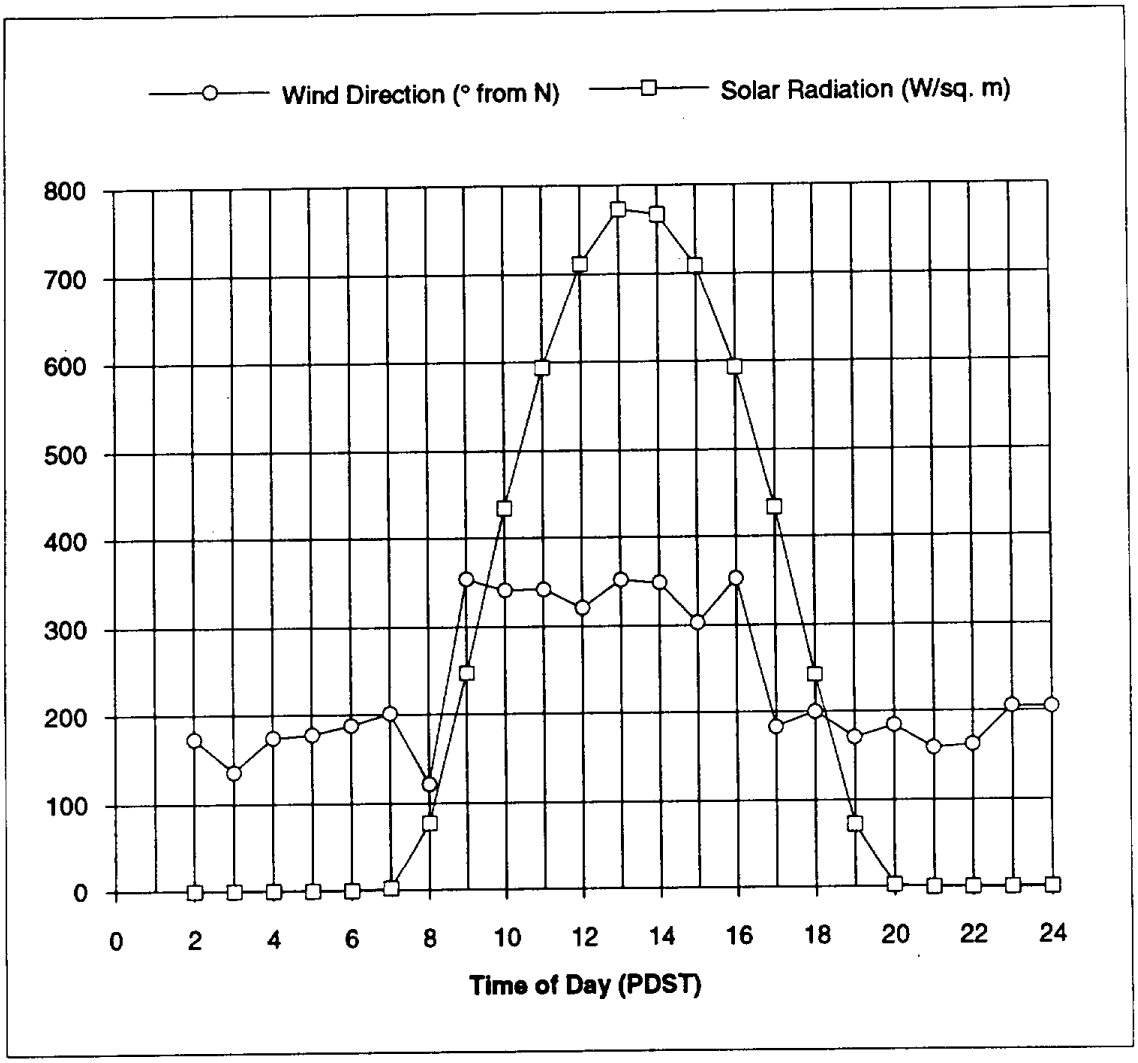

Figure 3.3.2.5. Inlet air, stack gas, and impinger temperatures, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF
Test Date 17-Sep-92

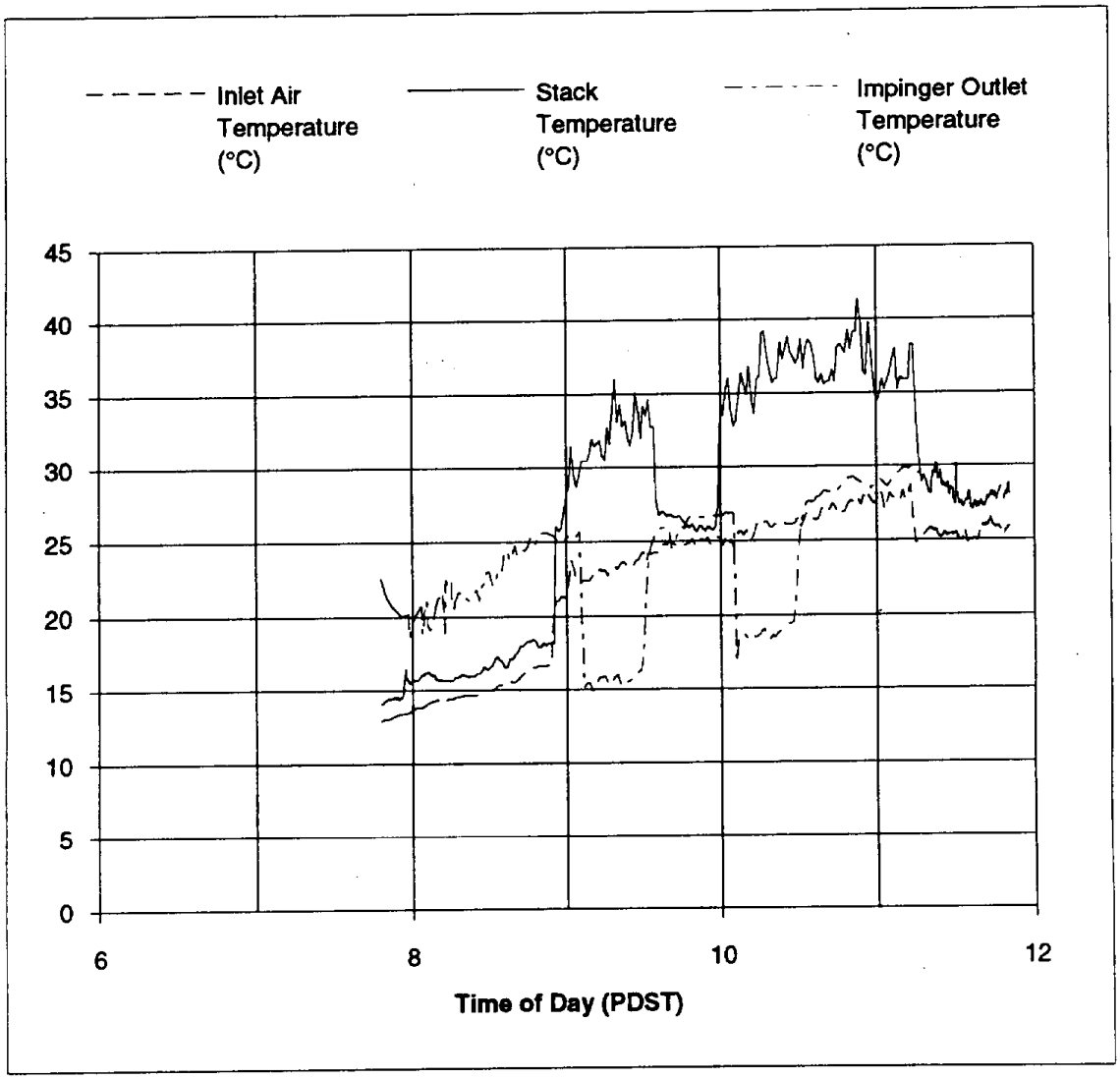

Figure 3.3.2.6. Conveyor speed and stack gas velocity, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

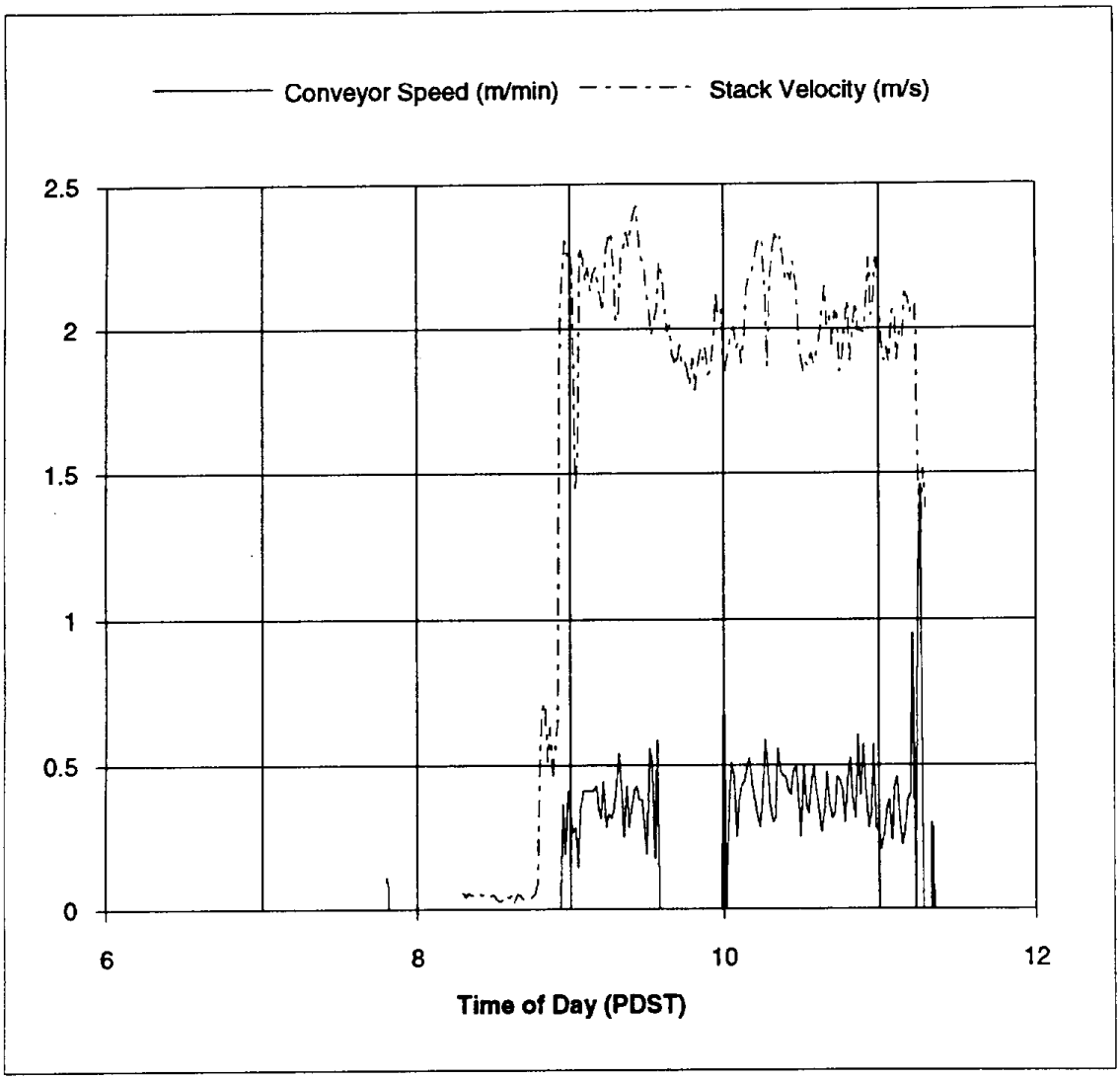

Figure 3.3.2.7. Conveyor speed with 10 min moving average, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

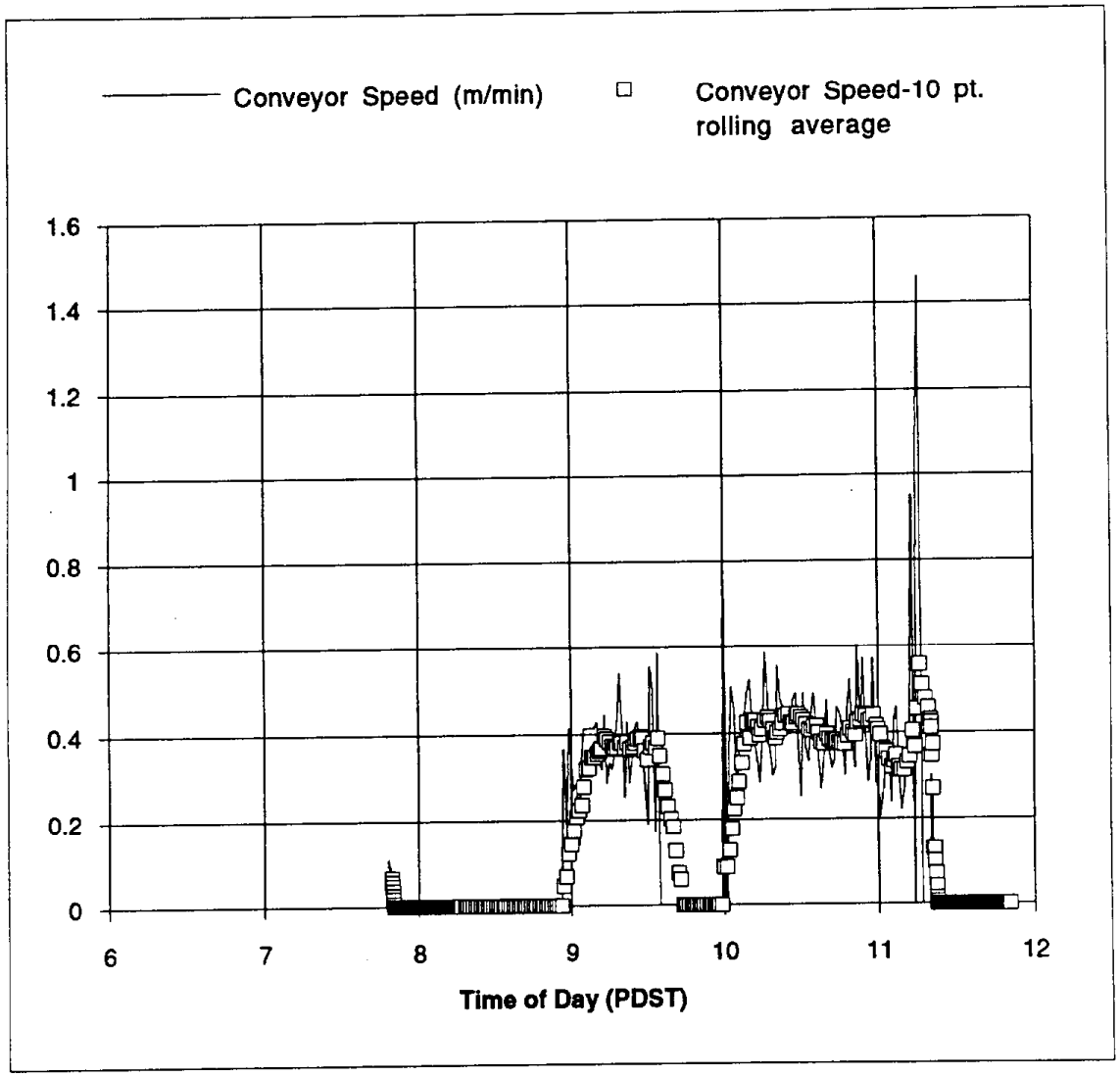

Figure 3.3.2.8. Conveyor travel, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

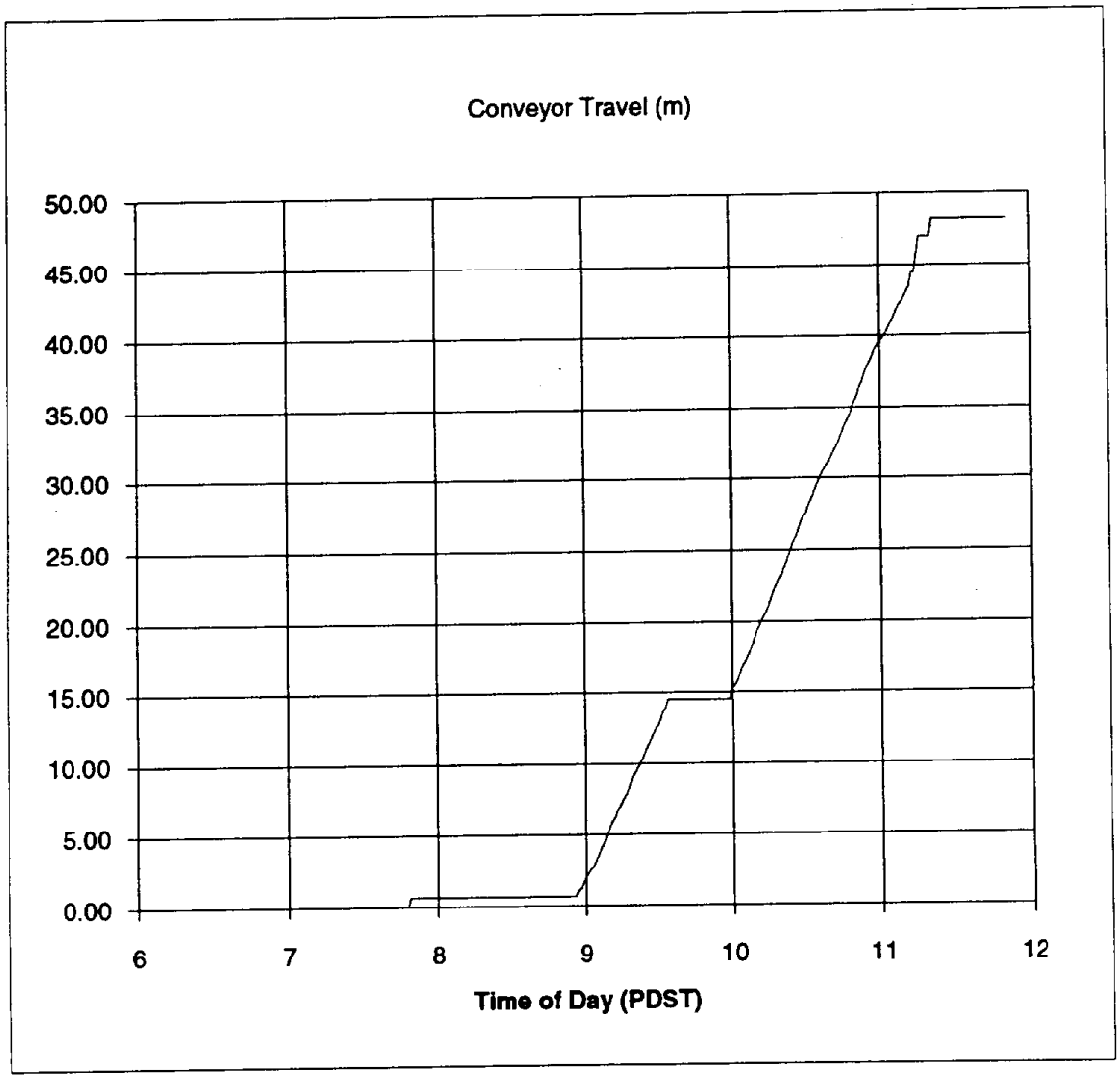

Figure 3.3.2.9. CO concentration in stack gas, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

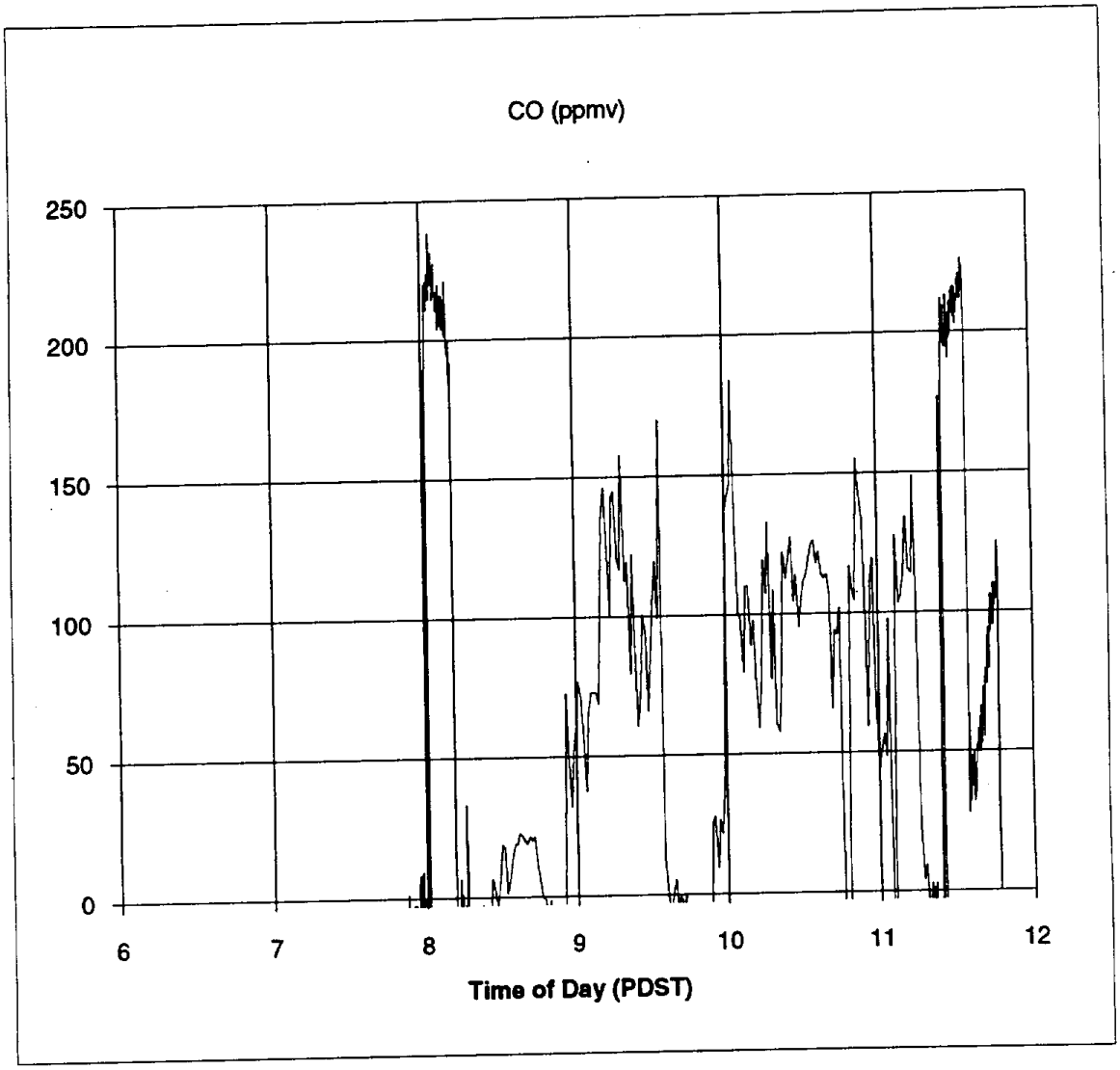

Figure 3.3.2.10. NO and NOx concentrations in stack gas, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF
Test Date 17-Sep-92

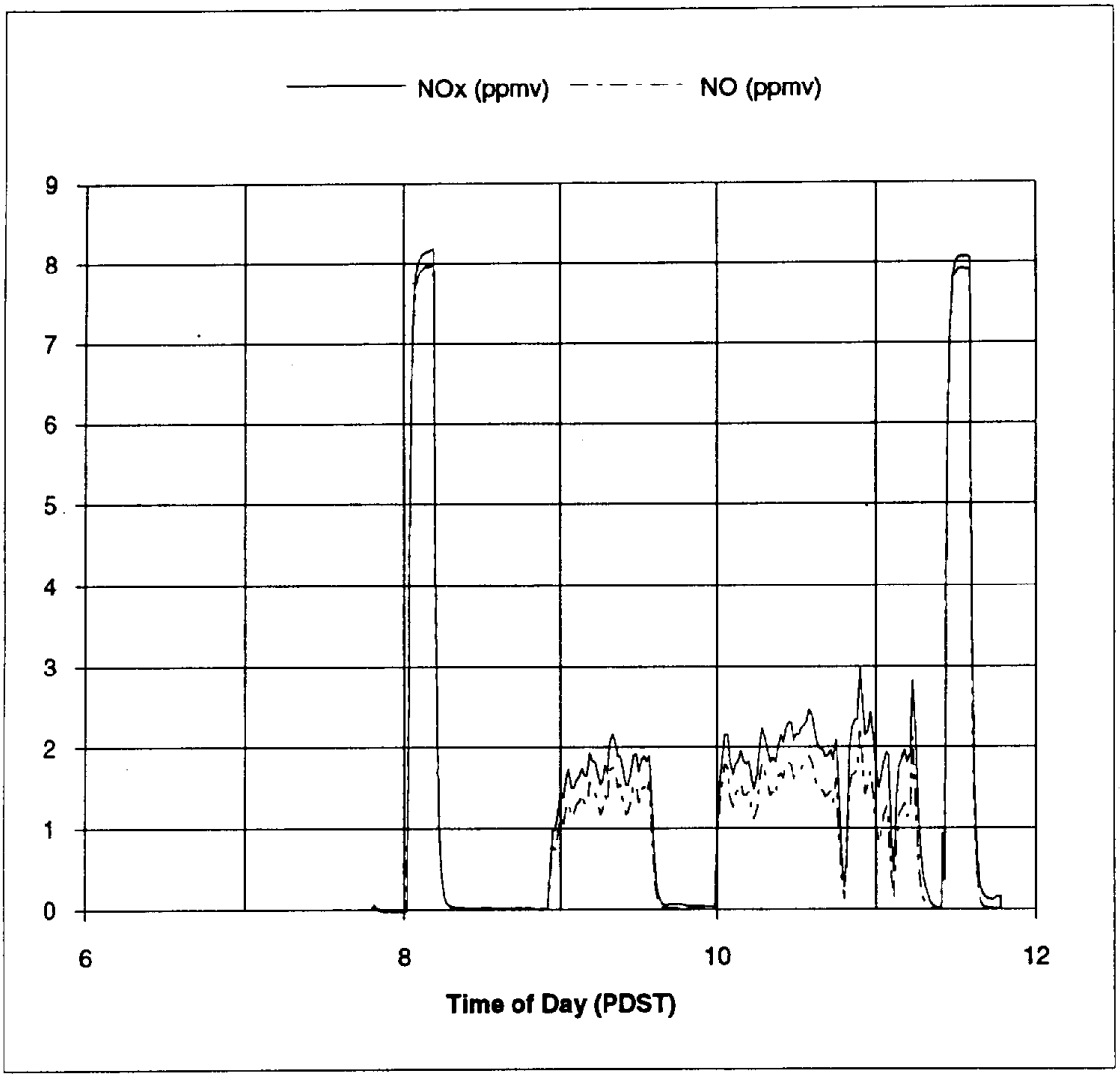

Figure 3.3.2.11. SO2 concentration in stack gas, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

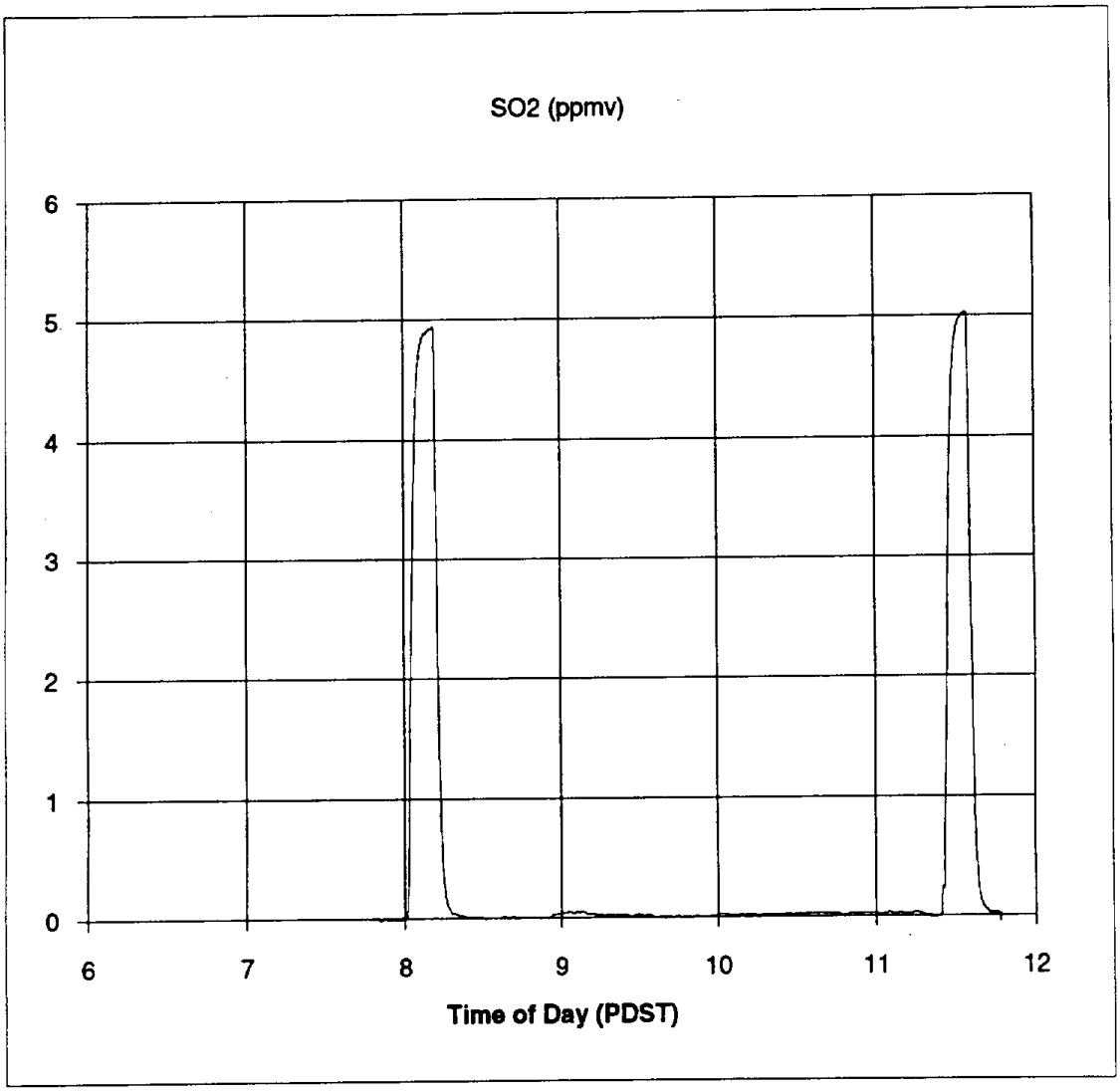

Figure 3.3.2.12. Total sulfur concentration in stack gas, 17 September 92.

Fuel Type: Barley Straw
Configuration: CRNF

Test Date 17-Sep-92

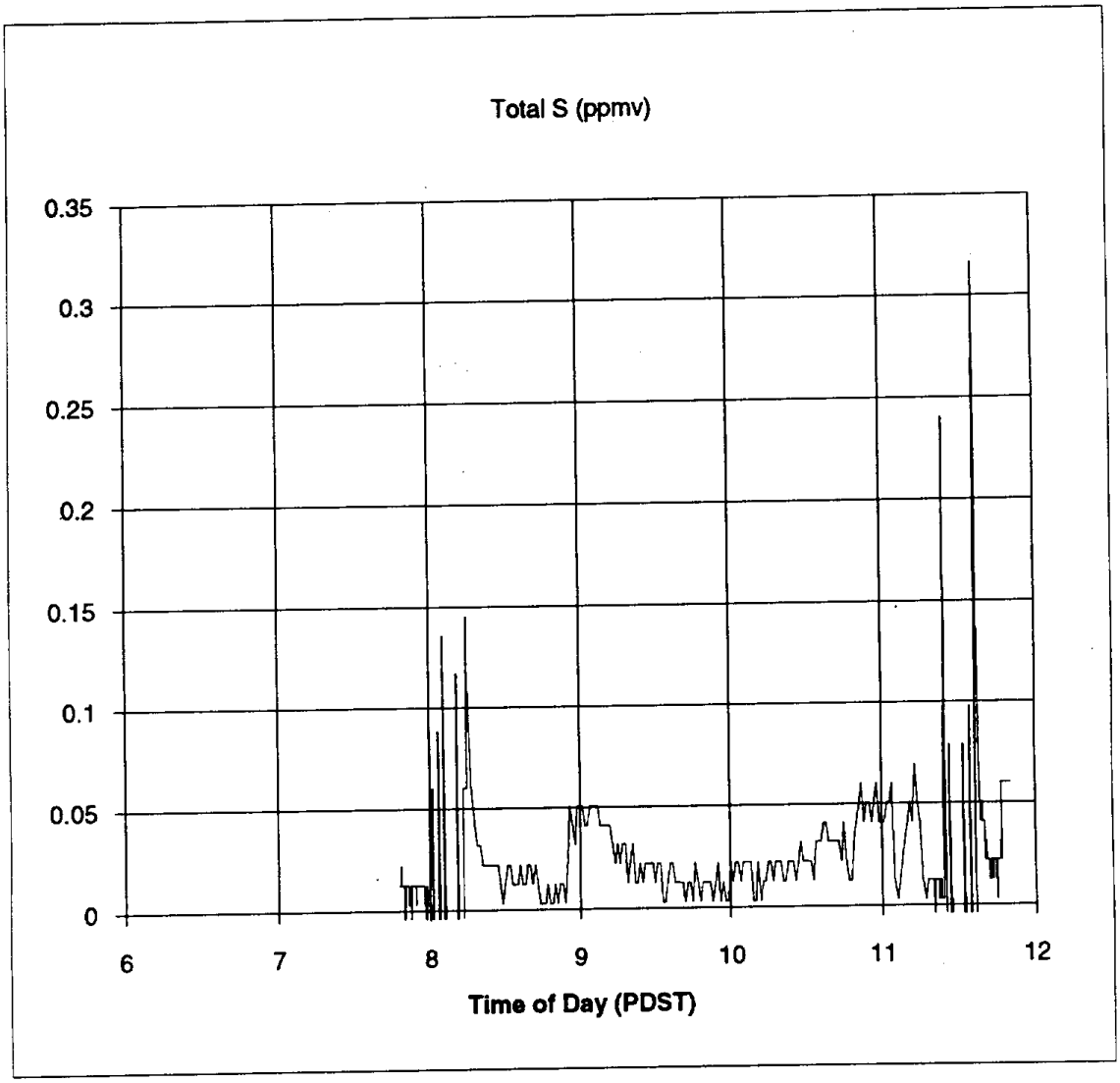

Figure 3.3.2.13. THC concentration in stack gas, 17 September 92.

Fuel Type: Barley Straw Test Date 17-Sep-92
Configuration: CRNF

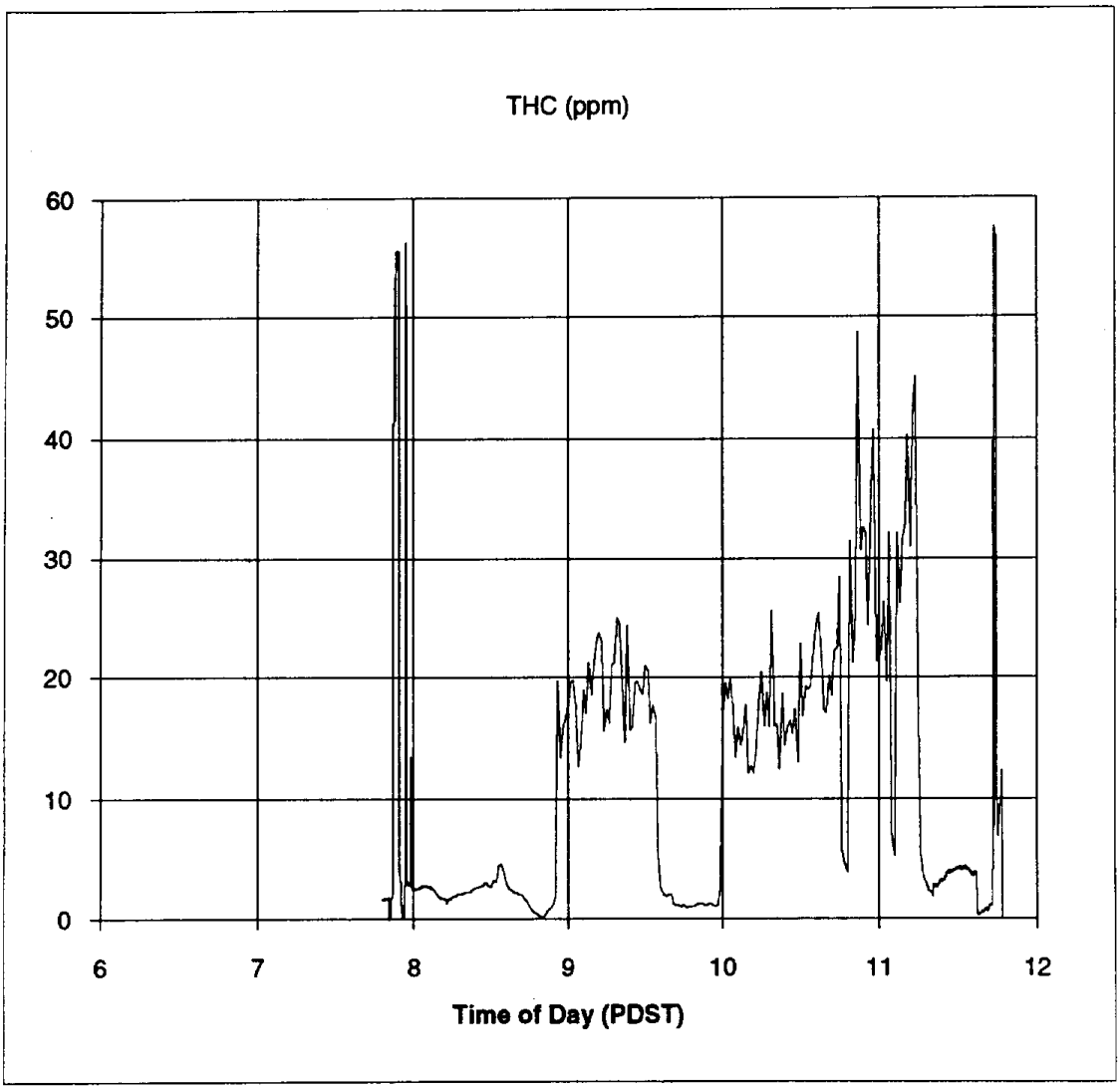

Figure 3.3.2.14. Particle size distribution, traverse 1, 17 September 92.

Fuel: Barley Straw

Date of Test: 17-Sep-92
Configuration: CRNF

Particle Size Distribution
Traverse 1:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	14.05	0.11	3.96	1.000
2	7.87	0.05	3.85	0.972
3	4.20	0.05	3.8	0.960
4	2.22	0.09	3.75	0.947
5	1.28	0.29	3.66	0.924
6	0.75	0.61	3.37	0.851
7	0.39	0.47	2.76	0.697
filter	0.00	2.29	2.29	0.578

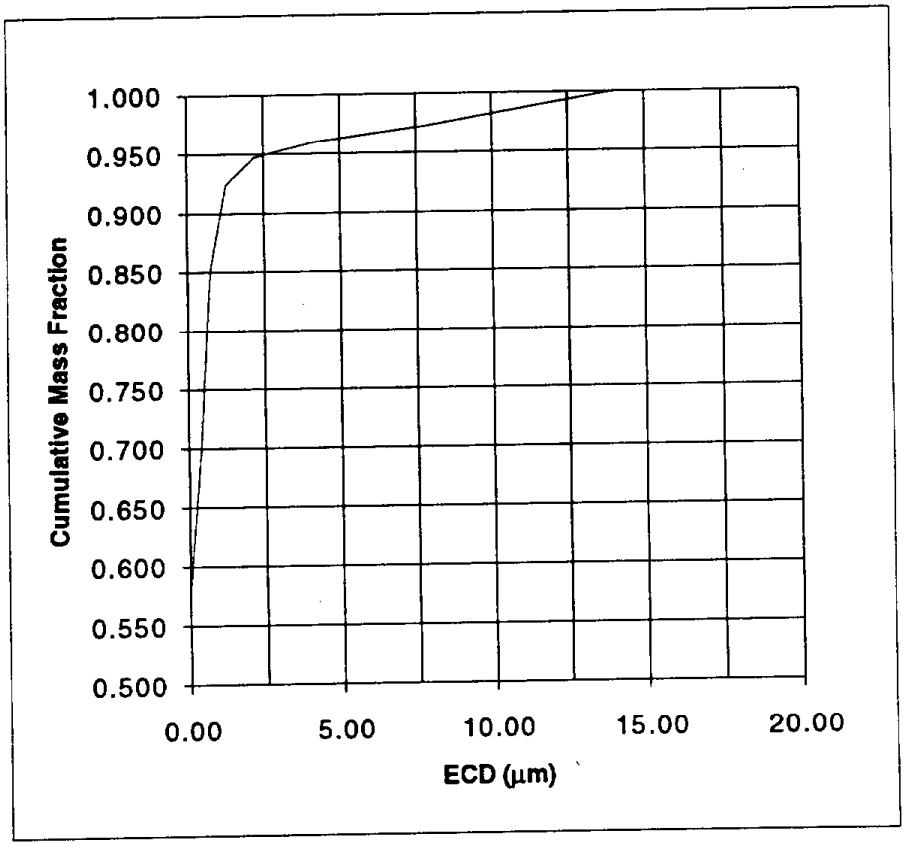

Figure 3.3.2.15. Particle size distribution, traverse 2, 17 September 92.

Fuel: Barley Straw

Date of Test: 17-Sep-92
Configuration: CRNF

Particle Size Distribution
Traverse 2:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.82	0.01	3.88	1.000
2	7.74	0.12	3.87	0.997
3	4.13	0.07	3.75	0.966
4	2.18	0.06	3.68	0.948
5	1.26	0.29	3.62	0.933
6	0.74	0.52	3.33	0.858
7	0.39	0.45	2.81	0.724
filter	0.00	2.36	2.36	0.608

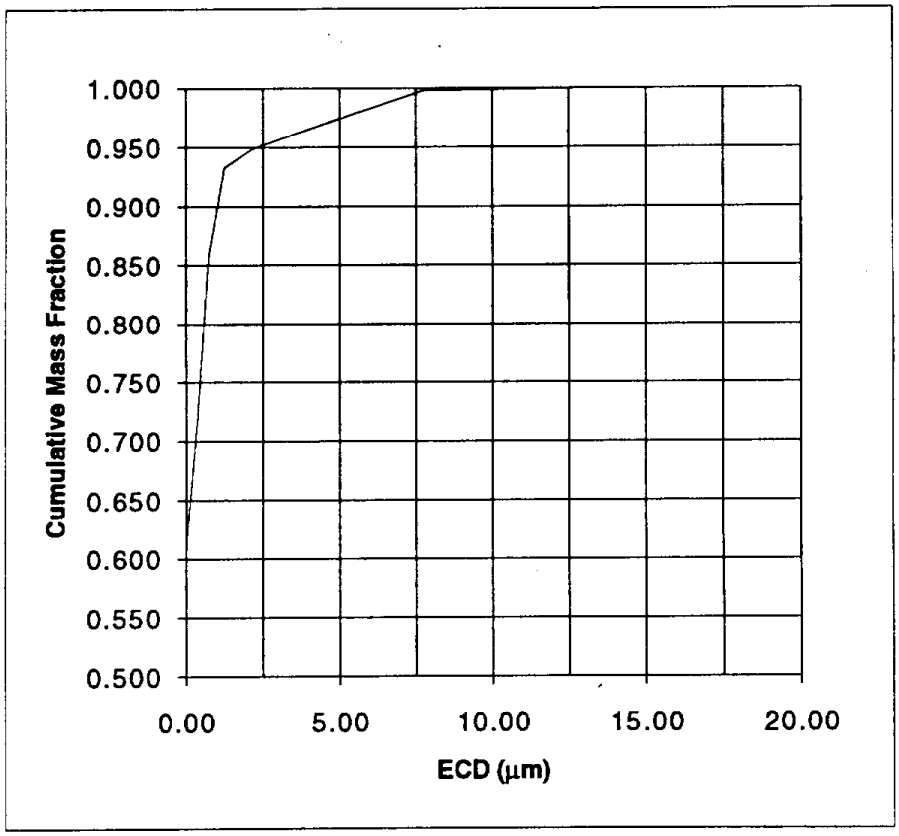

Figure 3.3.2.16. Nitrogen balance.
Date of Test: 17-Sep-92
Fuel Barley Straw

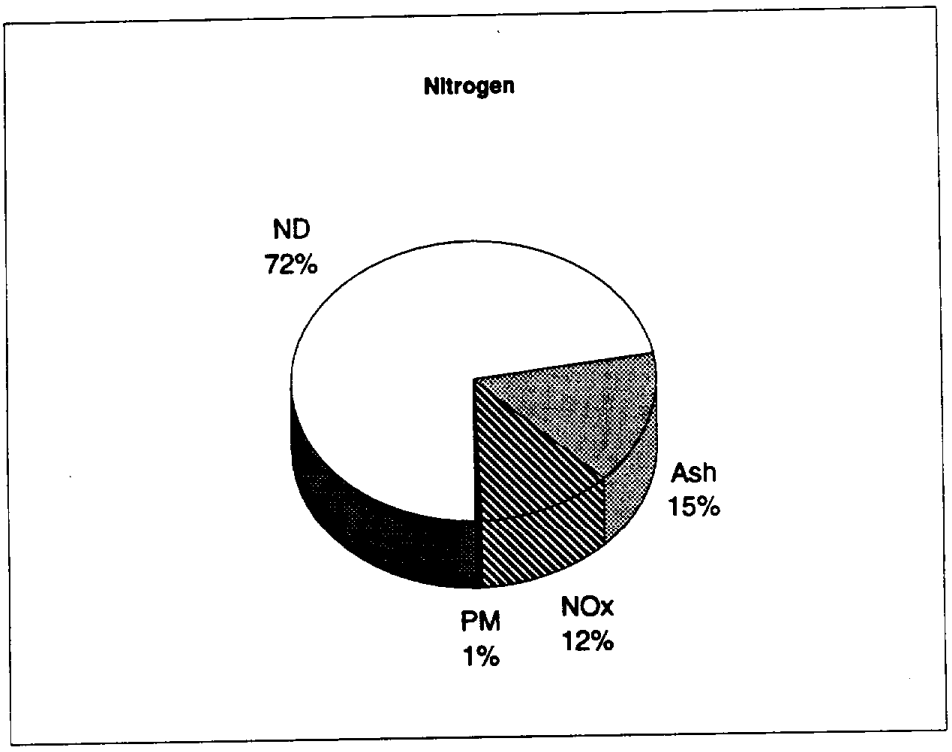

Figure 3.3.2.17. Sulfur balance.
Date of Test: 17-Sep-92
Fuel Barley Straw

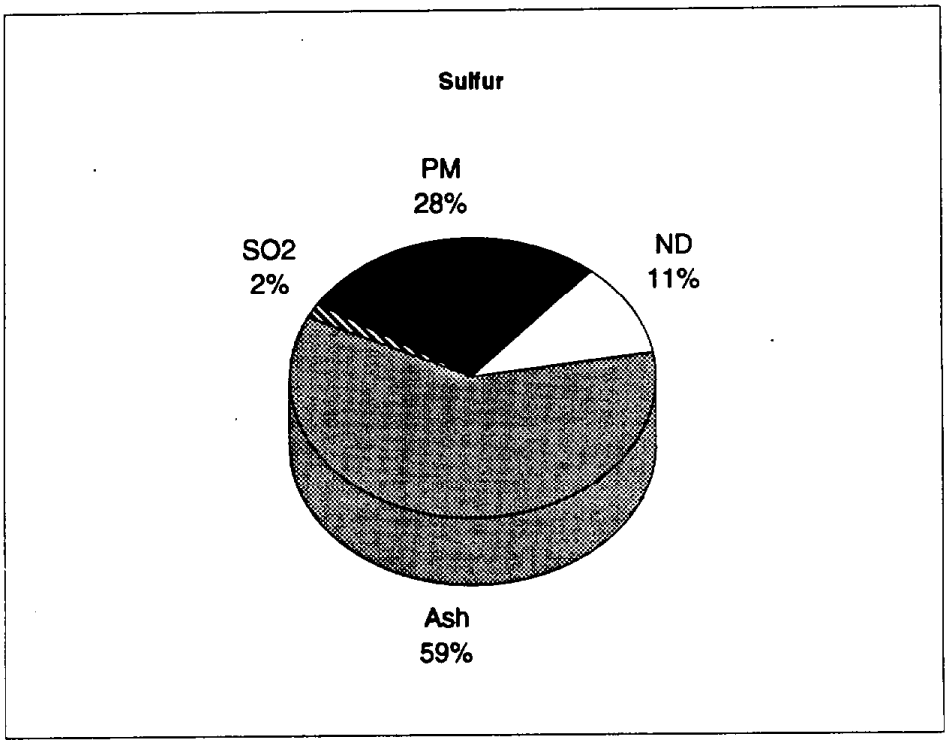

Figure 3.3.2.18. Relative abundance of major elements from DRUM impactor Barley Strawk, 17 September 92, (CRNF), run 1

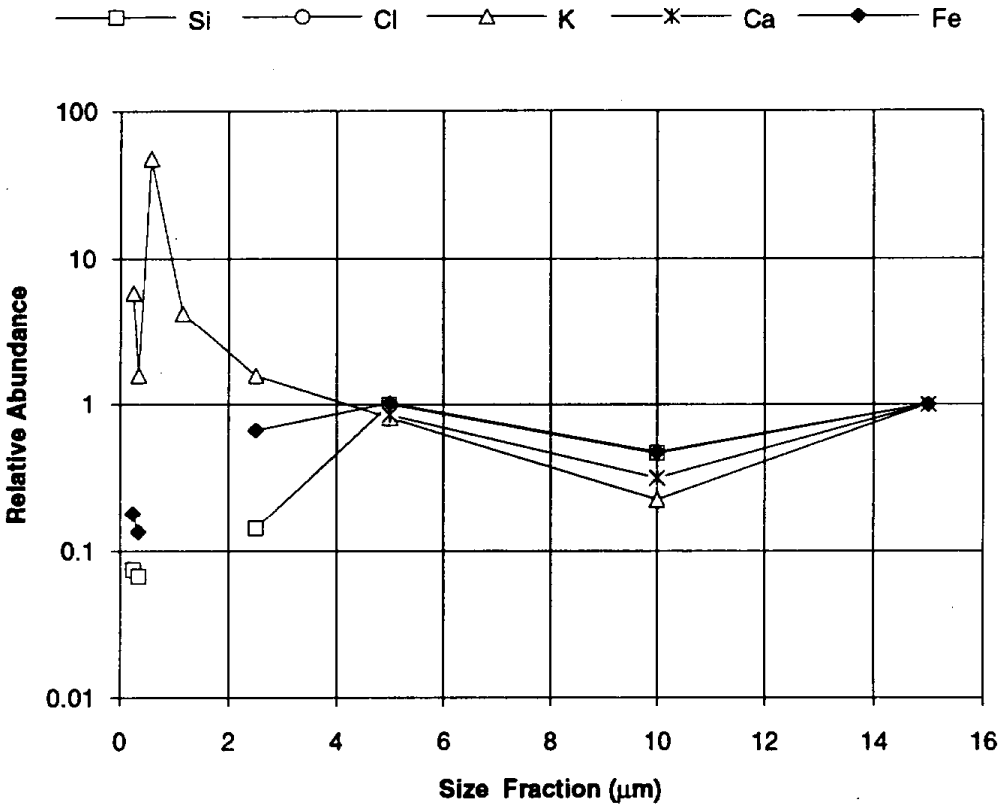

Figure 3.3.2.19. Relative abundance of major elements from DRUM impactor, Barley Straw, 17-Sep-92, (CRNF), run 2.

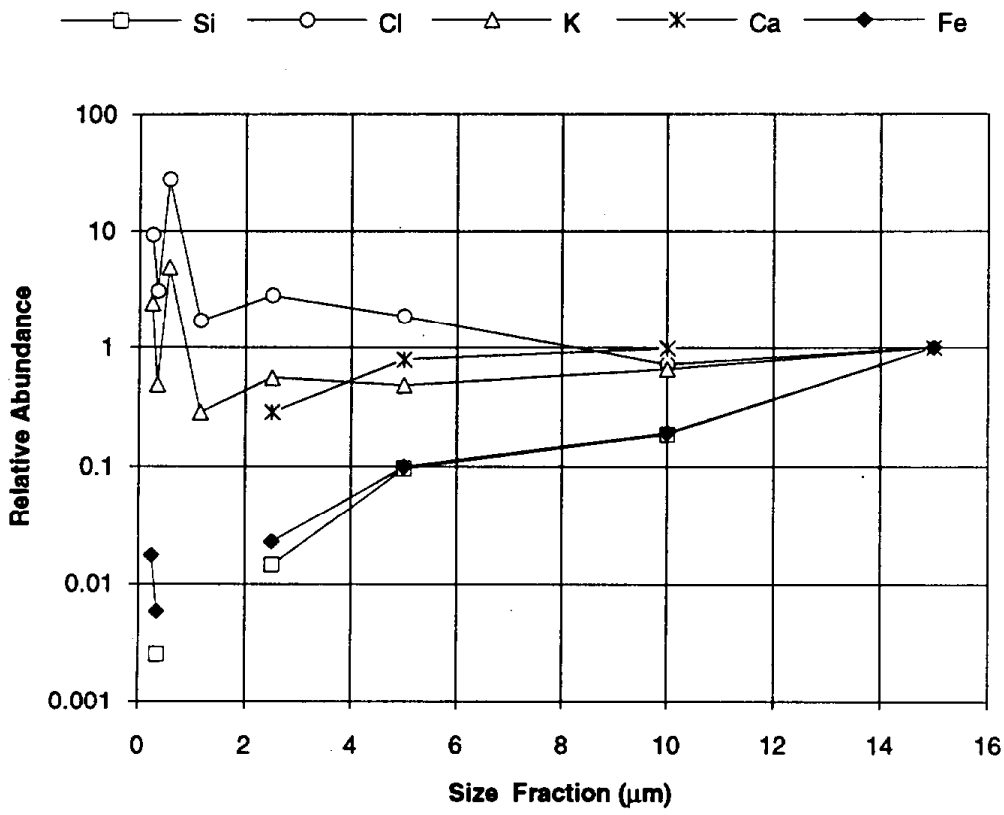

Figure 3.3.2.20. Mass fraction of PAH on primary filter samples, 17 September 1992, barley straw.

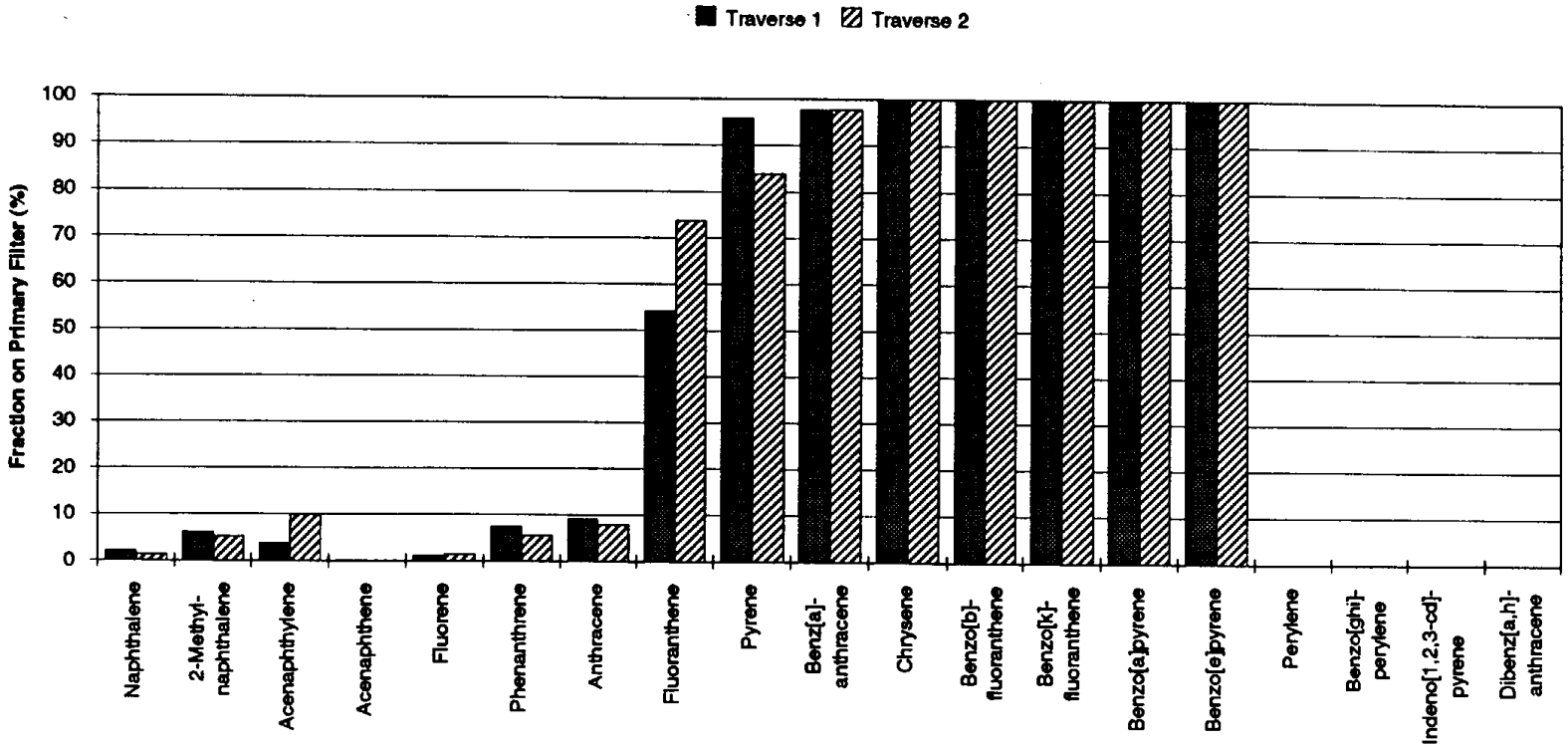

Table 3.4.1.1

Fuel and Ash Analyses

Run Date	7-Oct-92	7-Oct-92
Fuel Type	Corn Stover	Corn Stover
Sample Type	Fuel	Ash
Ultimate Analysis		
(% dry weight)		
C	44.73	8.05
H	5.89	0.72
N	0.50	0.25
Elemental Analysis		
(% by weight dry basis)		
N	0.59	0.32
P	0.09	0.39
K	1.79	13.24
Ca	0.17	1.36
Mg	0.39	1.85
Na	0.01	0.09
Cl	0.37	1.77
(mg/kg dry weight)		
S	620	2,020
B	14	60
Zn	24	102
Mn	58	593
Fe	247	5,100
Cu	4	32
Si		
Total (% dry weight)	54.13	28.58
Proximate Analysis		
(% dry weight)		
Ash	6.13	83.75
Volatiles	77.17	9.92
Fixed Carbon	16.70	6.34
Higher Heating Value		
(MJ/kg dry weight)	17.9252	1.1058

Table 3.4.1.2. Operating conditions and concentrations, 7 October 92.

Fuel:	Corn Stover	Date of Test:	7-Oct-92
		Configuration:	CRNF

	Run 1	Run 2
Fuel Loading Rate (g/sq.m w.b.):	809	1012
Total Fuel Consumption (kg w.b.)	21.0	49.7
Total Ash Recovered (kg w.b.)	1.8	4.2
Ash Fraction (w.b.)	0.08	0.08

	Traverse 1	Traverse 2
Mean Values		
Air Temperature (°C)	21.55	25.19
Air Relative Humidity (%)	15.43	13.46
Inlet Air Temperature (°C)	27.20	31.15
Stack Temperature (°C)	38.46	57.38
Impinger Outlet Temperature (°C)	16.82	22.04
Fire Spreading Rate (m/min)	0.48	0.72
Stack Gas Velocity (m/s)	2.28	2.27
Gas and PM Concentrations (less background)		
CO (ppmv)	83.80	142.59
NO (ppmv)	1.40	2.87
NOx (ppmv)	2.28	4.25
SO2 (ppmv)	0.17	0.36
THC (ppmv as CH4)	25.42	37.46
HC (ppmv as CH4 by GC)	9.36	20.54
CH4 (ppmv)	5.84	11.13
NMHC (ppmv as CH4)	19.58	26.33
NMHC (ppmv as CH4 by GC)	3.52	9.41
CO2 (ppmv by GC)	1,934	3,074
Total S (ppmv as SO2)	0.22	0.36
PM (mg/cu.m)	11.33	20.44
PM10 (mg/cu.m)	11.16	20.13
PM2.5 (mg/cu.m)	11.05	18.80

Table 3.4.1.3. Mass balance, corn stover, 7 October 92.

Fuel: Corn Stover

Date of Test: 7-Oct-92

Configuration: CRNF

Mass Balance

	Traverse 1	Traverse 2
Total Conveyor Travel (m)	17.34	17.18
Fuel Moisture Content (% w.b.)	9.0	9.0
Fuel Loading Rate (g/sq.m d.b.)	736	920
Total Fuel Consumption (g w.b.)	17,102	21,182
Total Fuel Consumption (g d.b.)	15,563	19,276
Residual Ash (g w.b.)	1,435	1,777
Fuel Vaporized (g w.b.)	15,668	19,405
Fuel Consumption Rate (g/s w.b.)	7.92	14.71
Fuel Consumption Rate (g/s d.b.)	7.21	13.39
Ash Generation Rate (g/s w.b.)	0.66	1.23
Fuel Vaporization Rate (g/s w.b.)	7.25	13.48
Stack Gas Density (kg/cu.m)	1.1342	1.0693
Stack Gas Flow Rate (cu.m/s)	3.39	3.37
Stack Gas Mass Flow Rate (kg/s)	3.85	3.61
Inlet Air Mass Flow Rate (kg/s)	3.84	3.59
Overall Air-Fuel Ratio (w.b.)	485.32	244.31
Overall Air-Fuel Ratio (d.b.)	533.32	268.47

Table 3.4.1.4. Emission factors, corn stover, 7 October 92 (integrated basis).

Fuel: Corn Stover | Date of Test: 7-Oct-92 | Configuration: CRNF

Emission Factors (% fuel dry weight)

Integrated Basis

	Traverse 1	Traverse 2	Average
CO	4.291	3.735	4.013
NO	0.077	0.081	0.079
NOx (as NO2)	0.192	0.184	0.188
SO2	0.020	0.022	0.021
THC (as CH4)	0.742	0.552	0.647
HC (as CH4 by GC)	0.276	0.305	0.291
CH4 (by GC)	0.172	0.165	0.169
NMHC (as CH4)	0.570	0.387	0.478
NMHC (as CH4 by GC)	0.104	0.140	0.122
CO2 (by GC)	156.808	125.676	141.242
Total S (as SO2)	0.026	0.022	0.024
SO2/Total S	0.78	0.99	0.88
PM	0.497	0.460	0.478
PM10	0.489	0.453	0.471
PM2.5	0.484	0.423	0.454
MMAD (μm)	0.241	0.182	0.212
σ	3.591	6.017	

Table 3.4.1.5. Emission factors, corn stover, 7 October 92 (average basis).

Fuel:	Corn Stover	Date of Test:	7-Oct-92
		Configuration:	CRNF

Emission Factors (% fuel dry weight)

Average Basis

	Traverse 1	Traverse 2	Average
CO	4.323	3.710	4.017
NO	0.078	0.080	0.079
NOx (as NO2)	0.193	0.182	0.187
SO2	0.020	0.021	0.021
THC (as CH4)	0.749	0.557	0.653
HC (as CH4 by GC)	0.276	0.305	0.291
CH4 (by GC)	0.172	0.165	0.169
NMHC (as CH4)	0.577	0.391	0.484
NMHC (as CH4 by GC)	0.104	0.140	0.122
CO2 (by GC)	156.808	125.676	141.242
Total S (as SO2)	0.026	0.021	0.024
SO2/Total S	0.77	1.00	0.89
PM	0.497	0.460	0.478
PM10	0.489	0.453	0.471
PM2.5	0.484	0.423	0.454
MMAD (μm)	0.241	0.182	0.212
σ	3.591	6.017	

Table 3.4.1.6. Carbon balance.

Date of Test: Fuel	7-Oct-92 Corn Stover Traverse 1	7-Oct-92 Corn Stover Traverse 2
Carbon Balance		
Dry Fuel Consumption Rate (g/s)	7.21	13.39
Ash Generation Rate (g/s)	0.66	1.23
Ash Fraction (% dry basis)	9.15	9.19
Fuel Carbon Concentration (%)	44.73	44.73
Residual Ash Carbon Concentration (%)	8.05	8.05
Carbon released to stack (g/s)	3.17	5.89
Maximum CO2 emission factor (%)	161.31	161.30
Stack Gas Density (kg/cubic meter)	1.13	1.07
Average CO2 concentration (ppmv)	1,934	3,074
Average CO concentration (ppmv)	83.80	142.59
Average THC concentration (ppmv as CH4)	25.42	37.46
PM Concentration (mg/cubic meter)	11.33	20.44
PM Carbon Concentration (%)	50.62	50.62
PM Carbon (mg/cubic meter)	5.74	10.35
Stack Gas Temperature (°C)	38.46	57.38
Impinger Temperature (°C)	16.82	22.04
PM molar concentration (ppm)	11.37	20.88
Estimated Average Stack Gas Velocity (m/s)	2.21	2.74
Emission Factors (% Average Basis):		
CO2	156.808	125.676
CO	4.323	3.710
THC (as CH4)	0.749	0.557
PM	0.497	0.460
Emission Factors (% Integrated Basis):		
CO2	156.808	125.676
CO	4.291	3.735
THC (as CH4)	0.742	0.552
PM	0.497	0.460
Closure (% Average Basis)	103	83
Closure (% Integrated Basis)	103	83

Table 3.4.1.7. Nitrogen balance

Date of Test:	7-Oct-92	7-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Nitrogen Balance		
Fuel Nitrogen Concentration (% dry weight)	0.59	0.59
Ash Nitrogen Concentration (% weight)	0.32	0.32
Emission Factors (% Average Basis):		
NOx (as NO2)	0.193	0.182
PM	0.497	0.460
Emission Factors (% Integrated Basis):		
NOx (as NO2)	0.192	0.184
NO3- Concentration of PM (% weight)	0.244	0.244
NH4+ Concentration of PM (% weight)	5.475	5.475
Nitrogen Concentration of PM (%)	4.313	4.313
Fuel Nitrogen (mg/s)	42.54	79.00
Ash Nitrogen (mg/s)	2.11	3.94
Nitrogen as NOx (mg/s Average Basis)	4.24	7.42
Nitrogen as NOx (mg/s Integrated Basis)	4.21	7.50
Nitrogen as PM (mg/s Average Basis)	1.55	2.66
Nitrogen as NOx+PM (mg/s Average Basis)	5.78	10.07
Nitrogen as NOx+PM (mg/s Integrated Basis)	5.76	10.16
NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.136	0.128
NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.135	0.129
Ash Nitrogen/Fuel Nitrogen	0.050	0.050
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.186	0.177
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.185	0.178

Table 3.4.1.8. Sulfur balance.

Date of Test:	7-Oct-92	7-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Sulfur Balance		
Fuel Sulfur Concentration (mg/kg dry weight)	620	620
Ash Sulfur Concentration (mg/kg weight)	2,020	2,020
Emission Factors (% Average Basis)		
SO2	0.020	0.021
PM	0.497	0.460
Emission Factors (% Integrated Basis)		
SO2	0.020	0.022
Sulfur Concentration of PM (% weight)	0.654	0.654
Fuel Sulfur (mg/s)	4.47	8.30
Ash Sulfur (mg/s)	1.33	2.48
Sulfur as SO2 (mg/s Average Basis)	0.72	1.41
Sulfur as SO2 (mg/s Integrated Basis)	0.72	1.47
Sulfur as PM (mg/s Average Basis)	0.23	0.40
Sulfur as SO2+PM (mg/s Average Basis)	0.96	1.81
Sulfur as SO2+PM (mg/s Integrated Basis)	0.96	1.88
SO2+PM Sulfur/Fuel Sulfur (Average Basis)	0.214	0.218
SO2+PM Sulfur/Fuel Sulfur (Integrated Basis)	0.214	0.226
Ash Sulfur/Fuel Sulfur	0.298	0.299
Closure (% Average Basis)	51	52
Closure (% Integrated Basis)	51	53

Table 3.4.1.9. Water balance.

Estimated Stack Humidity

Fuel	Corn Stover
Configuration	CRNF
Date of Test	7-Oct-92

	Traverse 1	Traverse 2
Ambient Air Temperature °C)	22	25
Ambient Air Relative Humidity (%)	15	13
Air Temperature (K)	295	298
Saturation Pressure (Pa)	2,573	3,205
Vapor Pressure (Pa)	397	431
Air Dew Point Temperature (°C)	-5.9	-4.8
Ambient Volume Fraction Water Vapor	0.0039	0.0043
Ambient Mass Fraction Water Vapor	0.0024	0.0026
Fuel Burning Rate (g/s wet basis)	7.92	14.71
Fuel Moisture Content (%)	9.0	9.0
Ash Fraction (wet basis)	0.08	0.08
Fuel Hydrogen Content (%)	5.89	5.89
Ash Hydrogen Content (%)	0.72	0.72
Moisture Evaporated (g/s)	0.71	1.32
Water of Combustion (g/s)	3.78	7.02
Total Fuel Water Added (g/s)	4.49	8.34
Inlet Air Mass Flowrate (g/s)	3,840	3,590
Inlet Air Water Vapor Flowrate (g/s)	9	9
Total Stack Water Vapor Flowrate (g/s)	14	18
Stack Gas Mass Flowrate (g/s)	3,847	3,604
Mass Fraction Water Vapor in Stack	0.0036	0.0049
Volume Fraction Water Vapor in Stack	0.0058	0.0080
Stack Vapor Pressure (Pa)	587	808
Stack Temperature (°C)	38	57
Stack Temperature (K)	312	331
Stack Saturation Pressure (Pa)	6,798	17,647
Stack Relative Humidity (%)	9	5
Stack Dew Point Temperature (°C)	-0.6	3.9
Impinger Outlet Temperature (°C)	16.8	22.0
Volume Stack Gas Sampled for PM (L)	335	235
Estimated Impinger/Desiccant Weight Gain (g)	1.5	1.4

Totals:

	Estimated	Measured
Total Impinger/Desiccant Weight Gain (g)	2.9	6.0
Estimated/Measured Weight Gain	0.48	

Table 3.4.1.10. Power balance.

Date of Test: Fuel	7-Oct-92 Corn Stover Traverse 1	7-Oct-92 Corn Stover Traverse 2
Power Balance		
Fuel Heating Value (MJ/kg dry weight)	17.8252	17.8252
Ash Heating Value (MJ/kg dry weight)	1.1058	1.1058
Average Energy Release Rate (kW)	127.8	237.3
Products of Incomplete Combustion (kW)		
CO	3.2	5.0
THC (as CH4)	3.0	4.1
PM	0.6	1.0
Heat Release Rate (kW)	121.0	227.1
Fireline Intensity (kW/m)	99.3	186.3
Stack Gas Flow (kg/s)	3.85	3.61
Stack Gas Temperature (°C)	38.46	57.38
Inlet Temperature (°C)	27.20	31.15
Sensible Power at Top of Stack (kW)	43.6	95.3
Tunnel Dissipation (kW)	77.4	131.9

Table 3.4.1.11. Mass concentrations (%) from DRI filter samples

Date	7-Oct-92		7-Oct-92		
Fuel	Corn Stover CRNF		Corn Stover CRNF		
Size Fraction	PM2.5		PM10		
Teflon Filter ID	ABTT036		ABTT037		
Quartz Filter ID	ABTQ036		ABTQ037		
Teflon Field Sample Flag					
Quartz field sample field					
Teflon mass sample flag					
Quartz mass sample flag					
Anions sample flag					
Ammonium analysis flag					
Sodium ion analysis flag					
Magnesium ion analysis flag					
Potassium ion analysis flag					
Carbon analysis flag					
XRF analysis flag					
		±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)	0.24	0.01	0.24	0.01	
Quartz sample volume (m^3)	0.24	0.01	0.24	0.01	
Teflon mass concentration (µg/m^3)	13,131	659	13,482	676	
	Concentration (%)	±Uncertainty	Concentration (%)	±Uncertainty	PM2.5/PM10
Cl-	26.2949	2.1708	26.4022	2.1755	1.00
NO3-	0.2340	0.0278	0.2442	0.0277	0.96
SO4=	2.2361	0.1657	2.2470	0.1662	1.00
NH4+	5.6065	0.4282	5.4749	0.4168	1.02
Na+	0.0639	0.0109	0.0653	0.0107	0.98
K+	15.1495	1.1412	15.3791	1.1558	0.99
C(org)	32.3201	3.1250	31.4674	3.0381	1.03
C(oht)	27.6952	4.2223	28.2030	4.2916	0.98
C(e)	18.5966	1.7605	19.1524	1.8102	0.97
C(eht)	0.2778	0.1732	0.1805	0.1175	1.54
C	50.9167		50.6198		1.01
Al	0.0412	0.0886	0.0635	0.0872	0.65
Si	0.0368	0.1165	0.1605	0.0425	0.23
P	0.0041	0.2180	0.0053	0.2138	0.77
S	0.6679	0.1096	0.6541	0.1075	1.02
Cl	20.2705	1.4355	19.8843	1.4080	1.02
K	12.4347	0.8802	12.2374	0.8662	1.02
Ca	0.0390	0.1780	0.1651	0.1757	0.24
Ti	0.0000	0.0239	0.0025	0.0220	0.00
V	0.0000	0.0143	0.0006	0.0095	0.00
Cr	0.0000	0.0041	0.0027	0.0014	0.00
Mn	0.0028	0.0011	0.0082	0.0012	0.34
Fe	0.0051	0.0037	0.0505	0.0051	0.10
Co	0.0003	0.0009	0.0003	0.0012	1.00
Ni	0.0000	0.0010	0.0011	0.0006	0.00
Cu	0.0007	0.0010	0.0009	0.0007	0.78
Zn	0.0182	0.0015	0.0196	0.0016	0.93
Ga	0.0000	0.0018	0.0000	0.0018	
As	0.0000	0.0021	0.0001	0.0021	0.00
Se	0.0000	0.0012	0.0004	0.0012	0.00
Br	0.0704	0.0051	0.0687	0.0050	1.02
Rb	0.0047	0.0011	0.0046	0.0011	1.02
Sr	0.0007	0.0011	0.0021	0.0007	0.33
Y	0.0011	0.0014	0.0004	0.0014	2.75
Zr	0.0000	0.0016	0.0000	0.0016	
Mo	0.0018	0.0027	0.0004	0.0027	4.50
Pd	0.0031	0.0107	0.0000	0.0104	
Ag	0.0000	0.0119	0.0054	0.0117	0.00
Cd	0.0000	0.0129	0.0000	0.0125	
In	0.0000	0.0143	0.0000	0.0139	
Sn	0.0000	0.0177	0.0000	0.0173	
Sb	0.0006	0.0200	0.0000	0.0192	
Ba	0.0000	0.0666	0.0042	0.0654	0.00
La	0.0274	0.0893	0.0107	0.0873	2.56
Au	0.0000	0.0031	0.0000	0.0031	
Hg	0.0015	0.0025	0.0009	0.0025	1.67
Tl	0.0001	0.0024	0.0000	0.0024	
Pb	0.0003	0.0031	0.0000	0.0031	
U	0.0004	0.0028	0.0003	0.0027	1.33
Sum of measured species	90.4545	4.0015	89.7594	3.9402	1.01

Table 3.4.1.12. Element ratios from DRI filter samples.

Date	7-Oct-92	7-Oct-92	
Fuel	Corn Stover	Corn Stover	
Configuration	CRNF	CRNF	
Size Fraction	PM2.5	PM10	PM2.5/PM10
Teflon Filter ID	ABTT036	ABTT037	
Quartz Filter ID	ABTQ036	ABTQ037	
Cl-/Cl	1.30	1.33	0.98
K+/K	1.22	1.26	0.97
Sulfate S/Total S	1.12	1.15	0.97
C(org)/C	0.63	0.62	1.02
Cl/K	1.63	1.62	1.00
Cl-/K+	1.74	1.72	1.01
Cl-/Na+	411.50	404.32	1.02
S/K	0.05	0.05	1.00
S/Na+	10.45	10.02	1.04
Al/Si	1.12	0.40	2.83

Table 3.4.1.13. Emission factors (mg/kg) from DRI filter samples.

Date	7-Oct-92		7-Oct-92		
Fuel	Corn Stover CRNF		Corn Stover CRNF		
Size Fraction	PM2.5		PM10		
Teflon Filter ID	ABTT036		ABTT037		
Quartz Filter ID	ABTQ036		ABTQ037		
Start Time	10:32				
Stop Time	10:56				
Start Time					
End Time					
Elapsed Time (minutes)	24				Traverse 2
PM (mg/m^3 by total filter)					20.440
PM10 (by total filter/impactor)					20.130
PM2.5 (by total filter/impactor)					18.800
PM emission factor (%)					0.460
PM10 emission factor (%)					0.453
PM2.5 emission factor (%)					0.423
		±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)	0.24	0.01	0.24	0.01	
Quartz sample volume (m^3)	0.24	0.01	0.24	0.01	
Teflon mass concentration (mg/m^3)	13.131	0.659	13.482	0.676	
Teflon mass/Total mass	0.698		0.670		
	Emission (mg/kg)	±Uncertainty	Emission (mg/kg)	±Uncertainty	PM2.5/PM10
Cl-	1229.6506	91.8248	1332.4729	98.5502	0.92
NO3-	10.9427	1.1759	12.3243	1.2548	0.89
SO4=	104.5686	7.0091	113.4022	7.5289	0.92
NH4+	262.1815	18.1129	276.3086	18.8810	0.95
Na+	2.9882	0.4611	3.2956	0.4847	0.91
K+	708.4488	48.2728	776.1563	52.3577	0.91
C(org)	1511.4121	132.1875	1588.1047	137.6259	0.95
C(oht)	1295.1340	178.6033	1423.3561	194.4095	0.91
C(e)	869.6485	74.4692	966.5881	82.0021	0.90
C(eht)	12.9910	7.3264	9.1095	5.3228	1.43
C	2381.0605	0.0000	2554.6928	0.0000	0.93
Al	1.9267	3.7478	3.2047	3.9502	0.60
Si	1.7209	4.9280	8.1002	1.9253	0.21
P	0.1917	9.2214	0.2675	9.6851	0.72
S	31.2336	4.6361	33.0113	4.8698	0.95
Cl	947.9265	60.7217	1003.5259	63.7824	0.94
K	581.4944	37.2325	617.6002	39.2389	0.94
Ca	1.8238	7.5294	8.3323	7.9592	0.22
Ti	0.0000	1.0110	0.1262	0.9966	0.00
V	0.0000	0.6049	0.0303	0.4304	0.00
Cr	0.0000	0.1734	0.1363	0.0634	0.00
Mn	0.1309	0.0465	0.4138	0.0544	0.32
Fe	0.2385	0.1565	2.5486	0.2310	0.09
Co	0.0140	0.0381	0.0151	0.0544	0.93
Ni	0.0000	0.0423	0.0555	0.0272	0.00
Cu	0.0327	0.0423	0.0454	0.0317	0.72
Zn	0.8511	0.0635	0.9892	0.0725	0.86
Ga	0.0000	0.0761	0.0000	0.0815	
As	0.0000	0.0888	0.0050	0.0951	0.00
Se	0.0000	0.0508	0.0202	0.0544	0.00
Br	3.2922	0.2157	3.4672	0.2265	0.95
Rb	0.2198	0.0465	0.2322	0.0498	0.95
Sr	0.0327	0.0465	0.1060	0.0317	0.31
Y	0.0514	0.0592	0.0202	0.0634	2.55
Zr	0.0000	0.0677	0.0000	0.0725	
Mo	0.0842	0.1142	0.0202	0.1223	4.17
Pd	0.1450	0.4526	0.0000	0.4711	
Ag	0.0000	0.5034	0.2725	0.5300	0.00
Cd	0.0000	0.5457	0.0000	0.5663	
In	0.0000	0.6049	0.0000	0.6297	
Sn	0.0000	0.7487	0.0000	0.7837	
Sb	0.0281	0.8460	0.0000	0.8698	
Ba	0.0000	2.8172	0.2120	2.9626	0.00
La	1.2813	3.7774	0.5400	3.9547	2.37
Au	0.0000	0.1311	0.0000	0.1404	
Hg	0.0701	0.1058	0.0454	0.1133	1.54
Tl	0.0047	0.1015	0.0000	0.1087	
Pb	0.0140	0.1311	0.0000	0.1404	
U	0.0187	0.1184	0.0151	0.1223	1.24
Sum of measured species	4,230	169	4,530	167	0.93

Table 3.4.1.14. Element concentrations (ng/m^3) from CNL filter samples.

Fuel:	Corn
Date:	7-Oct-92
Time:	
Filter ID:	AG-43

Element	Concentration	±Uncertainty
	ng/m^3	
H	280,300	27,800
Na	246,140	47,600
Mg	76,780	16,600
Al		
Si	55,310	5,700
P		
S		
Cl	4,129,040	208,200
K	2,456,360	123,900
Ca		
Ti	1,790	1,000
V	4,290	1,000
Cr	1,390	600
Mn	2,880	600
Fe	16,070	1,000
Ni	710	200
Cu	910	300
Zn	1,790	200
As		
Pb		
Se	350	200
Br	8,470	600
Rb		
Sr		
Zr		

Table 3.4.1.15. Element emission factors (mg/kg) from CNL filter samples.

Fuel:	Corn	
Date:	7-Oct-92	
Time:		
Filter ID:	AG-43	
Fuel rate (g/s)		7.21
Stack gas flow rate (m^3/s)		3.39
Stack Temperature (°C)		38.46
Ambient Temperature (°C)		21.55

Element	Emission factor (mg/kg)	±Uncertainty (mg/kg)
H	124.6	12.4
Na	109.4	21.2
Mg	34.1	7.4
Al		
Si	24.6	2.5
P		
S		
Cl	1,836.0	92.6
K	1,092.3	55.1
Ca		
Ti	0.8	0.4
V	1.9	0.4
Cr	0.6	0.3
Mn	1.3	0.3
Fe	7.1	0.4
Ni	0.3	0.1
Cu	0.4	0.1
Zn	0.8	0.1
As		
Pb		
Se	0.2	0.1
Br	3.8	0.3
Rb		
Sr		
Zr		

Table 3.4.1.16. Relative element concentrations by stage from DRUM impactor.

Stage 1: 10 - 15 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	21,031.08	1,151.70	2.2098	1
S	1,881.96	237.60	0.1977	1
Cl	1,991.73	311.10	0.2093	1
K	9,517.02	661.80	1.0000	1
Ca	8,510.85	726.00	0.8943	1
Ti				
V	110.67	41.10	0.0116	1
Cr				
Mn	356.64	63.30	0.0375	1
Fe	6,133.80	348.00	0.6445	1
Ni	95.34	23.10	0.0100	1
Cu				
Zn	1,228.11	113.70	0.1290	1
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.17. Relative element concentrations by stage from DRUM impactor.

Stage 2: 5 - 10 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	436.98	220.50	0.1964	
Al				
Si	1,402.14	145.80	0.6303	0.0667
S	504.33	91.20	0.2267	0.2680
Cl	674.37	101.10	0.3031	0.3386
K	2,224.68	177.00	1.0000	0.2338
Ca	1,359.21	141.90	0.6110	0.1597
Ti				
V	94.89	29.70	0.0427	0.8574
Cr				
Mn				
Fe	580.41	51.30	0.2609	0.0946
Ni	92.43	19.50	0.0415	0.9695
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.18. Relative element concentrations by stage from DRUM impactor.

Stage 3: 2.5 - 5 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg	1,555.50	277.50	0.2284	
Al				
Si	3,331.35	227.70	0.4891	0.1584
S	661.86	109.80	0.0972	0.3517
Cl	2,909.01	207.00	0.4271	1.4605
K	6,810.99	439.20	1.0000	0.7157
Ca	4,257.72	372.90	0.6251	0.5003
Ti				
V	160.44	49.80	0.0236	1.4497
Cr				
Mn	199.11	32.70	0.0292	0.5583
Fe	1,794.63	120.00	0.2635	0.2926
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.19. Relative element concentrations by stage from DRUM impactor.

Stage 4: 1.15 - 2.5 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	4,297.62	399.60	0.2576	
Na				
Mg	474.63	144.60	0.0285	
Al				
Si	874.53	104.70	0.0524	0.0416
S				
Cl	17,131.35	925.20	1.0270	8.6012
K	16,680.39	904.80	1.0000	1.7527
Ca				
Ti				
V				
Cr	166.14	43.80	0.0100	
Mn	160.50	37.20	0.0096	0.4500
Fe	829.56	70.50	0.0497	0.1352
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.20. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 4 (-)
H	3,264.60	336.00	0.1666	
Na				
Mg	246.93	125.10	0.0126	
Al				
Si				
S				
Cl	20,057.76	1,079.40	1.0233	10.0705
K	19,600.38	1,072.80	1.0000	2.0595
Ca				
Ti				
V				
Cr				
Mn				
Fe	247.32	69.60	0.0126	0.0403
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.21. Relative element concentrations by stage from DRUM impactor.

Stage 6: 0.34 - 0.56 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	9,642.33	1,927.50	0.0659	
Na				
Mg				
Al	1,254.36	210.60	0.0086	
Si				
S				
Cl	219,684.45	11,084.70	1.5018	110.2983
K	146,276.91	7,425.30	1.0000	15.3700
Ca				
Ti				
V				
Cr				
Mn	229.53	75.30	0.0016	0.6436
Fe				
Ni				
Cu	102.15	30.00	0.0007	
Zn	413.67	173.70	0.0028	0.3368
As				
Se				
Br	803.52	93.90	0.0055	
Rb				
Sr				
Pb				

Table 3.4.1.22. Relative element concentrations by stage from DRUM impactor.

Stage 7: 0.24 - 0.34 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H				
Na				
Mg				
Al				
Si	202.80	66.90	0.0230	0.0096
S				
Cl	10,196.28	584.70	1.1572	5.1193
K	8,811.03	538.80	1.0000	0.9258
Ca				
Ti				
V				
Cr	182.04	57.90	0.0207	
Mn	105.63	39.00	0.0120	0.2962
Fe	127.32	28.20	0.0145	0.0208
Ni				
Cu	124.53	36.90	0.0141	
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.1.23. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	7-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-•)
H	5,813.43	1,143.00	0.1493	
Na				
Mg				
Al	359.19	107.40	0.0092	
Si				
S				
Cl	51,602.70	2,686.80	1.3250	25.9085
K	38,944.59	2,063.40	1.0000	4.0921
Ca				
Ti				
V				
Cr				
Mn	190.62	53.70	0.0049	0.5345
Fe	140.55	36.60	0.0036	0.0229
Ni				
Cu				
Zn	205.77	45.60	0.0053	0.1676
As				
Se				
Br				
Rb	225.27	59.70	0.0058	
Sr				
Pb				

Table 3.4.1.24
VOC Concentrations (ppbv)

Date	7-Oct-92	7-Oct-92
Fuel	Corn Stover	Corn Stover
Traverse	Traverse 1	Traverse 2
Acetic acid		
Propanone (acetone)	70.2	90.6
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	8.4	8.9
Dimethylbutane		
Hexane		
Phenol	28.1	30.8
Dimethylfuran	43.6	83.6
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	31.4	20.4
Benzonitrile		
Benzaldehyde		
Methylphenol (hydroxy toluene)		
Styrene	5.4	8
Xylene		
Trimethylpentane		
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	5	8.6
C10H12		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		
No match r.t. (6.7)	35.6	33.1
No match r.t. (8.51)		
No match r.t. (8.71)		
No match r.t. (8.73)		
No match r.t.(6.4)		
No match r.t.(8.5)		

Table 3.4.1.25
VOC Emission Factors (mg/kg)

Date	7-Oct-92	7-Oct-92
Fuel	Corn Stover	Corn Stover
Traverse	Traverse 1	Traverse 2
Fuel Consumption Rate (g/s d.b)	7.21	13.39
Stack Gas Mass Flow Rate (kg/s)	3.85	3.61
Acetic acid		
Propanone (acetone)	75	49
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	12	6
Dimethylbutane		
Hexane		
Phenol	49	27
Dimethylfuran	77	75
2-methyl 2-cyclopenten-1-one		
2-chloro phenol		
Toluene	53	17
Benzonitrile		
Benzaldehyde		
Methylphenol (hydroxy toluene)		
Styrene	10	8
Xylene		
Trimethylpentane		
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	12	10
Unknown		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		

Table 3.4.1.26. PAH emission factors, corn stover, 7 October 1992 (zero indicates not detected).

	Traverse 1 Filter	Traverse 2 Filter	Trap	Traverse 1 Sorbent	Traverse 2 Sorbent	Impinger Rinsate	Total Traverse 1	Total Traverse 2	Total Average
					µg/kg dry fuel				
Naphthalene	14	101	0	1,101	1,434	5	1,120	1,539	1,330
2-Methyl-naphthalene	12	32	0	881	845	6	899	883	891
Acenaphthylene	3	15	0	523	451	0	527	467	497
Acenaphthene	0	23	0	857	377	0	857	400	629
Fluorene	6	0	0	95	59	5	106	64	85
Phenanthrene	78	135	0	1,780	1,628	13	1,871	1,775	1,823
Anthracene	6	31	0	262	327	3	271	362	316
Fluoranthene	610	271	0	553	477	10	1,173	758	966
Pyrene	519	331	0	500	447	10	1,028	787	908
Benz[a]-anthracene	41	232	0	12	43	10	63	285	174
Chrysene	71	343	0	0	42	5	76	390	233
Benzo[b]-fluoranthene	29	0	0	0	6	0	29	6	18
Benzo[k]-fluoranthene	61	0	0	0	0	0	61	0	30
Benzo[a]pyrene	11	0	0	0	0	0	11	0	6
Benzo[e]pyrene	0	0	0	0	0	0	0	0	0
Perylene	0	0	0	0	0	0	0	0	0
Benzo[ghi]-perylene	0	0	0	0	0	0	0	0	0
Indeno[1,2,3-cd]-pyrene	0	0	0	0	0	0	0	0	0
Dibenz[a,h]-anthracene	0	0	0	0	0	0	0	0	0
Total	1,461	1,513	0	6,564	6,136	68	8,092	7,717	7,904

Figure 3.4.1.1. Ambient air conditions, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

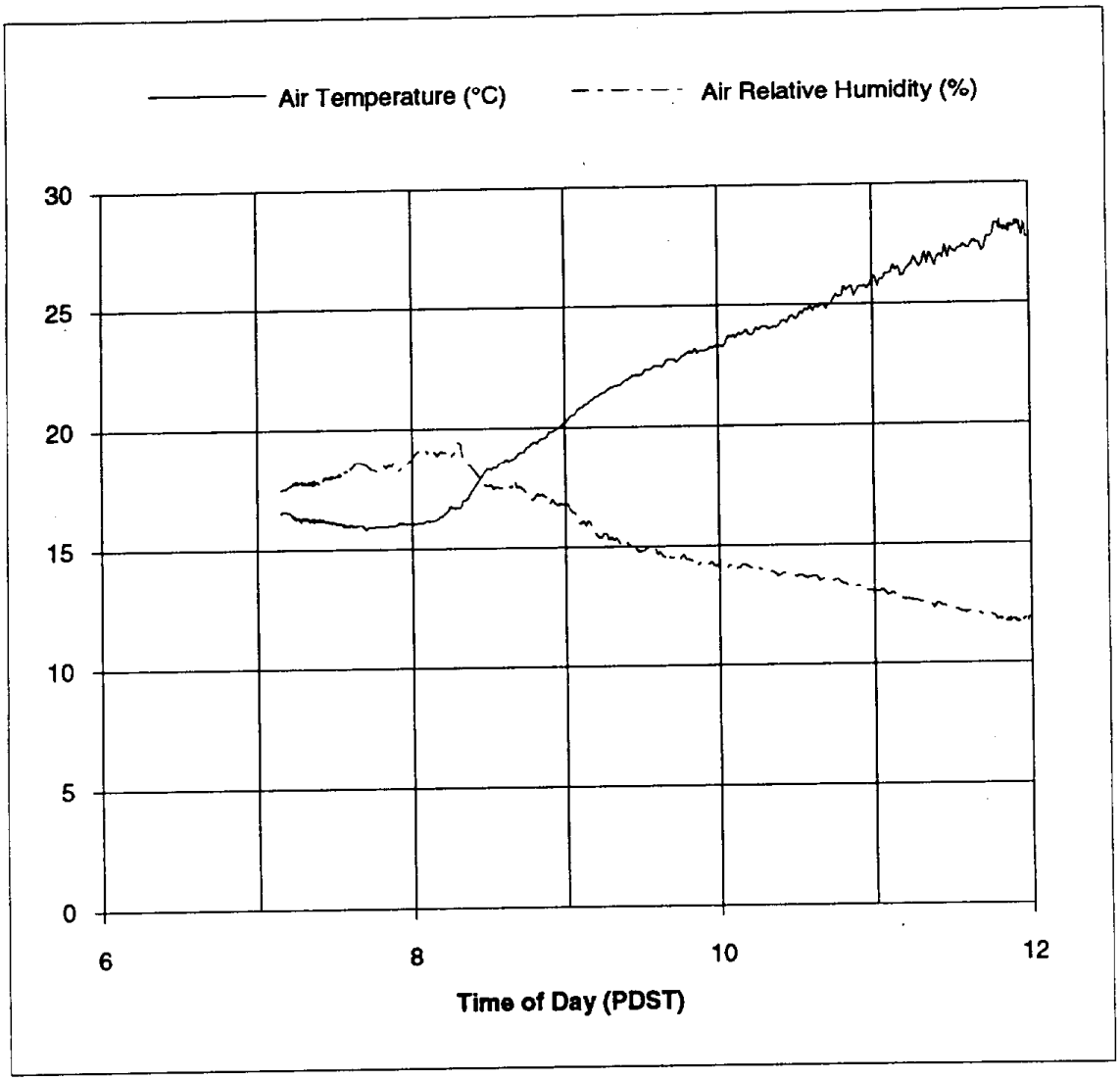

Figure 3.4.1.2. Air temperature and relative humidity from CIMIS station.

Fuel: Corn Stover Date of Test: 7-Oct-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

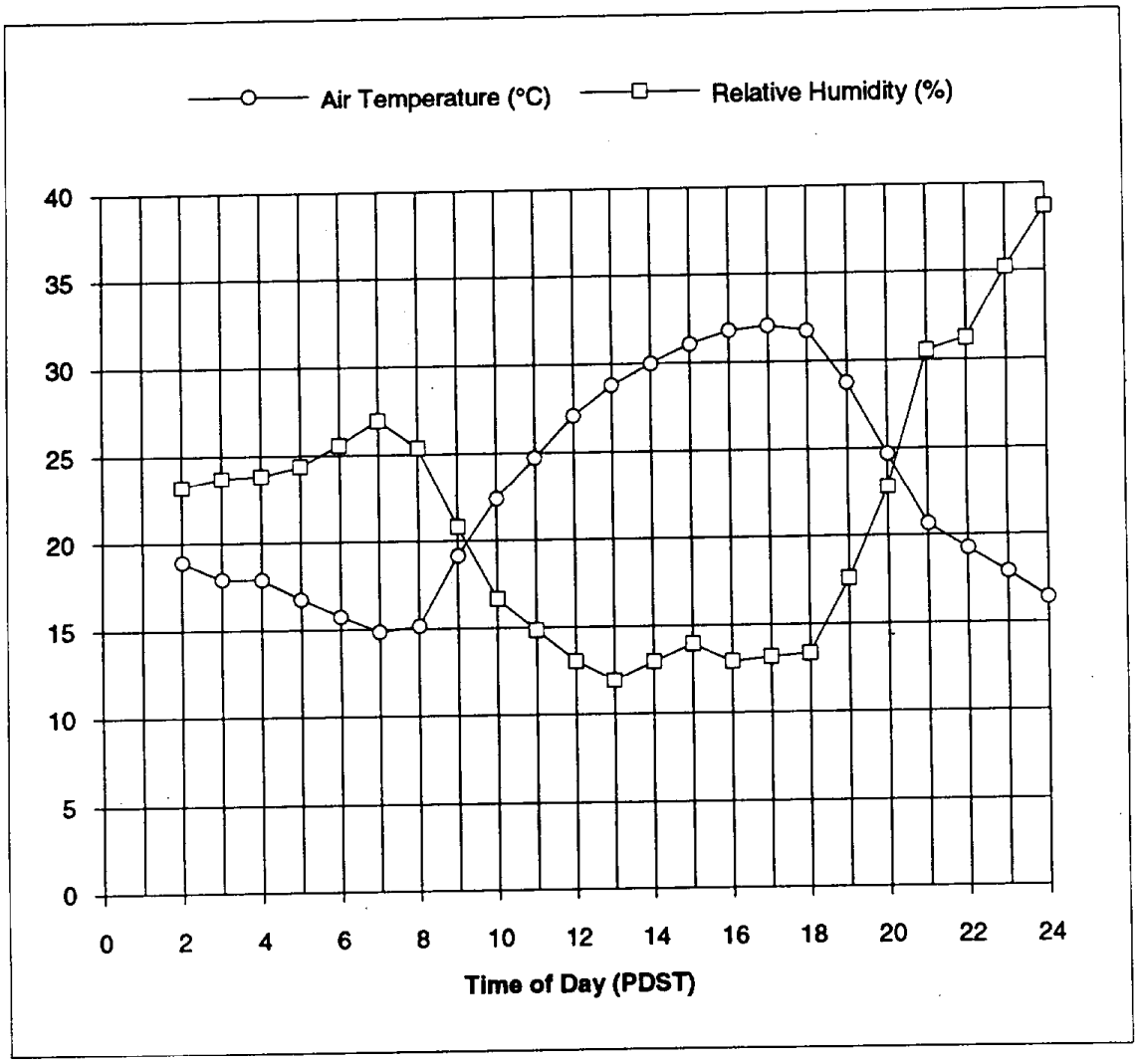

Figure 3.4.1.3. Wind speed from CIMIS station.

Fuel: Corn Stover Date of Test: 7-Oct-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

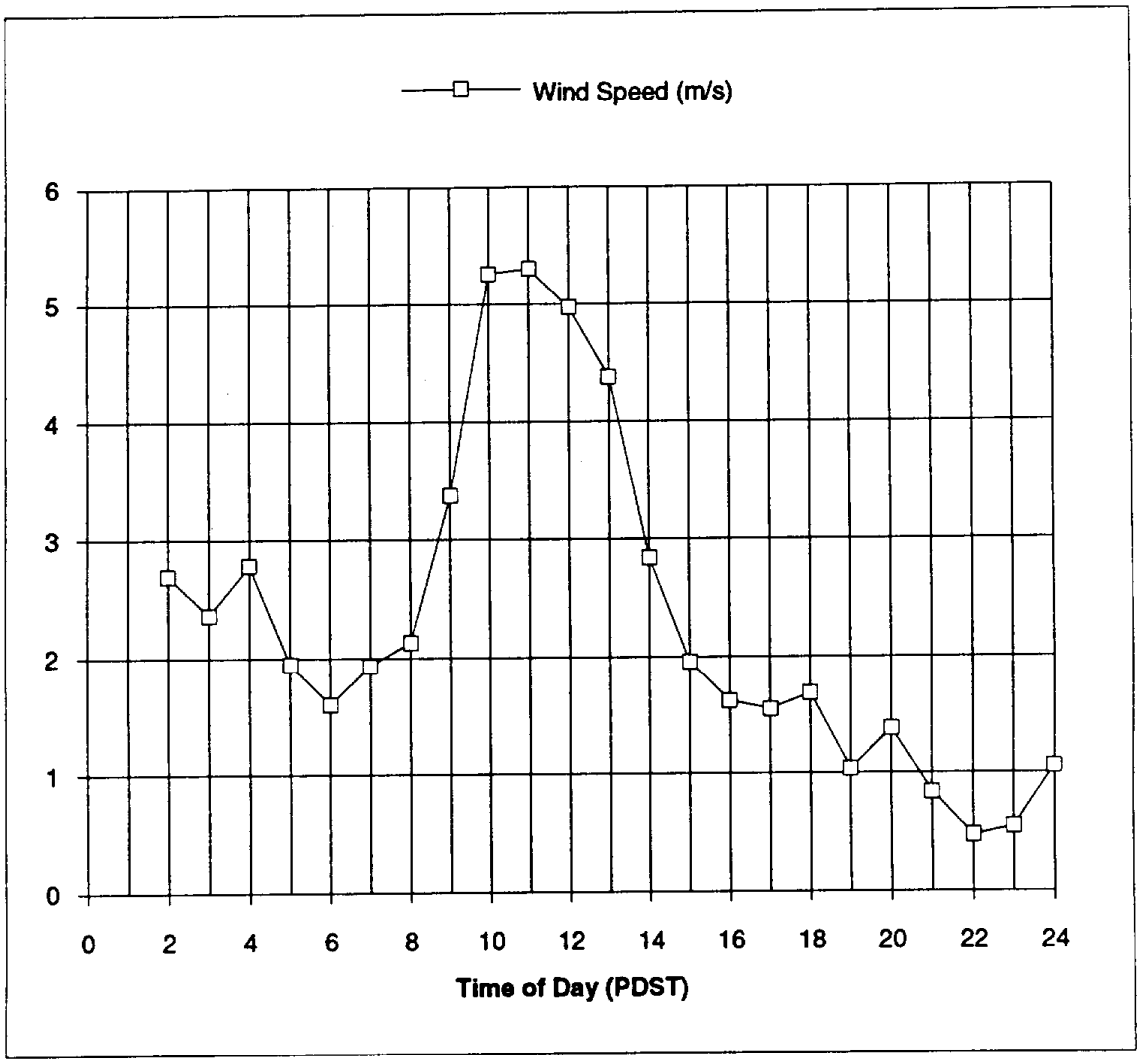

Figure 3.4.1.4. Wind direction and solar radiation from CIMIS station.

Fuel: Corn Stover Date of Test: 7-Oct-92

Configuration: CRNF

Hourly Average CIMIS Data for Davis, California

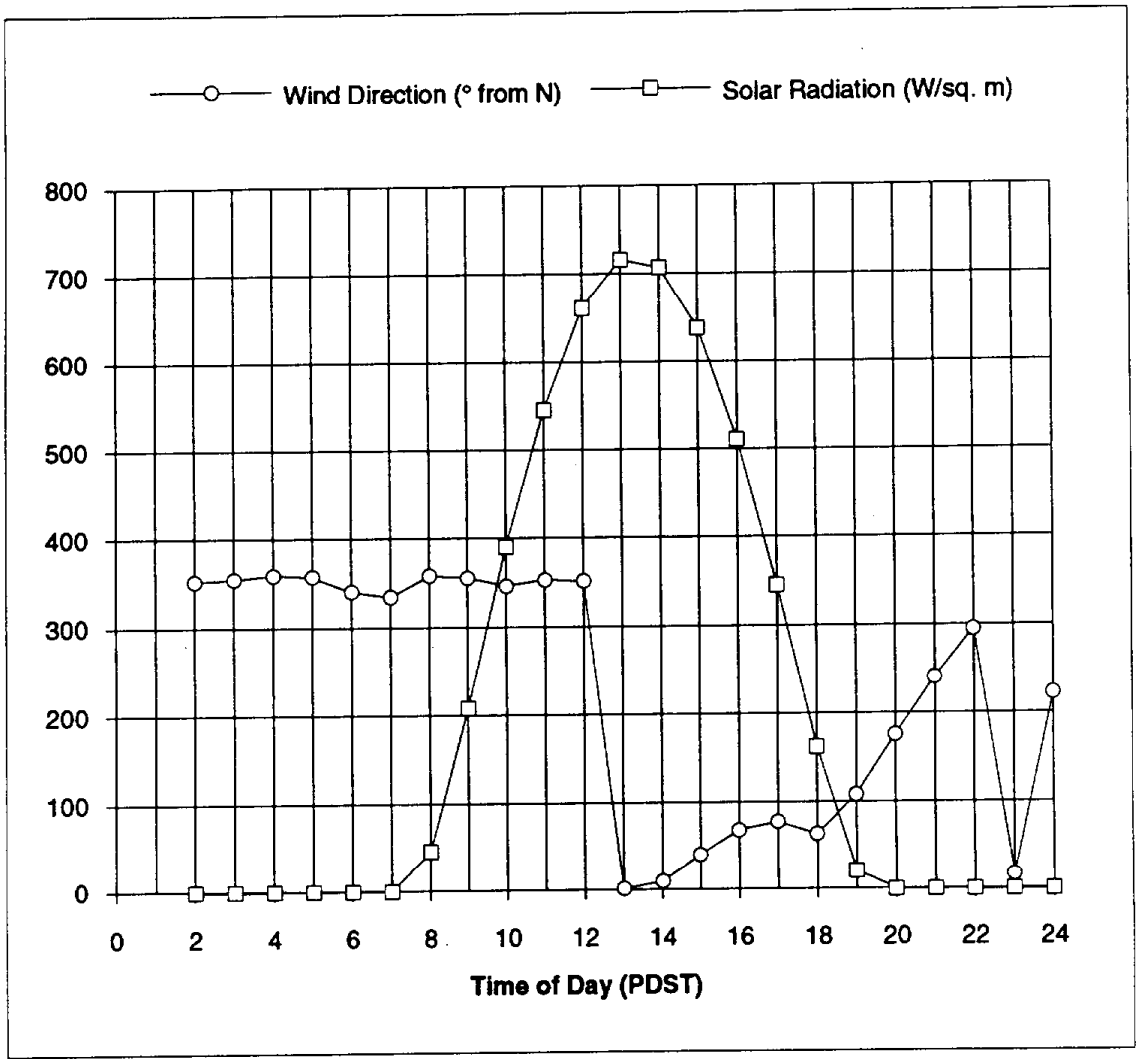

Figure 3.4.1.5. Inlet air, stack gas, and impinger temperatures, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF
Test Date 7-Oct-92

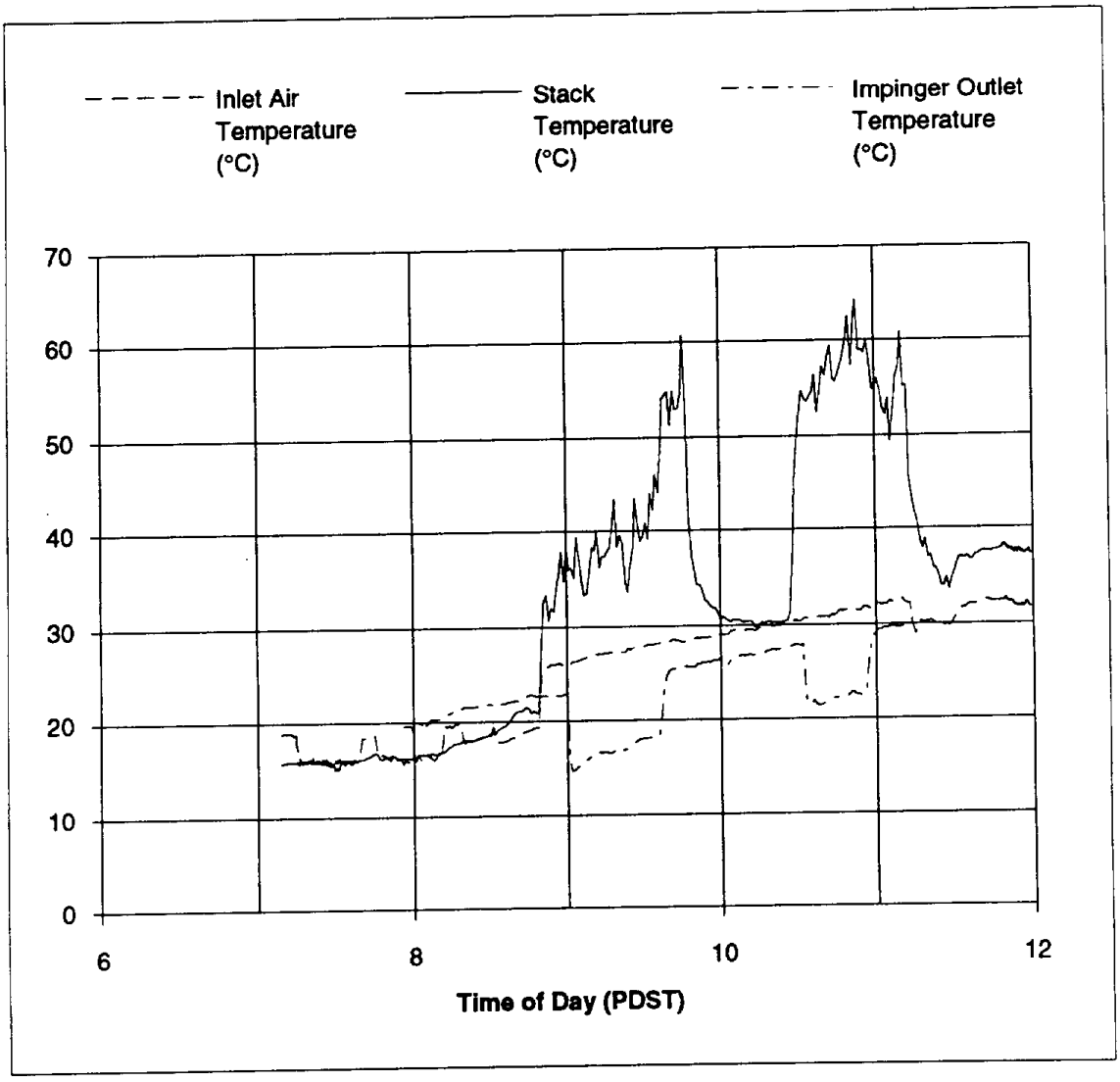

Figure 3.4.1.6. Conveyor speed and stack gas velocity, 7 October 92.

Fuel Type:	Corn Stover	Test Date	7-Oct-92
Configuration:	CRNF		

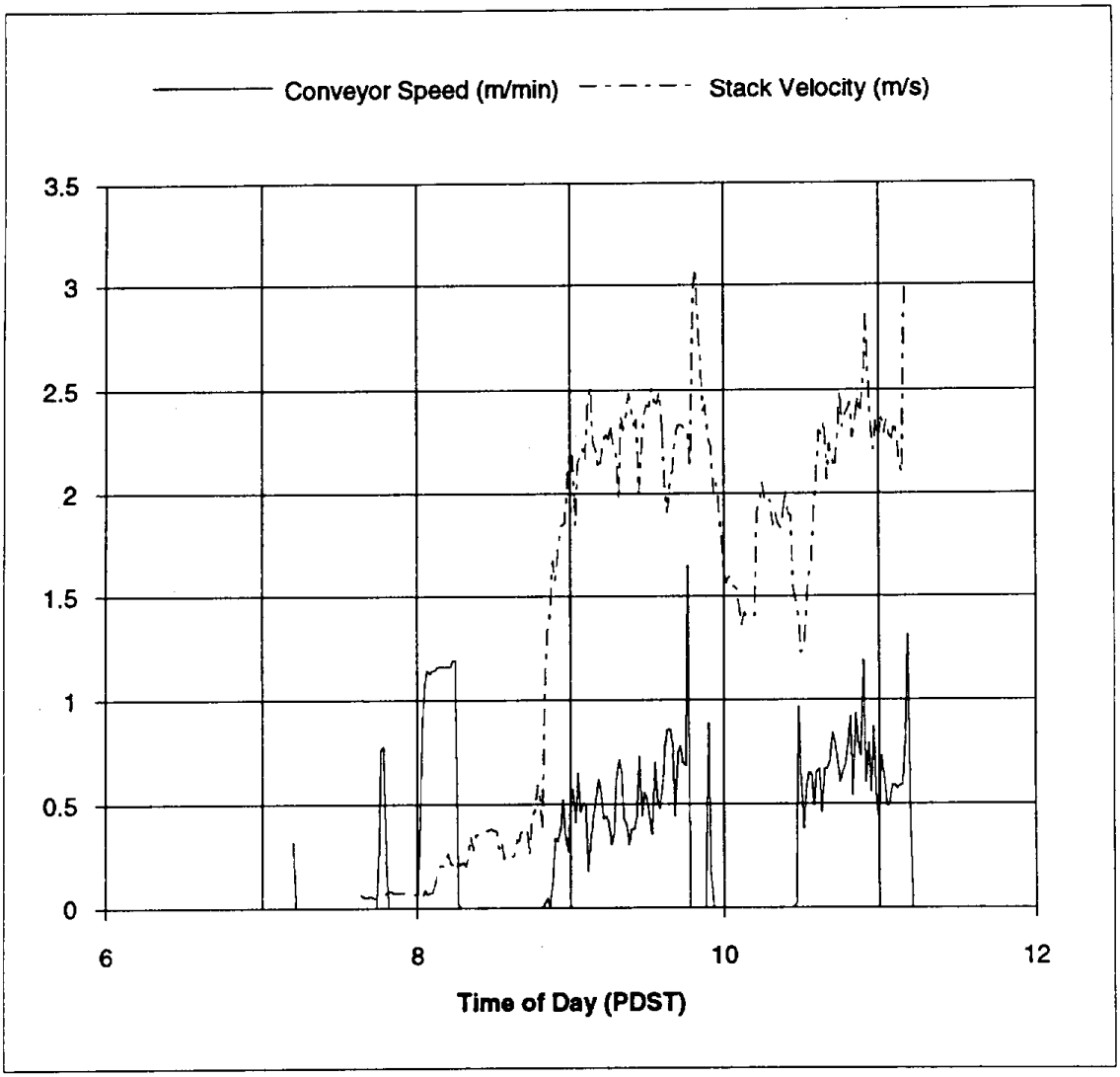

Figure 3.4.1.7. Conveyor speed with 10 min moving average, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

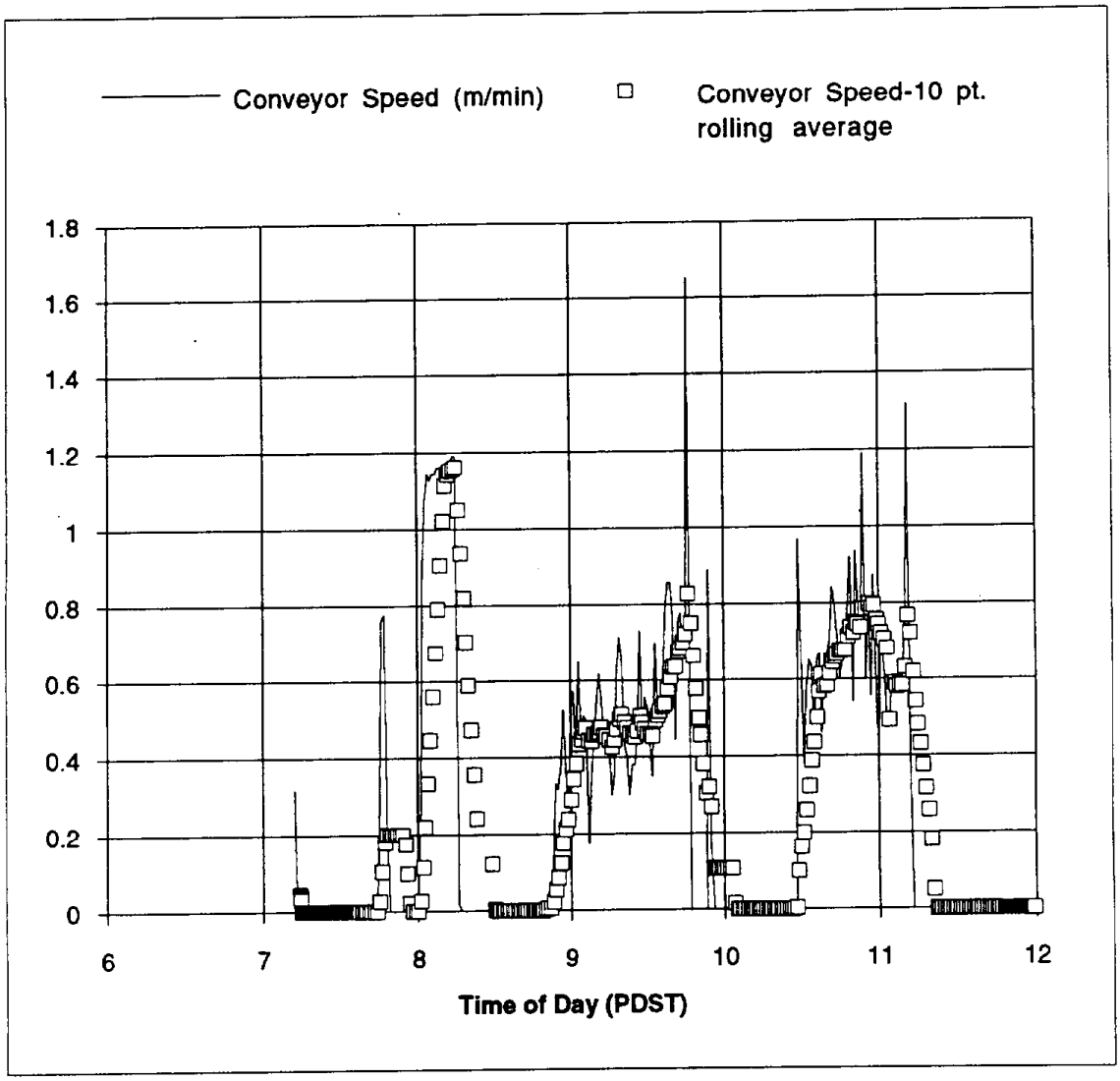

Figure 3.4.1.8. Conveyor travel, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

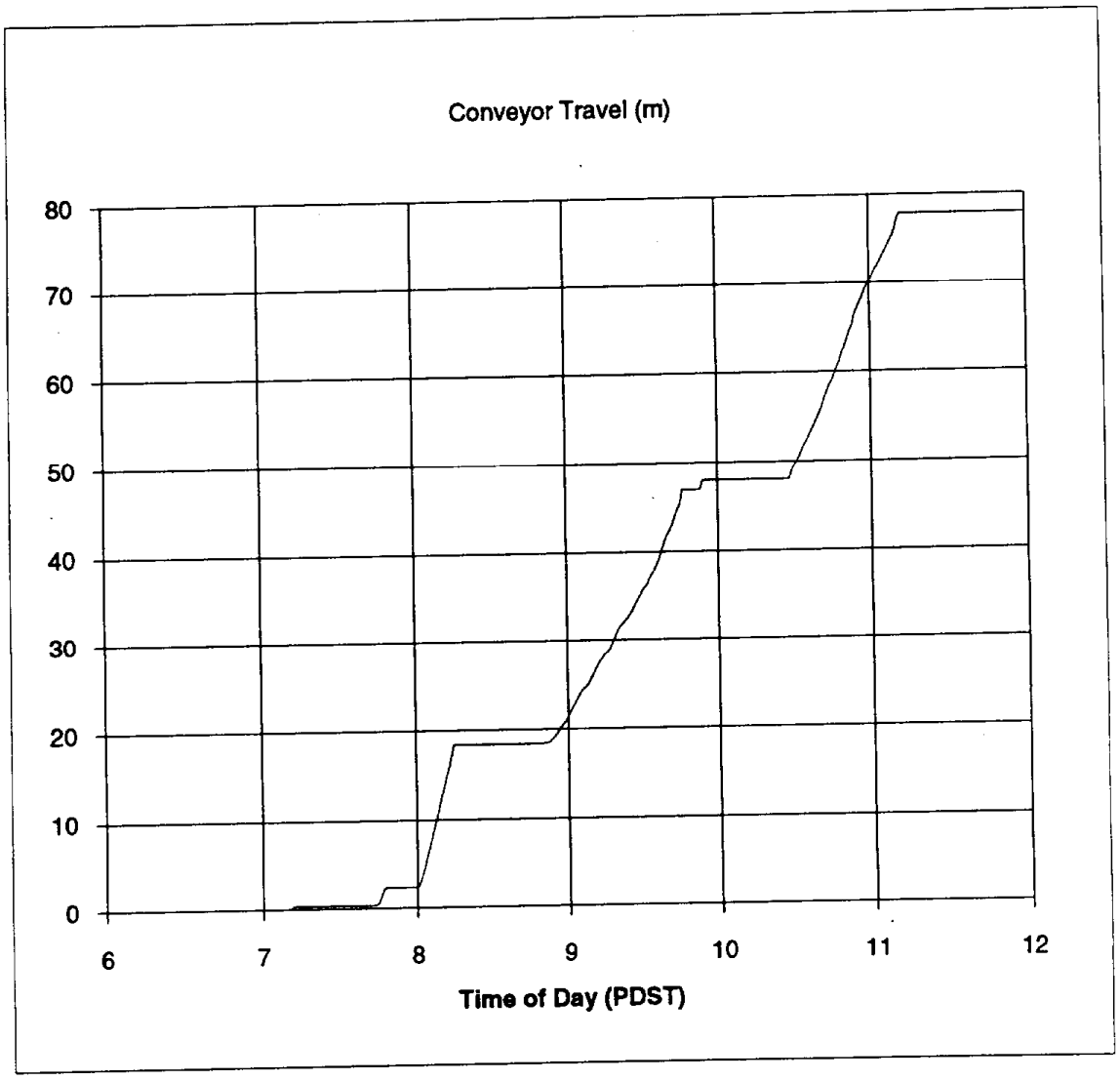

Figure 3.4.1.9. CO concentration in stack gas, 7 October 92.

Fuel Type:
Configuration: Corn Stover
CRNF

Test Date 7-Oct-92

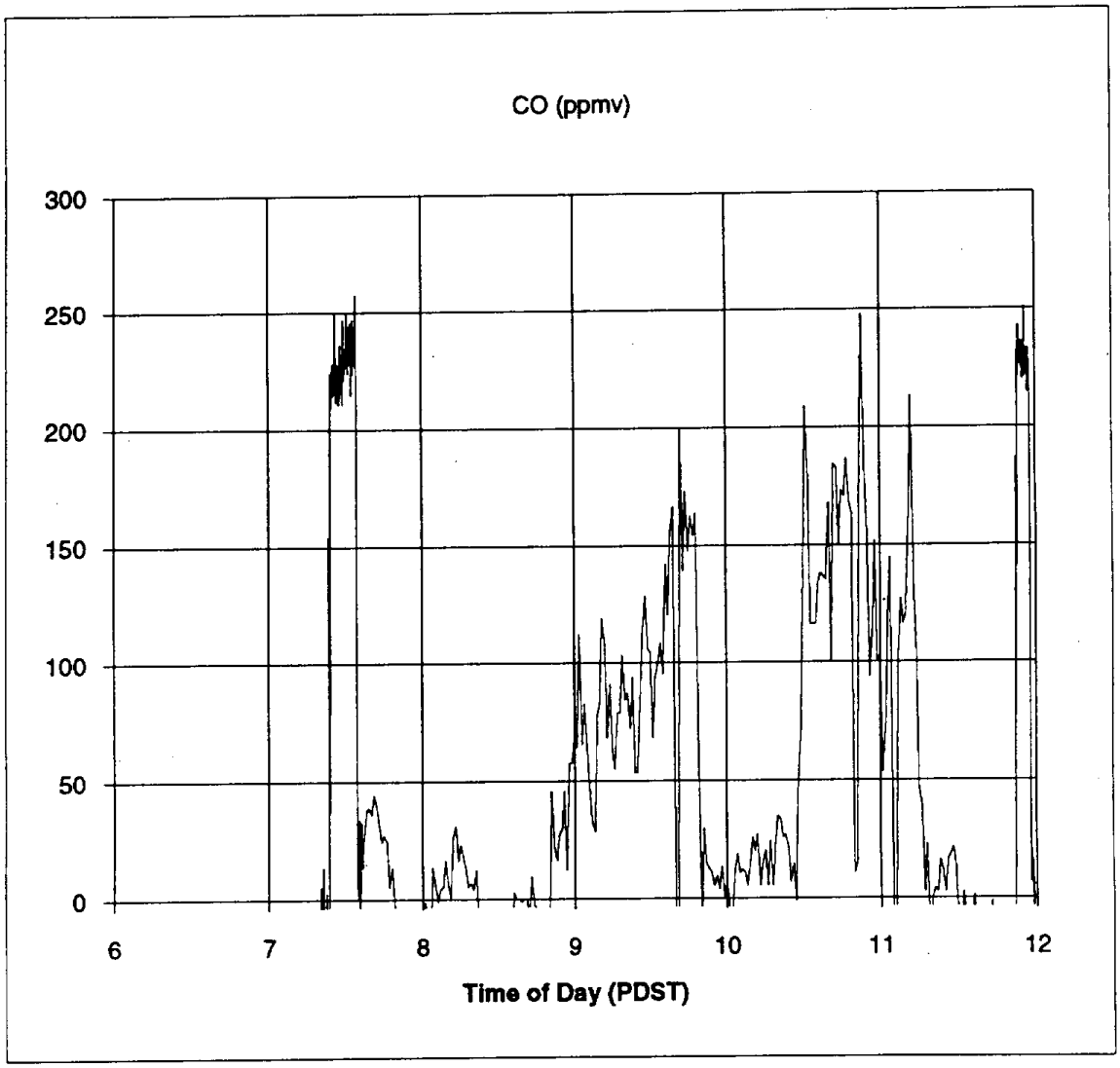

Figure 3.4.1.10. NO and NOx concentrations in stack gas, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF
Test Date 7-Oct-92

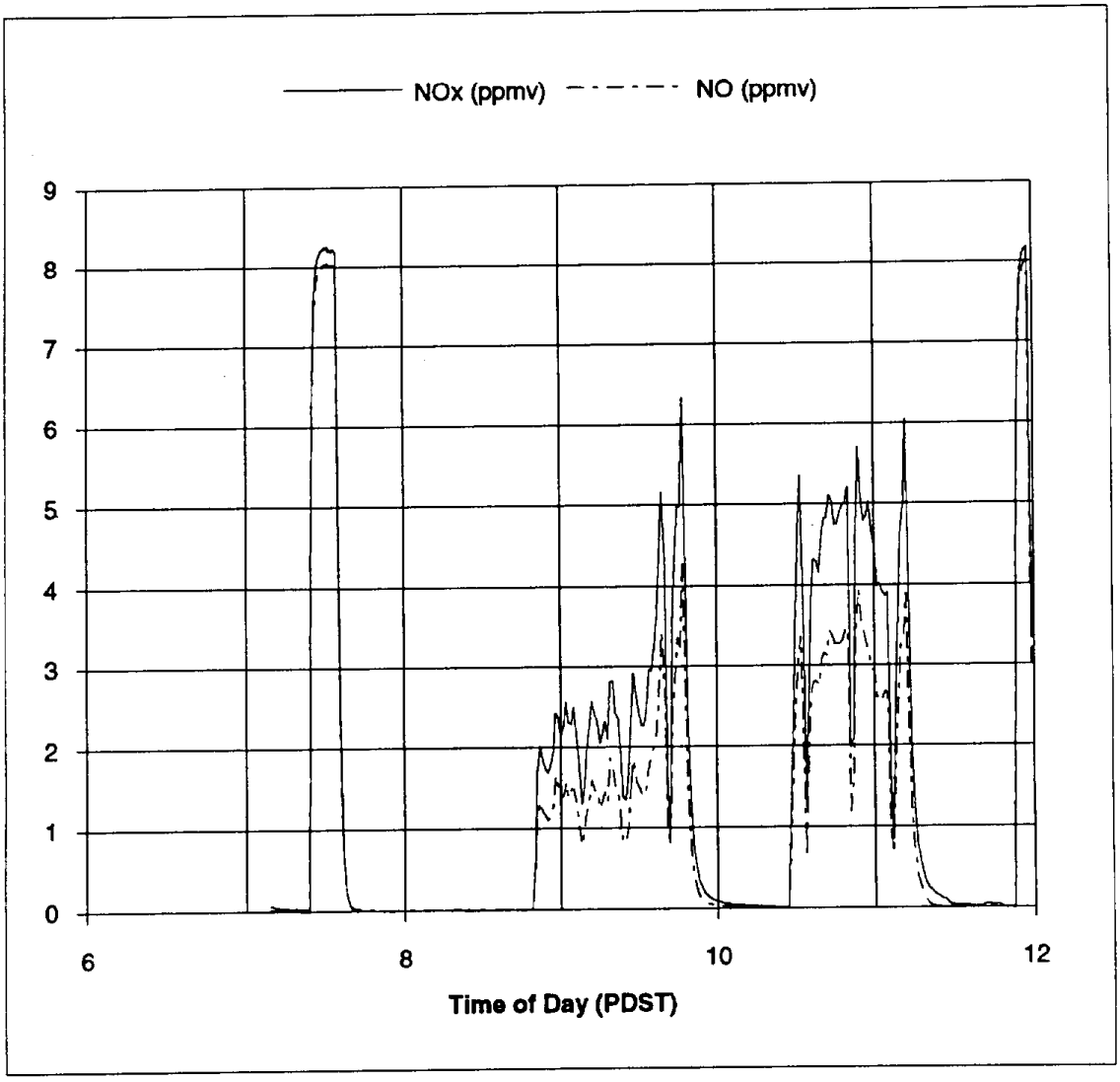

Figure 3.4.1.11. SO2 concentration in stack gas, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

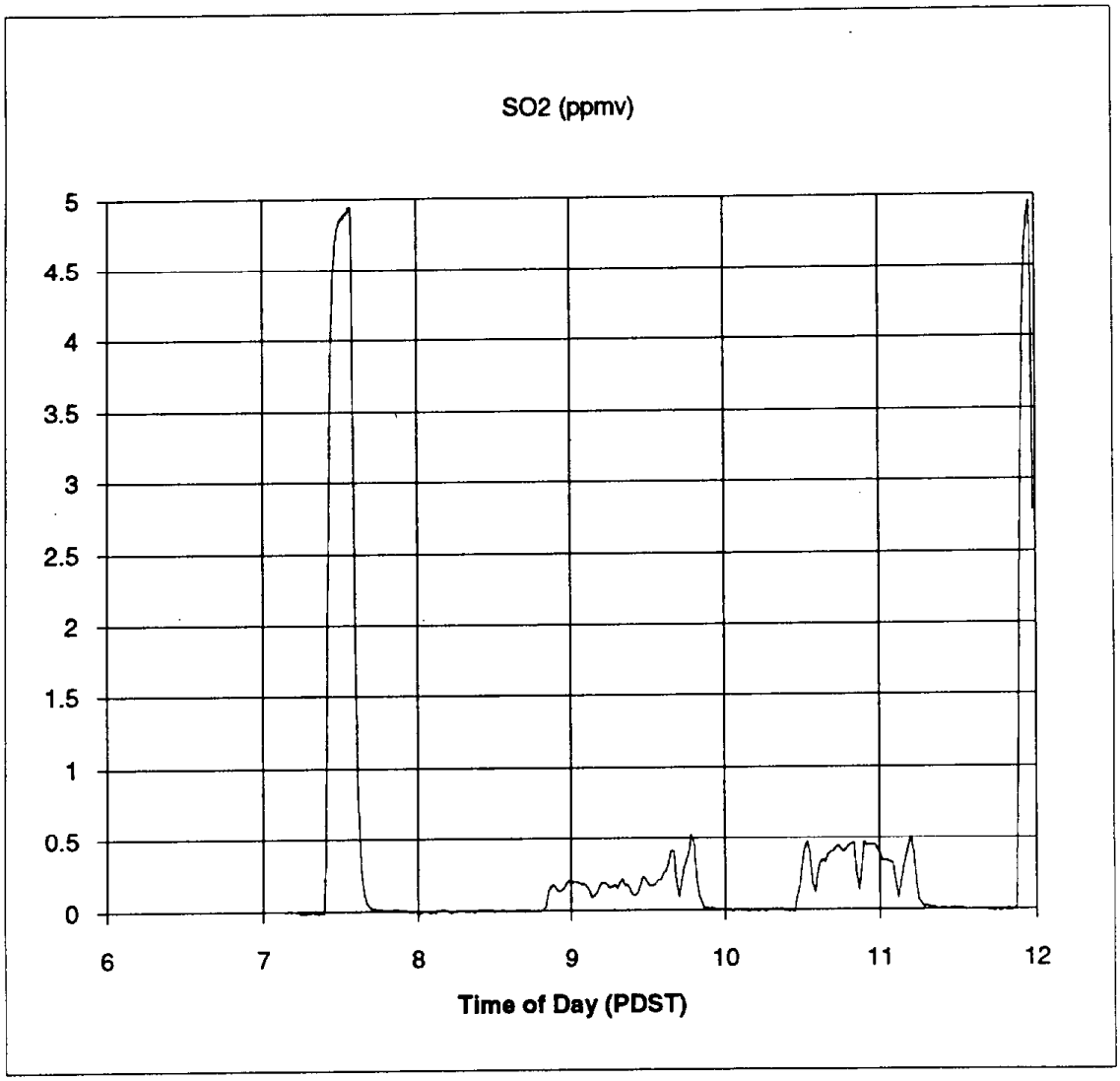

Figure 3.4.1.12. Total sulfur concentration in stack gas, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

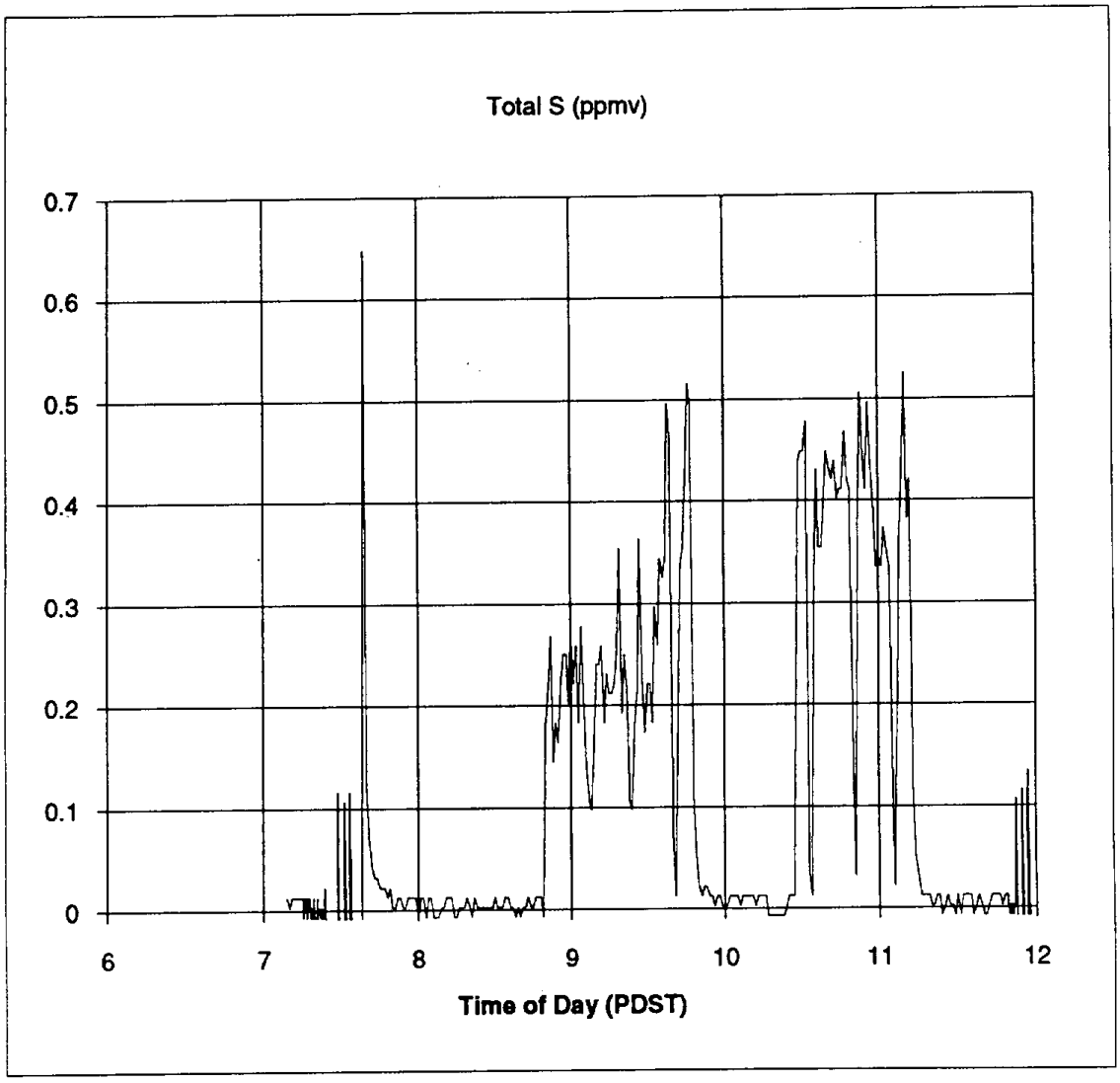

Figure 3.4.1.13. THC concentration in stack gas, 7 October 92.

Fuel Type: Corn Stover
Configuration: CRNF

Test Date 7-Oct-92

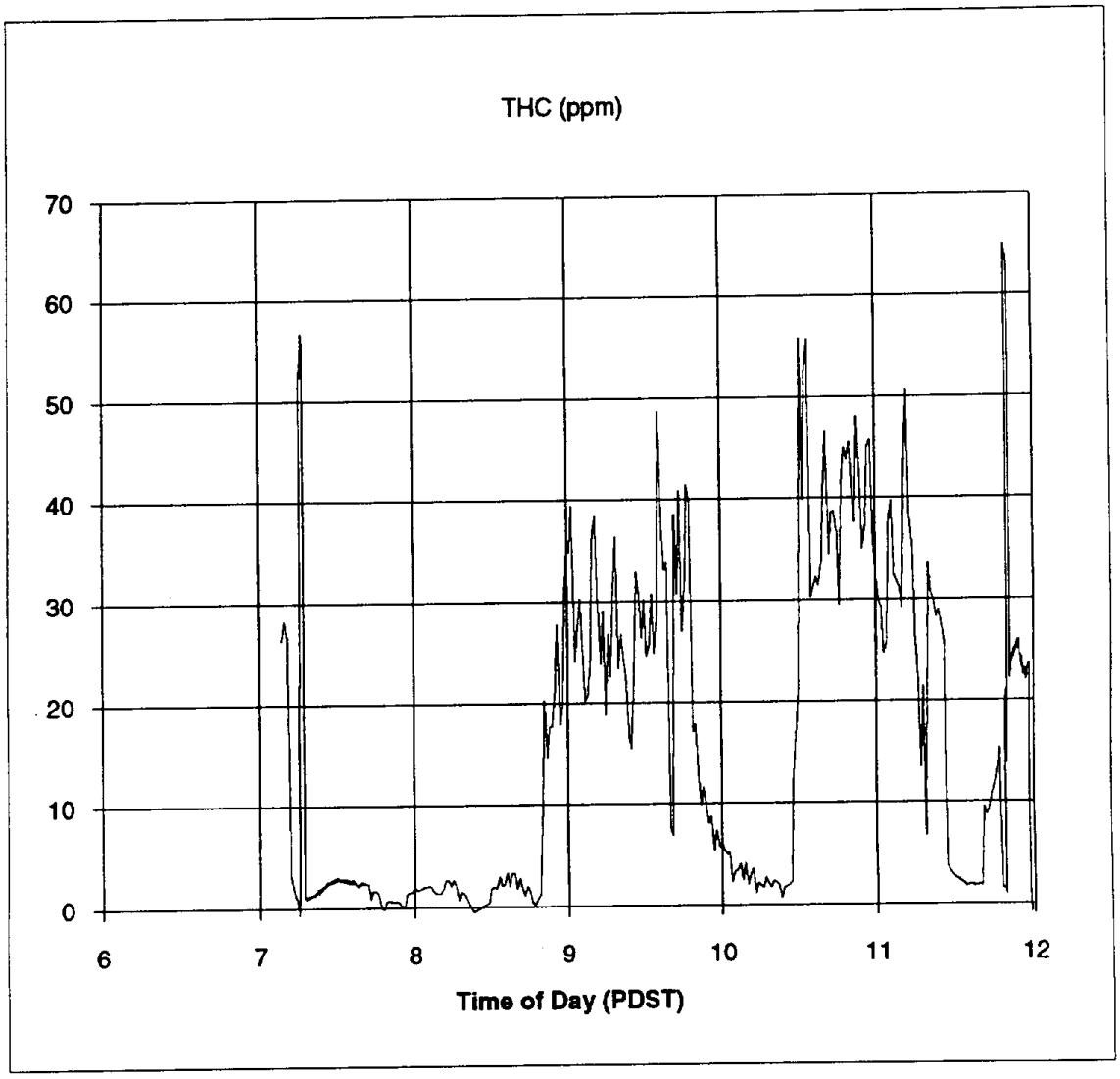

Figure 3.4.1.14. Particle size distribution, traverse 1, 7 October 92.

Fuel: Corn Stover

Date of Test: 7-Oct-92
Configuration: CRNF

Particle Size Distribution
Traverse 1:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.87	0.08	6.00	1.000
2	7.77	0.01	5.92	0.987
3	4.14	0.09	5.91	0.985
4	2.19	0.16	5.82	0.970
5	1.26	0.2	5.66	0.943
6	0.74	0.96	5.46	0.910
7	0.39	0.9	4.50	0.750
filter	0.00	3.6	3.60	0.600

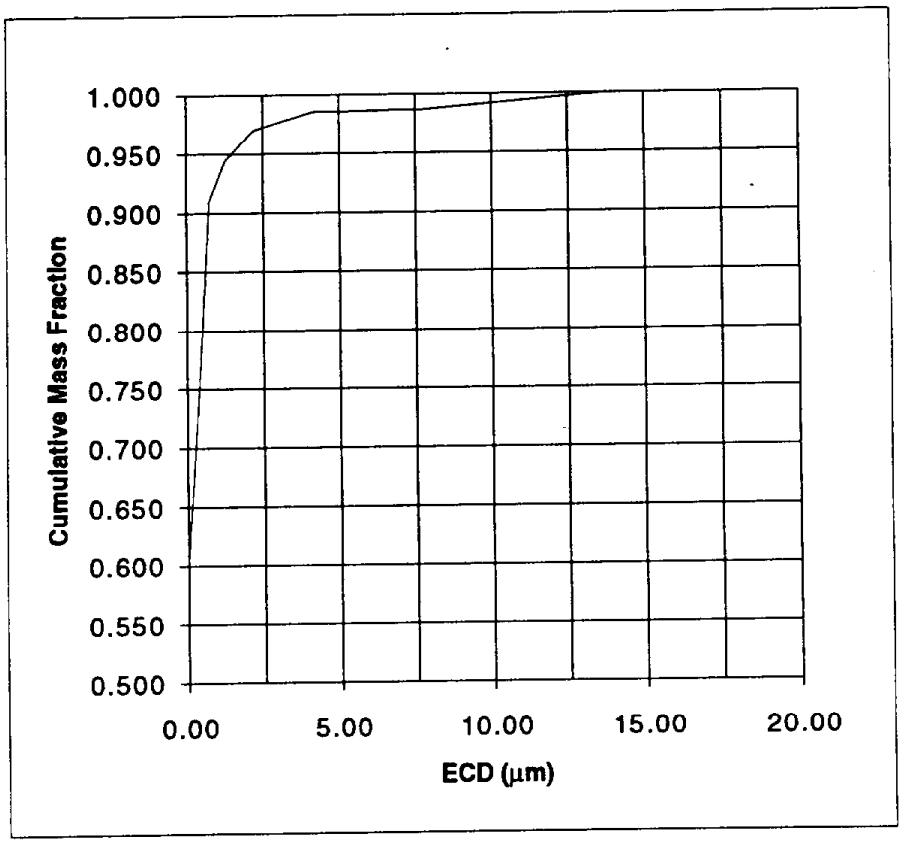

Figure 3.4.1.15. Particle size distribution, traverse 2, 7 October 92.

Fuel: Corn Stover

Date of Test: 7-Oct-92
Configuration: CRNF

Particle Size Distribution
Traverse 2:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.51	0.21	7.84	1.000
2	7.57	0.24	7.63	0.973
3	4.03	0.21	7.39	0.943
4	2.13	0.26	7.18	0.916
5	1.23	0.43	6.92	0.883
6	0.72	0.89	6.49	0.828
7	0.38	0.93	5.60	0.714
filter	0.00	4.67	4.67	0.596

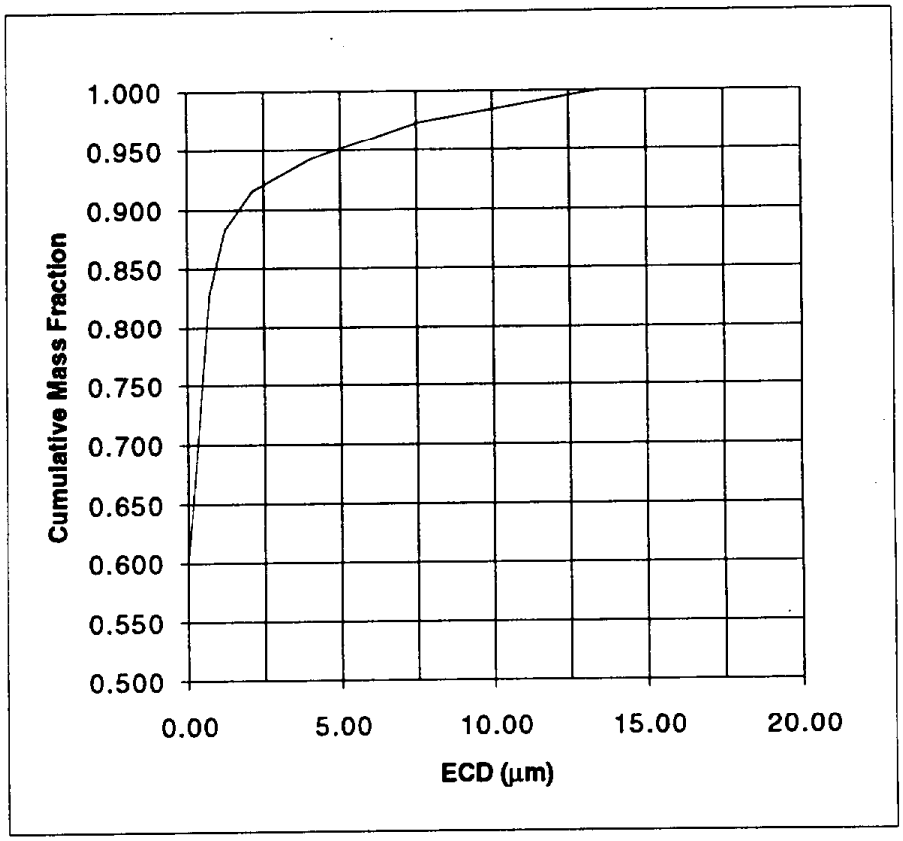

Figure 3.4.1.16. Nitrogen balance.
Date of Test: 7-Oct-92
Fuel Corn Stover

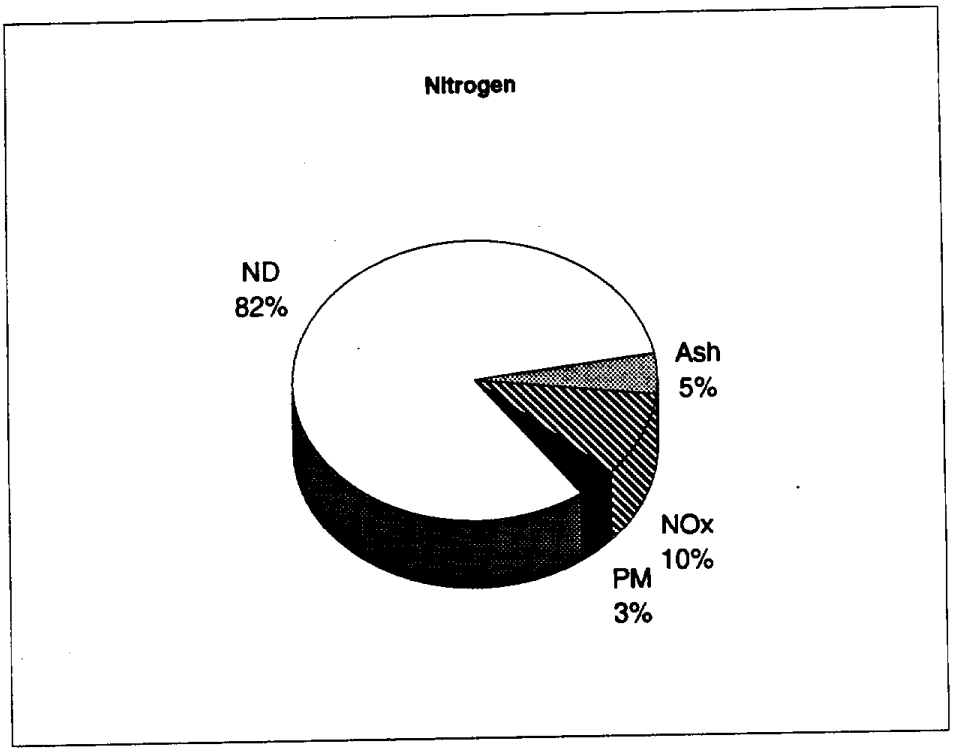

Figure 3.4.1.17. Sulfur balance.
Date of Test: 7-Oct-92
Fuel Corn Stover

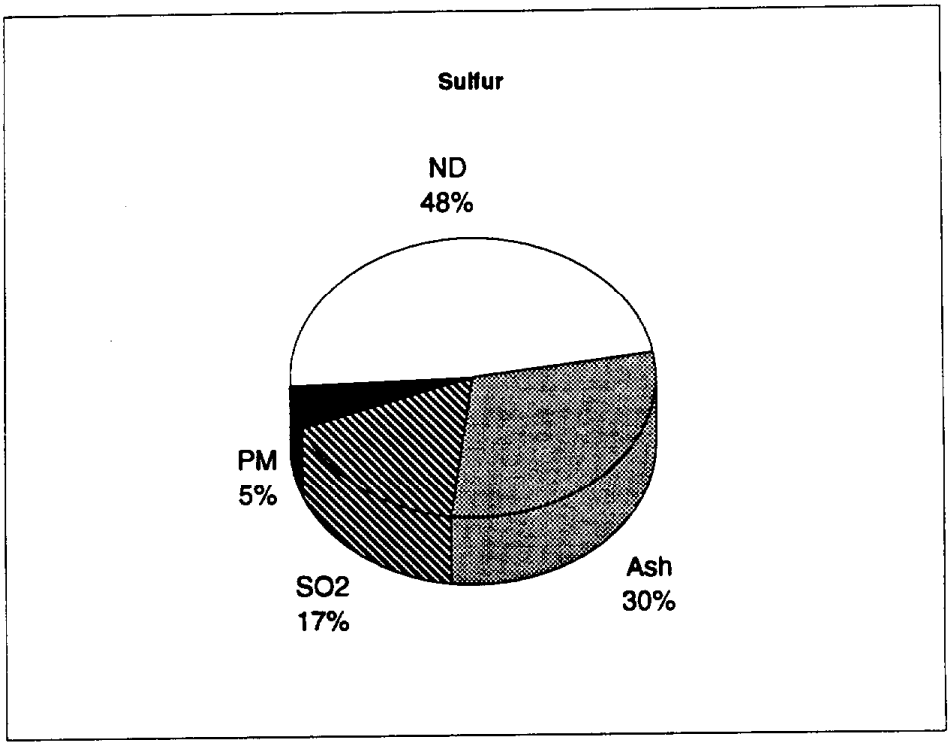

Figure 3.4.1.18. Relative abundance of major elements from DRUM impactor, Corn Stover, 7-Oct-92, (CRNF).

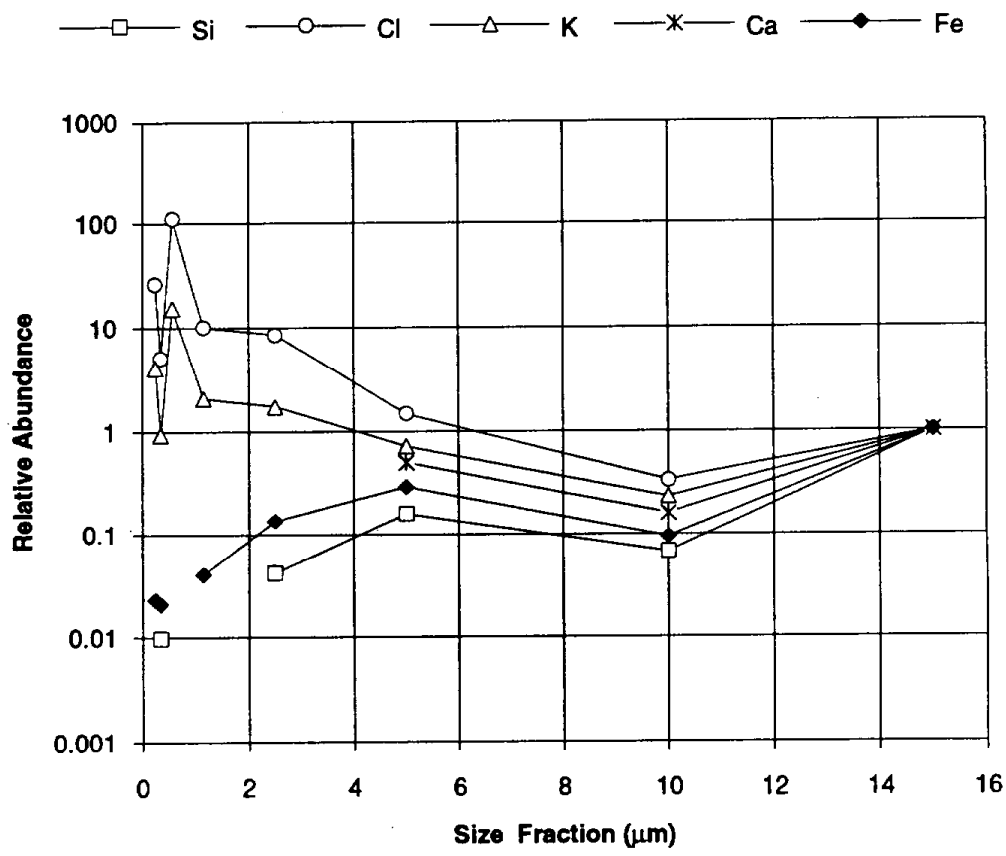

Figure 3.4.1.19. Mass fraction of PAH on primary filter samples, 7 October 1992, corn stover.

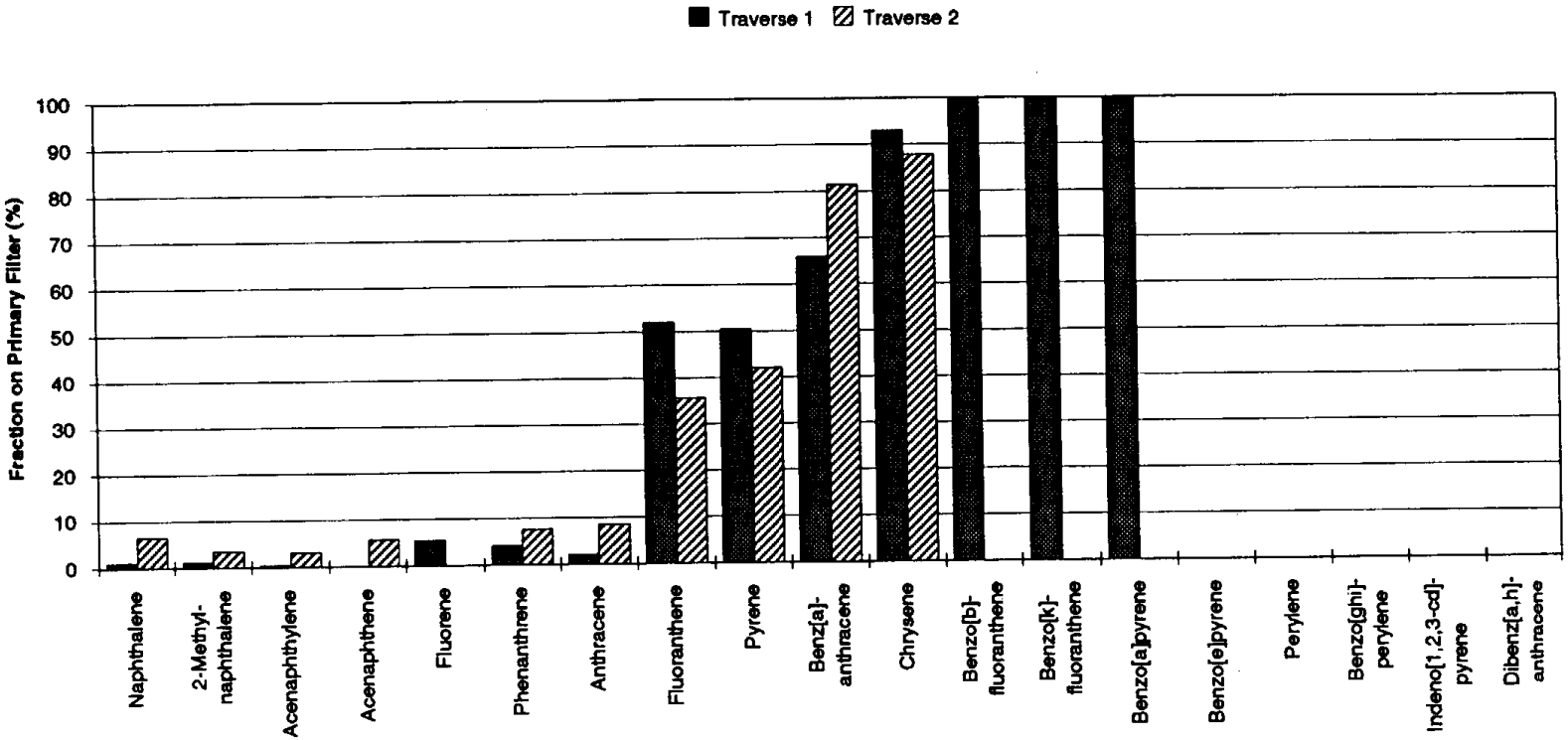

Table 3.4.2.1

Fuel and Ash Analyses

Run Date	9-Oct-92	9-Oct-92
Fuel Type	Corn Stover	Corn Stover
Sample Type	Fuel	Ash
Ultimate Analysis		
(% dry weight)		
C	44.82	9.67
H	5.86	0.75
N	0.47	0.22
Elemental Analysis		
(% by weight dry basis)		
N	0.57	0.29
P	0.06	0.37
K	1.73	16.60
Ca	0.17	1.56
Mg	0.37	4.14
Na	0.01	0.10
Cl	0.35	2.79
(mg/kg dry weight)		
S	571	2,630
B	9	74
Zn	12	82
Mn	48	431
Fe	323	30,800
Cu	4	30
Si		
Total (% dry weight)	54.03	39.67
Proximate Analysis		
(% dry weight)		
Ash	6.11	83.27
Volatiles	77.48	25.06
Fixed Carbon	16.41	-8.33
Higher Heating Value		
(MJ/kg dry weight)	18.0071	1.6016

Table 3.4.2.2. Operating conditions and species concentrations, corn stover, CEWF

Fuel:	Corn Stover	Date of Test:	9-Oct-92
		Configuration:	CEWF

Fuel Loading Rate (g/sq.m w.b.):	1010
Total Fuel Consumption (kg w.b.)	72.6
Total Ash Recovered (kg w.b.)	6.2
Ash Fraction (w.b.)	0.08

	Traverse 1	Traverse 2
Mean Values		
Air Temperature (°C)	19.19	24.30
Air Relative Humidity (%)	28.74	22.26
Inlet Air Temperature (°C)	23.48	28.83
Stack Temperature (°C)	27.97	41.49
Impinger Outlet Temperature (°C)	15.64	22.41
Fire Spreading Rate (m/min)	0.27	0.44
Stack Gas Velocity (m/s)	2.92	2.89
Gas and PM Concentrations (less background)		
CO (ppmv)	28.72	85.55
NO (ppmv)	0.54	1.47
NOx (ppmv)	0.91	2.32
SO2 (ppmv)	0.07	0.19
THC (ppmv as CH4)	13.29	21.75
HC (ppmv as CH4 by GC)	7.97	7.83
CH4 (ppmv)	3.76	4.78
NMHC (ppmv as CH4)	9.53	16.97
NMHC (ppmv as CH4 by GC)	4.21	3.05
CO2 (ppmv by GC)	857	1,282
Total S (ppmv as SO2)	0.08	0.23
PM (mg/cu.m)	14.30	7.98
PM10 (mg/cu.m)	14.09	7.86
PM2.5 (mg/cu.m)	13.66	7.38

Table 3.4.2.3. Mass balance, corn stover, CEWF

Fuel: Corn Stover

Date of Test: 9-Oct-92

Configuration: CEWF

Mass Balance

	Traverse 1	Traverse 2
Total Conveyor Travel (m)	6.45	21.34
Fuel Moisture Content (% w.b.)	9.0	7.3
Fuel Loading Rate (g/sq.m d.b.)	919	936
Total Fuel Consumption (g w.b.)	7,937	26,273
Total Fuel Consumption (g d.b.)	7,222	24,347
Residual Ash (g w.b.)	674	2,231
Fuel Vaporized (g w.b.)	7,263	24,042
Fuel Consumption Rate (g/s w.b.)	5.51	9.12
Fuel Consumption Rate (g/s d.b.)	5.02	8.45
Ash Generation Rate (g/s w.b.)	0.47	0.77
Fuel Vaporization Rate (g/s w.b.)	5.04	8.35
Stack Gas Density (kg/cu.m)	1.1737	1.1233
Stack Gas Flow Rate (cu.m/s)	4.33	4.30
Stack Gas Mass Flow Rate (kg/s)	5.09	4.83
Inlet Air Mass Flow Rate (kg/s)	5.08	4.82
Overall Air-Fuel Ratio (w.b.)	922.02	528.17
Overall Air-Fuel Ratio (d.b.)	1013.21	569.95

Table 3.4.2.4. Emission factors, corn stover, CEWF (integrated basis).

Fuel: Corn Stover | Date of Test: 9-Oct-92 | Configuration: CEWF

Emission Factors (% fuel dry weight)

Integrated Basis

	Traverse 1	Traverse 2	Average
CO	2.781	4.706	3.744
NO	0.055	0.087	0.071
NOx (as NO2)	0.143	0.210	0.177
SO2	0.015	0.023	0.019
THC (as CH4)	0.614	0.616	0.615
HC (as CH4 by GC)	0.446	0.247	0.346
CH4 (by GC)	0.210	0.151	0.180
NMHC (as CH4)	0.404	0.465	0.435
NMHC (as CH4 by GC)	0.236	0.096	0.166
CO2 (by GC)	131.933	111.068	121.500
Total S (as SO2)	0.018	0.028	0.023
SO2/Total S	0.81	0.82	0.82
PM	1.185	0.381	0.783
PM10	1.167	0.375	0.771
PM2.5	1.132	0.352	0.742
MMAD (μm)	0.109	0.202	0.156
σ	3.811	5.701	

Table 3.4.2.5. Emission factors, corn stover, CEWF (average basis)

Fuel: Corn Stover | Date of Test: 9-Oct-92 | Configuration: CEWF

Emission Factors (% fuel dry weight)

Average Basis

	Traverse 1	Traverse 2	Average
CO	2.813	4.716	3.764
NO	0.057	0.087	0.072
NOx (as NO2)	0.146	0.210	0.178
SO2	0.015	0.023	0.019
THC (as CH4)	0.744	0.685	0.714
HC (as CH4 by GC)	0.446	0.247	0.346
CH4 (by GC)	0.210	0.151	0.180
NMHC (as CH4)	0.533	0.535	0.534
NMHC (as CH4 by GC)	0.236	0.096	0.166
CO2 (by GC)	131.933	111.068	121.500
Total S (as SO2)	0.019	0.029	0.024
SO2/Total S	0.80	0.82	0.81
PM	1.185	0.381	0.783
PM10	1.167	0.375	0.771
PM2.5	1.132	0.352	0.742
MMAD (μm)	0.109	0.202	0.156
σ	3.811	5.701	

Table 3.4.2.6. Carbon balance.

Date of Test:	9-Oct-92	9-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Carbon Balance		
Dry Fuel Consumption Rate (g/s)	5.02	8.45
Ash Generation Rate (g/s)	0.47	0.77
Ash Fraction (% dry basis)	9.36	9.11
Fuel Carbon Concentration (%)	44.82	44.82
Residual Ash Carbon Concentration (%)	9.67	9.67
Carbon released to stack (g/s)	2.20	3.71
Maximum CO2 emission factor (%)	161.02	161.11
Stack Gas Density (kg/cubic meter)	1.17	1.12
Average CO2 concentration (ppmv)	857	1,282
Average CO concentration (ppmv)	28.72	85.55
Average THC concentration (ppmv as CH4)	13.29	21.75
PM Concentration (mg/cubic meter)	14.30	7.98
PM Carbon Concentration (%)	49.09	49.09
PM Carbon (mg/cubic meter)	7.02	3.92
Stack Gas Temperature (°C)	27.97	41.49
Impinger Temperature (°C)	15.64	22.41
PM molar concentration (ppm)	13.86	7.92
Estimated Average Stack Gas Velocity (m/s)	3.34	3.85
Emission Factors (% Average Basis):		
CO2	131.933	111.068
CO	2.813	4.716
THC (as CH4)	0.744	0.685
PM	1.185	0.381
Emission Factors (% Integrated Basis):		
CO2	131.933	111.068
CO	2.781	4.706
THC (as CH4)	0.614	0.616
PM	1.185	0.381
Closure (% Average Basis)	87	75
Closure (% Integrated Basis)	86	75

Table 3.4.2.7. Nitrogen balance

Date of Test:	9-Oct-92	9-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Nitrogen Balance		
Fuel Nitrogen Concentration (% dry weight)	0.57	0.57
Ash Nitrogen Concentration (% weight)	0.29	0.29
Emission Factors (% Average Basis):		
NOx (as NO2)	0.146	0.210
PM	1.185	0.381
Emission Factors (% Integrated Basis):		
NOx (as NO2)	0.143	0.210
NO3- Concentration of PM (% weight)	0.309	0.309
NH4+ Concentration of PM (% weight)	6.601	6.601
Nitrogen Concentration of PM (%)	5.204	5.204
Fuel Nitrogen (mg/s)	28.61	48.17
Ash Nitrogen (mg/s)	1.36	2.23
Nitrogen as NOx (mg/s Average Basis)	2.23	5.40
Nitrogen as NOx (mg/s Integrated Basis)	2.18	5.40
Nitrogen as PM (mg/s Average Basis)	3.10	1.68
Nitrogen as NOx+PM (mg/s Average Basis)	5.33	7.08
Nitrogen as NOx+PM (mg/s Integrated Basis)	5.28	7.08
NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.186	0.147
NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.185	0.147
Ash Nitrogen/Fuel Nitrogen	0.048	0.046
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Average)	0.234	0.193
Ash+NOx+PM Nitrogen/Fuel Nitrogen (Integrated)	0.232	0.193

Table 3.4.2.8. Sulfur balance.

Date of Test:	9-Oct-92	9-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Sulfur Balance		
Fuel Sulfur Concentration (mg/kg dry weight)	571	571
Ash Sulfur Concentration (mg/kg weight)	2,630	2,630
Emission Factors (% Average Basis)		
SO2	0.015	0.023
PM	1.185	0.381
Emission Factors (% Integrated Basis)		
SO2	0.015	0.023
Sulfur Concentration of PM (% weight)	0.593	0.593
Fuel Sulfur (mg/s)	2.87	4.82
Ash Sulfur (mg/s)	1.24	2.03
Sulfur as SO2 (mg/s Average Basis)	0.38	0.97
Sulfur as SO2 (mg/s Integrated Basis)	0.38	0.97
Sulfur as PM (mg/s Average Basis)	0.35	0.19
Sulfur as SO2+PM (mg/s Average Basis)	0.73	1.16
Sulfur as SO2+PM (mg/s Integrated Basis)	0.73	1.16
SO2+PM Sulfur/Fuel Sulfur (Average Basis)	0.254	0.241
SO2+PM Sulfur/Fuel Sulfur (Integrated Basis)	0.254	0.241
Ash Sulfur/Fuel Sulfur	0.431	0.420
Closure (% Average Basis)	69	66
Closure (% Integrated Basis)	69	66

Table 3.4.2.9. Water balance.

Estimated Stack Humidity

Fuel	Corn Stover
Configuration	CEWF
Date of Test	9-Oct-92

	Traverse 1	Traverse 2
Ambient Air Temperature °C)	19	24
Ambient Air Relative Humidity (%)	29	22
Air Temperature (K)	292	297
Saturation Pressure (Pa)	2,224	3,039
Vapor Pressure (Pa)	639	677
Air Dew Point Temperature (°C)	0.6	1.4
Ambient Volume Fraction Water Vapor	0.0063	0.0067
Ambient Mass Fraction Water Vapor	0.0039	0.0041
Fuel Burning Rate (g/s wet basis)	5.51	9.12
Fuel Moisture Content (%)	9.0	7.3
Ash Fraction (wet basis)	0.08	0.08
Fuel Hydrogen Content (%)	5.86	5.86
Ash Hydrogen Content (%)	0.75	0.75
Moisture Evaporated (g/s)	0.50	0.67
Water of Combustion (g/s)	2.61	4.41
Total Fuel Water Added (g/s)	3.11	5.08
Inlet Air Mass Flowrate (g/s)	5,080	4,820
Inlet Air Water Vapor Flowrate (g/s)	20	20
Total Stack Water Vapor Flowrate (g/s)	23	25
Stack Gas Mass Flowrate (g/s)	5,085	4,828
Mass Fraction Water Vapor in Stack	0.0045	0.0052
Volume Fraction Water Vapor in Stack	0.0073	0.0084
Stack Vapor Pressure (Pa)	738	847
Stack Temperature (°C)	28	41
Stack Temperature (K)	301	315
Stack Saturation Pressure (Pa)	3,776	7,991
Stack Relative Humidity (%)	20	11
Stack Dew Point Temperature (°C)	2.6	4.6
Impinger Outlet Temperature (°C)	15.6	22.4
Volume Stack Gas Sampled for PM (L)	292	593
Estimated Impinger/Desiccant Weight Gain (g)	1.6	3.7

Totals:

	Estimated	Measured
Total Impinger/Desiccant Weight Gain (g)	5.3	7.8
Estimated/Measured Weight Gain	0.68	

Table 3.4.2.10. Power balance.

Date of Test:	9-Oct-92	9-Oct-92
Fuel	Corn Stover Traverse 1	Corn Stover Traverse 2
Power Balance		
Fuel Heating Value (MJ/kg dry weight)	18.0071	18.0071
Ash Heating Value (MJ/kg dry weight)	1.6016	1.6016
Average Energy Release Rate (kW)	89.6	150.9
Products of Incomplete Combustion (kW)		
CO	1.4	4.0
THC (as CH4)	2.1	3.2
PM	1.0	0.5
Heat Release Rate (kW)	85.2	143.2
Fireline Intensity (kW/m)	69.9	117.4
Stack Gas Flow (kg/s)	5.09	4.83
Stack Gas Temperature (°C)	27.97	41.49
Inlet Temperature (°C)	23.48	28.83
Sensible Power at Top of Stack (kW)	23.0	61.5
Tunnel Dissipation (kW)	62.2	81.6

Table 3.4.2.11. Mass concentrations (%) from DRI filter samples.

Date	9-Oct-92		9-Oct-92	
Fuel	Corn Stover CEWF		Corn Stover CEWF	
Size Fraction	PM2.5		PM10	
Teflon Filter ID	ABTT038		ABTT039	
Quartz Filter ID	ABTQ038		ABTQ039	
Teflon Field Sample Flag				
Quartz field sample field	H			
Teflon mass sample flag				
Quartz mass sample flag				
Anions sample flag				
Ammonium analysis flag				
Sodium ion analysis flag				
Magnesium ion analysis flag				
Potassium ion analysis flag				
Carbon analysis flag				
XRF analysis flag				
		±Uncertainty		±Uncertainty
Teflon sample volume (m^3)	0.36	0.02	0.36	0.02
Quartz sample volume (m^3)	0.36	0.02	0.36	0.02
Teflon mass concentration (µg/m^3)	6.017	304	6.311	318

	Concentration (%)	±Uncertainty	Concentration (%)	±Uncertainty	PM2.5/PM10
Cl-	25.1258	2.0777	27.0169	2.2332	0.93
NO3-	0.2881	0.0385	0.3090	0.0381	0.93
SO4=	1.7060	0.1282	1.8298	0.1370	0.93
NH4+	6.0707	0.4899	6.6008	0.5185	0.92
Na+	0.0581	0.0145	0.0361	0.0133	1.61
K+	12.1229	0.9148	13.2363	0.9984	0.92
C(org)	34.6425	3.3766	38.7921	3.7638	0.89
C(oht)	29.7957	4.5747	35.6063	5.4386	0.84
C(e)	9.2659	0.8807	10.2949	0.9752	0.90
C(eht)	0.7710	0.4731	0.1056	0.0867	7.30
C	43.9084		49.0870		0.89
Al	0.0615	0.0981	0.1100	0.0331	0.56
Si	0.0776	0.1282	0.2433	0.0496	0.32
P	0.0138	0.2373	0.0207	0.2286	0.67
S	0.5894	0.1157	0.5934	0.1120	0.99
Cl	22.0710	1.5700	21.2497	1.5109	1.04
K	12.2687	0.8725	12.0203	0.8544	1.02
Ca	0.0384	0.1760	0.1027	0.1726	0.37
Ti	0.0026	0.0305	0.0057	0.0299	0.46
V	0.0012	0.0133	0.0012	0.0130	1.00
Cr	0.0013	0.0029	0.0013	0.0029	1.00
Mn	0.0039	0.0014	0.0073	0.0015	0.53
Fe	0.0096	0.0054	0.0749	0.0075	0.13
Co	0.0004	0.0012	0.0000	0.0018	
Ni	0.0001	0.0013	0.0003	0.0013	0.33
Cu	0.0007	0.0014	0.0012	0.0010	0.58
Zn	0.0128	0.0014	0.0131	0.0014	0.98
Ga	0.0005	0.0024	0.0000	0.0024	
As	0.0004	0.0028	0.0004	0.0028	1.00
Se	0.0002	0.0015	0.0007	0.0016	0.29
Br	0.0642	0.0048	0.0624	0.0046	1.03
Rb	0.0039	0.0012	0.0047	0.0012	0.83
Sr	0.0006	0.0014	0.0017	0.0010	0.35
Y	0.0011	0.0018	0.0003	0.0018	3.67
Zr	0.0011	0.0021	0.0003	0.0021	3.67
Mo	0.0020	0.0036	0.0000	0.0036	
Pd	0.0006	0.0143	0.0038	0.0140	0.16
Ag	0.0008	0.0164	0.0033	0.0158	0.24
Cd	0.0014	0.0172	0.0000	0.0169	
In	0.0000	0.0193	0.0000	0.0189	
Sn	0.0000	0.0242	0.0005	0.0235	0.00
Sb	0.0042	0.0272	0.0026	0.0264	1.62
Ba	0.0035	0.0923	0.0179	0.0898	0.20
La	0.0220	0.1228	0.0000	0.1196	
Au	0.0000	0.0040	0.0000	0.0041	
Hg	0.0007	0.0033	0.0002	0.0033	3.50
Tl	0.0011	0.0032	0.0000	0.0032	
Pb	0.0000	0.0041	0.0000	0.0041	
U	0.0013	0.0034	0.0000	0.0034	
Sum of measured species	85.5876	3.9748	90.5765	4.3040	0.94

Table 3.4.2.12. Element ratios from DRI filter samples.

Date	9-Oct-92	9-Oct-92	
Fuel	Corn Stover	Corn Stover	
Configuration	CEWF	CEWF	
Size Fraction	PM2.5	PM10	PM2.5/PM10
Teflon Filter ID	ABTT038	ABTT039	
Quartz Filter ID	ABTQ038	ABTQ039	
Cl-/Cl	1.14	1.27	0.90
K+/K	0.99	1.10	0.90
Sulfate S/Total S	0.96	1.03	0.94
C(org)/C	0.79	0.79	1.00
Cl/K	1.80	1.77	1.02
Cl-/K+	2.07	2.04	1.02
Cl-/Na+	432.46	748.39	0.58
S/K	0.05	0.05	0.97
S/Na+	10.14	16.44	0.62
Al/Si	0.79	0.45	1.75

Table 3.4.2.13. Emission factors (mg/kg) from DRI filter samples.

Date	9-Oct-92		9-Oct-92		
Fuel	Corn Stover CEWF		Corn Stover CEWF		
Size Fraction	PM2.5		PM10		
Teflon Filter ID	ABTT038		ABTT039		
Quartz Filter ID	ABTQ038		ABTQ039		
Start Time	9:39				
Stop Time	10:15				
Start Time					
End Time					
Elapsed Time (minutes)	36				Traverse 2
PM (mg/m^3 by total filter)					10.010
PM10 (by total filter/impactor)					9.860
PM2.5 (by total filter/impactor)					9.260
PM emission factor (%)					0.381
PM10 emission factor (%)					0.375
PM2.5 emission factor (%)					0.352
		±Uncertainty		±Uncertainty	
Teflon sample volume (m^3)	0.36	0.02	0.36	0.02	
Quartz sample volume (m^3)	0.36	0.02	0.36	0.02	
Teflon mass concentration (mg/m^3)	6.017	0.304	6.311	0.318	
Teflon mass/Total mass	0.650		0.640		
	Emission (mg/kg)	±Uncertainty	Emission (mg/kg)	±Uncertainty	PM2.5/PM10
Cl-	1033.3602	73.1350	1118.5393	83.7450	0.92
NO3-	11.8488	1.3552	12.7931	1.4288	0.93
SO4=	70.1634	4.5126	75.7564	5.1375	0.93
NH4+	249.6724	17.2445	273.2828	19.4438	0.91
Na+	2.3895	0.5104	1.4946	0.4988	1.60
K+	498.5840	32.2010	548.0022	37.4400	0.91
C(org)	1424.7578	118.8563	1606.0499	141.1425	0.89
C(oht)	1225.4213	161.0294	1474.1531	203.9475	0.83
C(e)	381.0829	31.0006	426.2240	36.5700	0.89
C(eht)	31.7093	16.6531	4.3720	3.2513	7.25
C	1805.8407	0.0000	2032.2738	0.0000	0.89
Al	2.5293	3.4531	4.5542	1.2413	0.56
Si	3.1915	4.5126	10.0730	1.8600	0.32
P	0.5676	8.3530	0.8570	8.5725	0.66
S	24.2405	4.0726	24.5676	4.2000	0.99
Cl	907.7240	55.2640	879.7688	56.6588	1.03
K	504.5804	30.7120	497.6581	32.0400	1.01
Ca	1.5793	6.1952	4.2519	6.4725	0.37
Ti	0.1069	1.0736	0.2360	1.1213	0.45
V	0.0494	0.4682	0.0497	0.4875	0.99
Cr	0.0535	0.1021	0.0538	0.1088	0.99
Mn	0.1604	0.0493	0.3022	0.0563	0.53
Fe	0.3948	0.1901	3.1010	0.2813	0.13
Co	0.0165	0.0422	0.0000	0.0675	
Ni	0.0041	0.0458	0.0124	0.0488	0.33
Cu	0.0288	0.0493	0.0497	0.0375	0.58
Zn	0.5264	0.0493	0.5424	0.0525	0.97
Ga	0.0206	0.0845	0.0000	0.0900	
As	0.0165	0.0986	0.0166	0.1050	0.99
Se	0.0082	0.0528	0.0290	0.0600	0.28
Br	2.6404	0.1690	2.5835	0.1725	1.02
Rb	0.1604	0.0422	0.1946	0.0450	0.82
Sr	0.0247	0.0493	0.0704	0.0375	0.35
Y	0.0452	0.0634	0.0124	0.0675	3.64
Zr	0.0452	0.0739	0.0124	0.0788	3.64
Mo	0.0823	0.1267	0.0000	0.1350	
Pd	0.0247	0.5034	0.1573	0.5250	0.16
Ag	0.0329	0.5773	0.1366	0.5925	0.24
Cd	0.0576	0.6054	0.0000	0.6338	
In	0.0000	0.6794	0.0000	0.7088	
Sn	0.0000	0.8518	0.0207	0.8813	0.00
Sb	0.1727	0.9574	0.1076	0.9900	1.60
Ba	0.1439	3.2490	0.7411	3.3675	0.19
La	0.9048	4.3226	0.0000	4.4850	
Au	0.0000	0.1408	0.0000	0.1538	
Hg	0.0288	0.1162	0.0083	0.1238	3.48
Tl	0.0452	0.1126	0.0000	0.1200	
Pb	0.0000	0.1443	0.0000	0.1538	
U	0.0535	0.1197	0.0000	0.1275	
Sum of measured species	3,520	140	3,750	152	0.94

Table 3.4.2.14. Element concentrations (ng/m^3) from CNL filter samples.

Fuel:	Corn
Date:	9-Oct-92
Time:	
Filter ID:	AG-45

Element	Concentration (ng/m^3)	±Uncertainty
H	262,190	28,400
Na		
Mg	93,480	15,600
Al	31,510	6,100
Si	20,070	3,100
P		
S		
Cl	2,283,820	116,100
K	1,176,230	60,000
Ca		
Ti		
V		
Cr		
Mn		
Fe	11,200	800
Ni	560	200
Cu		
Zn		
As	460	200
Pb		
Se		
Br	3,810	400
Rb		
Sr		
Zr		

Table 3.4.2.15. Element emission factors (mg/kg) from CNL filter samples.

Fuel:	Corn	
Date:	9-Oct-92	
Time:		
Filter ID:	AG-45	
Fuel rate (g/s)		5.02
Stack gas flow rate (m^3/s)		4.33
Stack Temperature (°C)		27.97
Ambient Temperature (°C)		19.19

Element	Emission factor (mg/kg)	±Uncertainty (mg/kg)
H	219.6	23.8
Na		
Mg	78.3	13.1
Al	26.4	5.1
Si	16.8	2.6
P		
S		
Cl	1,912.5	97.2
K	985.0	50.2
Ca		
Ti		
V		
Cr		
Mn		
Fe	9.4	0.7
Ni	0.5	0.2
Cu		
Zn		
As	0.4	0.2
Pb		
Se		
Br	3.2	0.3
Rb		
Sr		
Zr		

Table 3.4.2.16. Relative element concentrations by stage from DRUM impactor.

Stage 5: 0.56 - 1.15 μm

	9-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	3,483.00	854.53		
Na				
Mg				
Al				
Si				
S	921.09	281.37		
Cl				
K				
Ca	1,267.17	329.68		
Ti	5,064.69	753.47		
V	1,021.55	347.05		
Cr				
Mn	808.58	255.16		
Fe	599.18	155.05		
Ni				
Cu				
Zn				
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.2.17. Relative element concentrations by stage from DRUM impactor.

Stage 8: < 0.24 μm

	9-Oct-92 Concentration (relative)	±Uncertainty	Abundance Relative to Potassium (-)	Abundance Relative to Stage 1 (-)
H	6,644.05	598.42	0.3336	
Na				
Mg				
Al				
Si	193.74	78.00	0.0097	
S				
Cl	19,783.89	1,086.32	0.9934	
K	19,916.15	1,099.26	1.0000	
Ca				
Ti				
V				
Cr				
Mn				
Fe				
Ni				
Cu				
Zn	71.05	19.58	0.0036	
As				
Se				
Br				
Rb				
Sr				
Pb				

Table 3.4.2.18.
VOC concentrations (ppbv)

Date Fuel Traverse	9-Oct-92 Corn Stover Traverse 1	9-Oct-92 Corn Stover Traverse 2
Acetic acid		70
Propanone (acetone)		
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	17.3	48.3
Dimethylbutane		
Hexane		16.9
Phenol	21.7	52.6
Dimethylfuran	5.4	13.8
2-methyl 2-cyclopenten-1-one	5.6	13
2-chloro phenol	16	33
Toluene		
Benzonitrile	5.7	14.5
Benzaldehyde		
Methylphenol (hydroxy toluene)		15.2
Styrene		
Xylene		
Trimethylpentane		
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	1.9	3.3
C10H12		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		
No match r.t. (6.7)		
No match r.t. (8.51)		
No match r.t. (8.71)		
No match r.t. (8.73)		
No match r.t.(6.4)		
No match r.t.(8.5)		

Table 3.4.2.19.
VOC emission factors (mg/kg)

Date	9-Oct-92	9-Oct-92
Fuel	Corn Stover	Corn Stover
Traverse	Traverse 1	Traverse 2
Fuel Consumption Rate (g/s d.b)	5.02	8.45
Stack Gas Mass Flow Rate (kg/s)	5.09	4.83
Acetic acid		
Propanone (acetone)		80
Methyl ester acetic acid (methylacetate)		
Butane		
Dimethyloxirane		
Pentene		
Methylbutanone (isopropylmethyl ketone)		
Furancarboxaldehyde (furfural)		
Benzene	47	74
Dimethylbutane		
Hexane		
Phenol		31
Dimethylfuran	73	100
2-methyl 2-cyclopenten-1-one	18	26
2-chloro phenol	25	33
Toluene	52	60
Benzonitrile		
Benzaldehyde	21	30
Methylphenol (hydroxy toluene)		
Styrene		31
Xylene		
Trimethylpentane		
Benzofuran		
Methoxymethylphenol (creosol)		
Naphthalene	9	8
Unknown		
Alpha-pinene		
Camphene		
Δ3-Carene		
Limonene		

Table 3.4.2.20. PAH emission factors, corn stover, 9 October 1992 (zero indicates not detected).

	Traverse 1 Filter	Traverse 2 Filter	Trap	Traverse 1 Sorbent	Traverse 2 Sorbent	Impinger Rinsate	Total Traverse 1	Total Traverse 2	Total Average
					µg/kg dry fuel				
Naphthalene	647	192	10	11,006	3,397	2	11,665	3,601	7,633
2-Methyl-naphthalene	3,928	93	6	3,923	763	1	7,858	863	4,360
Acenaphthylene	541	51	0	13	10	0	555	61	308
Acenaphthene	1,343	14	14	-2	-1	0	1,355	27	691
Fluorene	12	-1	0	252	49	1	265	49	157
Phenanthrene	378	108	92	1,676	421	7	2,152	626	1,389
Anthracene	32	28	0	0	60	1	33	89	61
Fluoranthene	930	168	27	89	22	4	1,050	221	635
Pyrene	960	165	24	54	18	3	1,040	210	625
Benz[a]-anthracene	345	75	0	0	2	0	345	77	211
Chrysene	436	100	45	0	0	1	482	146	314
Benzo[b]-fluoranthene	18,459	162	0	0	0	0	18,459	162	9,311
Benzo[k]-fluoranthene	8,195	303	0	0	0	0	8,195	303	4,249
Benzo[a]pyrene	28,634	37	0	0	0	0	28,634	37	14,336
Benzo[e]pyrene	22,433	83	0	0	0	0	22,433	83	11,258
Perylene	4,158	4	0	0	0	0	4,158	4	2,081
Benzo[ghi]-perylene	567	0	0	0	0	0	567	0	283
Indeno[1,2,3-cd]-pyrene	9,672	0	0	0	0	0	9,672	0	4,836
Dibenz[a,h]-anthracene	565	0	0	0	0	0	565	0	283
Total	102,236	1,582	218	17,011	4,740	19	119,484	6,558	63,021

Figure 3.4.2.1. Ambient air conditions, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF

Test Date 9-Oct-92

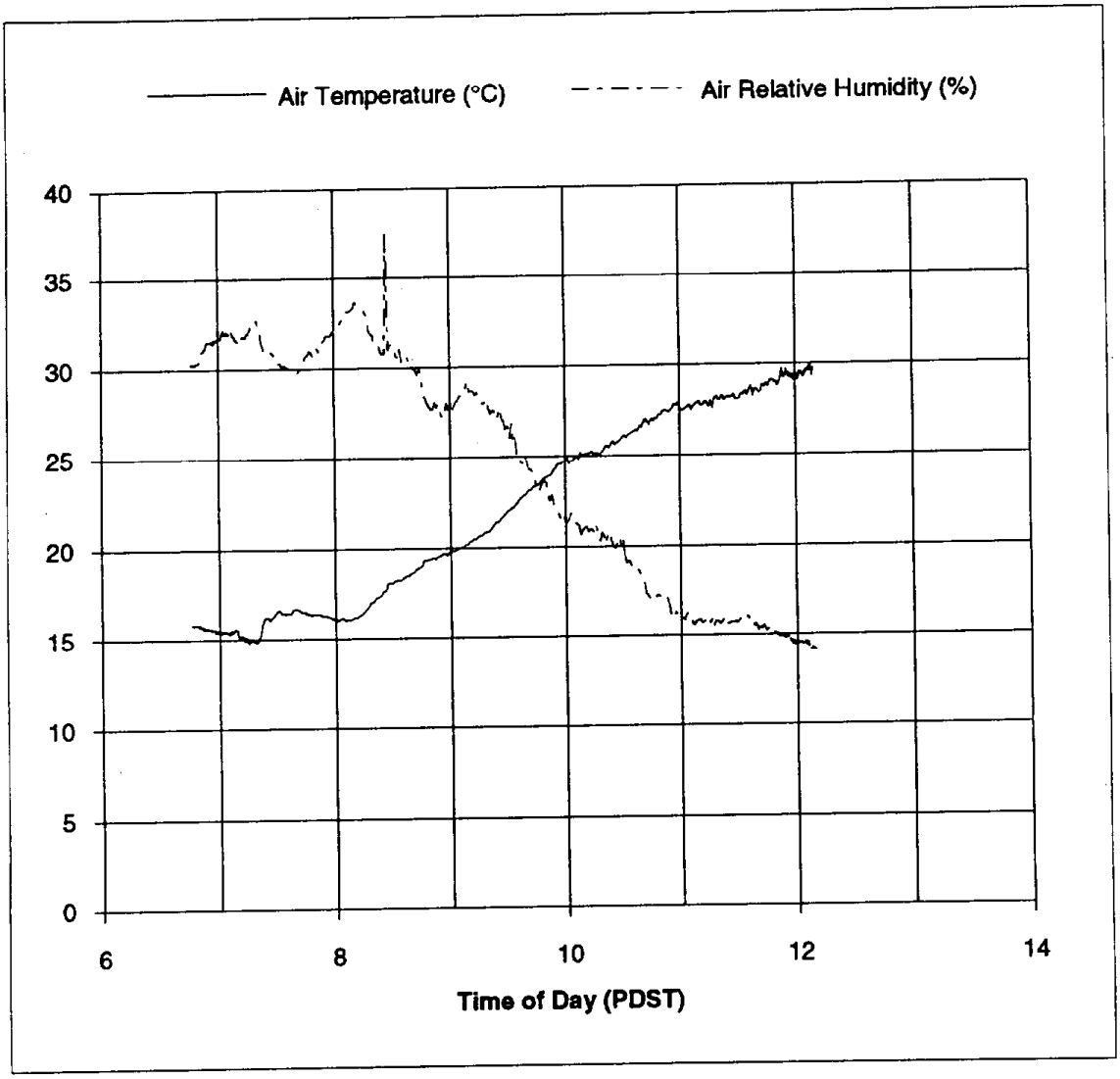

Figure 3.4.2.2. Air temperature and relative humidity from CIMIS station.

Fuel: Corn Stover Date of Test: 9-Oct-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

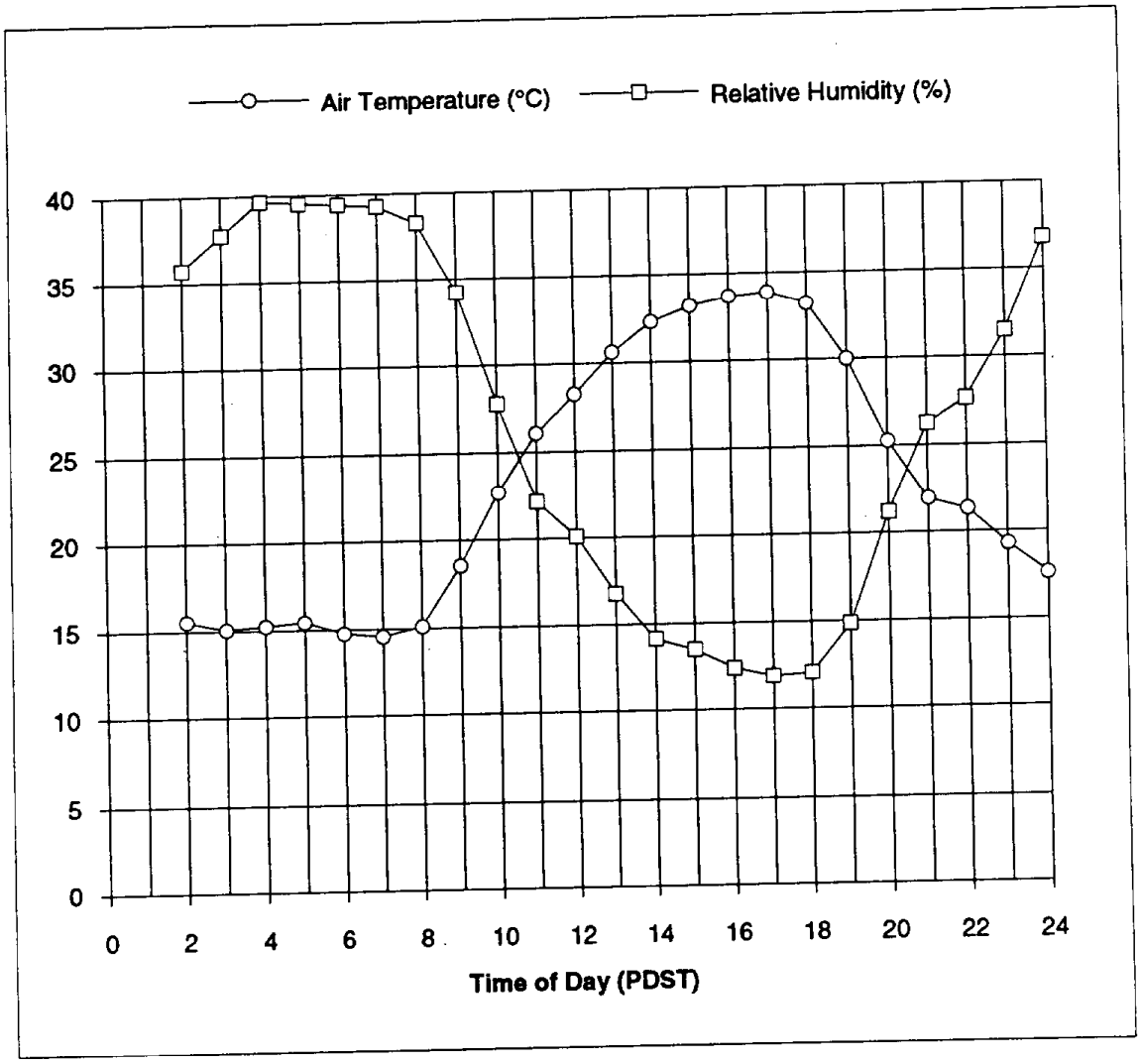

Figure 3.4.2.3. Wind speed from CIMIS station.

Fuel: Corn Stover Date of Test: 9-Oct-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

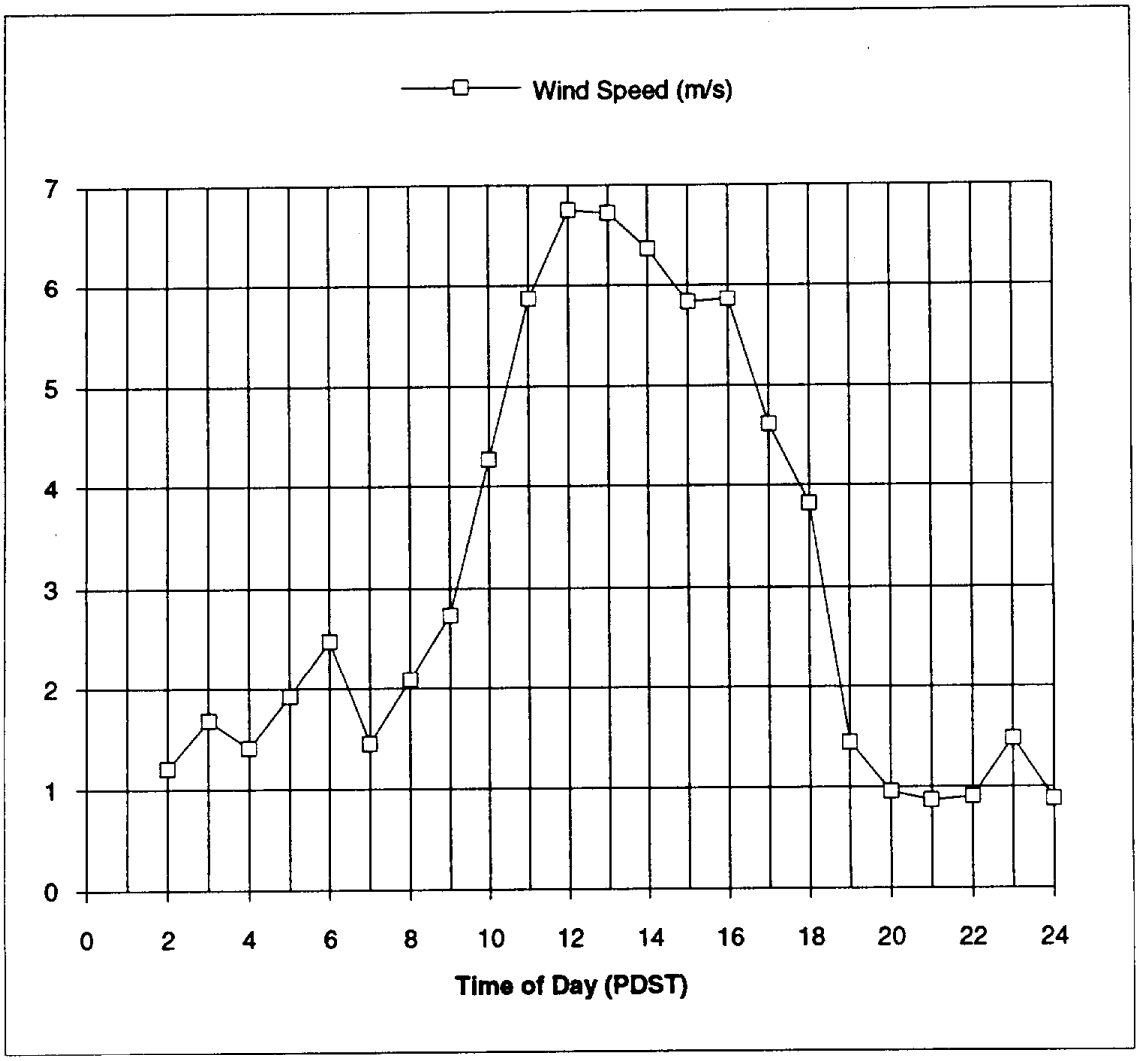

Figure 3.4.2.4. Wind direction and solar radiation from CIMIS station.

Fuel: Corn Stover Date of Test: 9-Oct-92

Configuration: CEWF

Hourly Average CIMIS Data for Davis, California

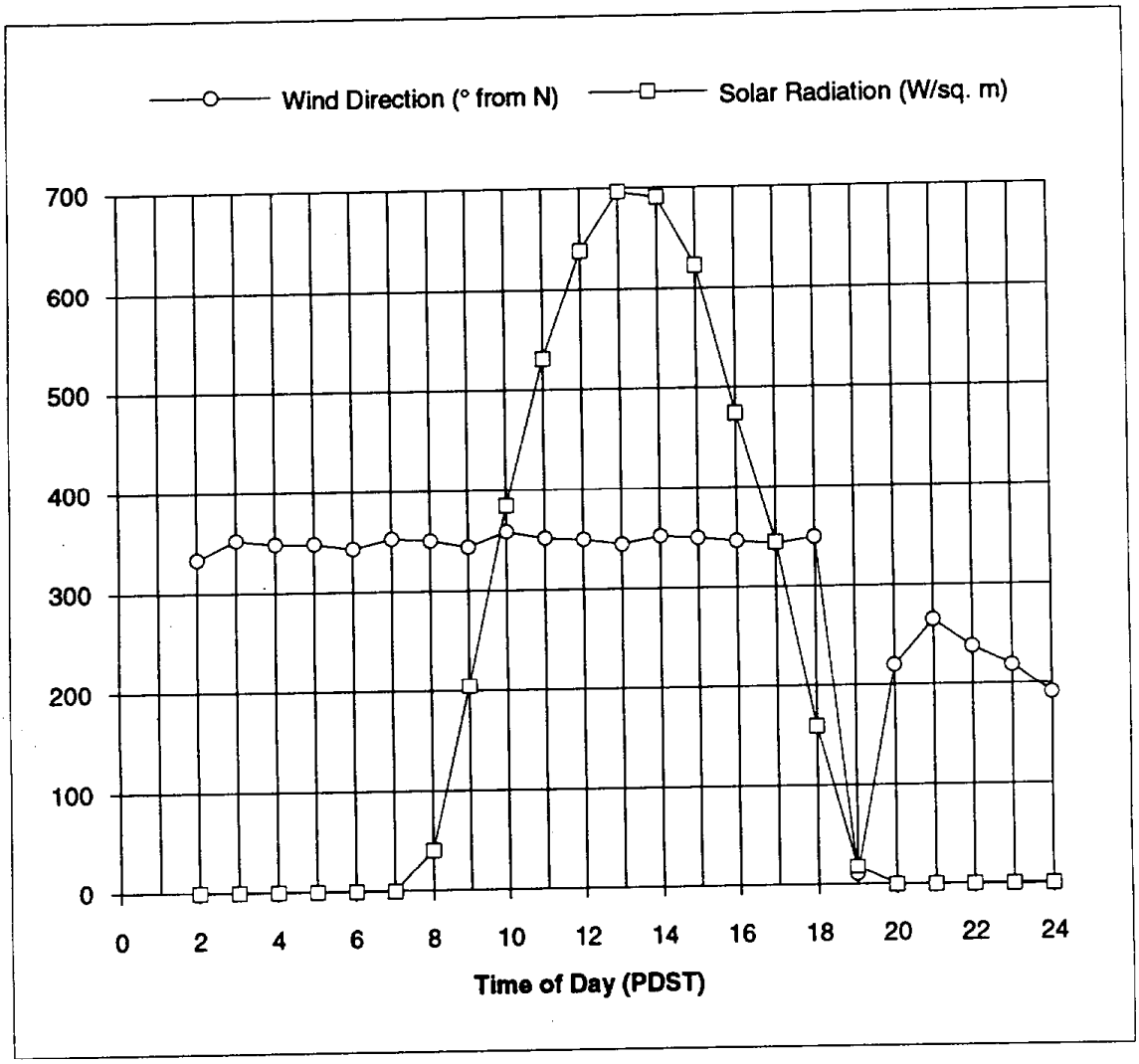

Figure 3.4.2.5. Inlet air, stack gas, and impinger temperatures, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF
Test Date 9-Oct-92

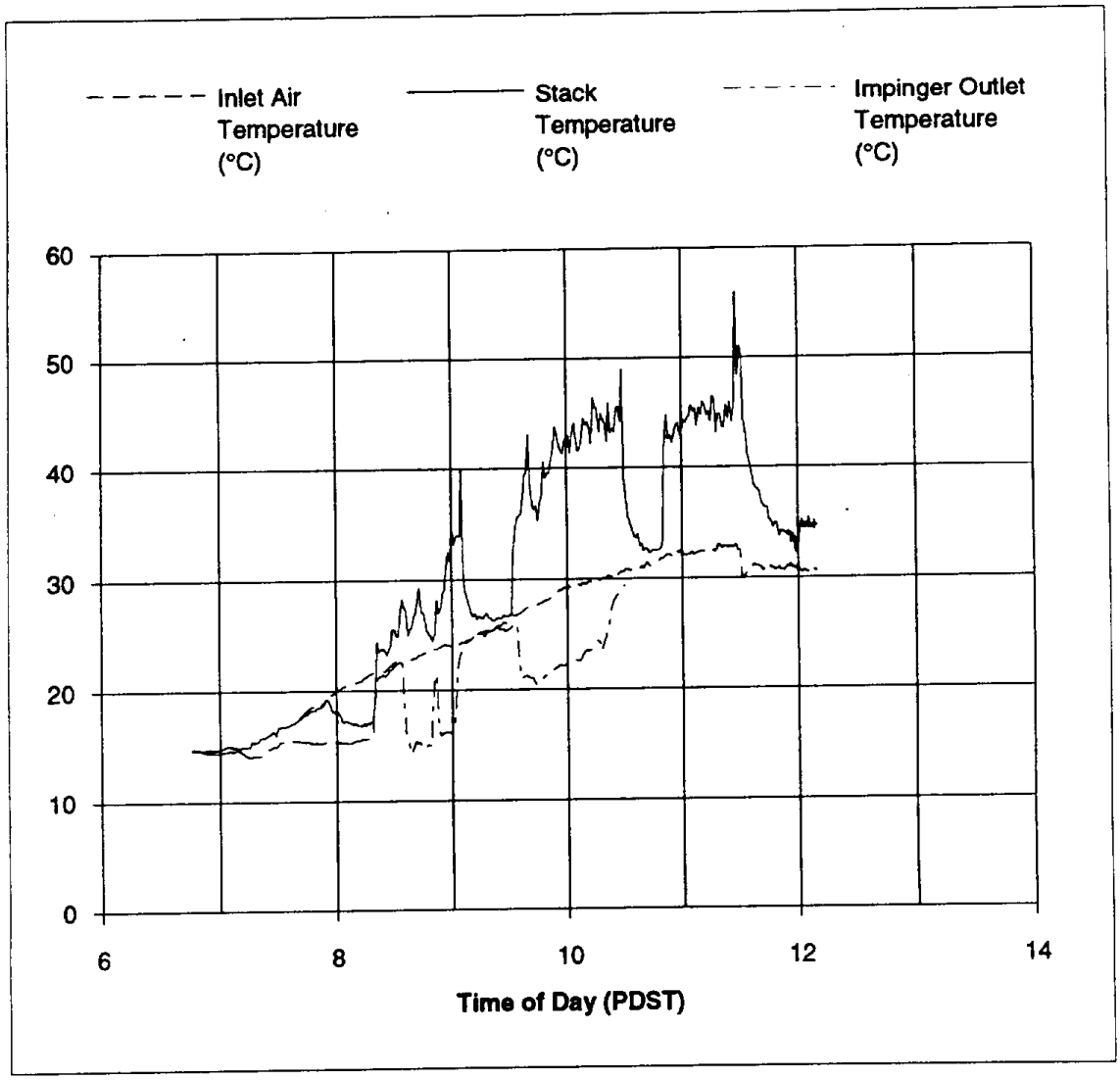

Figure 3.4.2.6. Conveyor speed and stack gas velocity, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF

Test Date 9-Oct-92

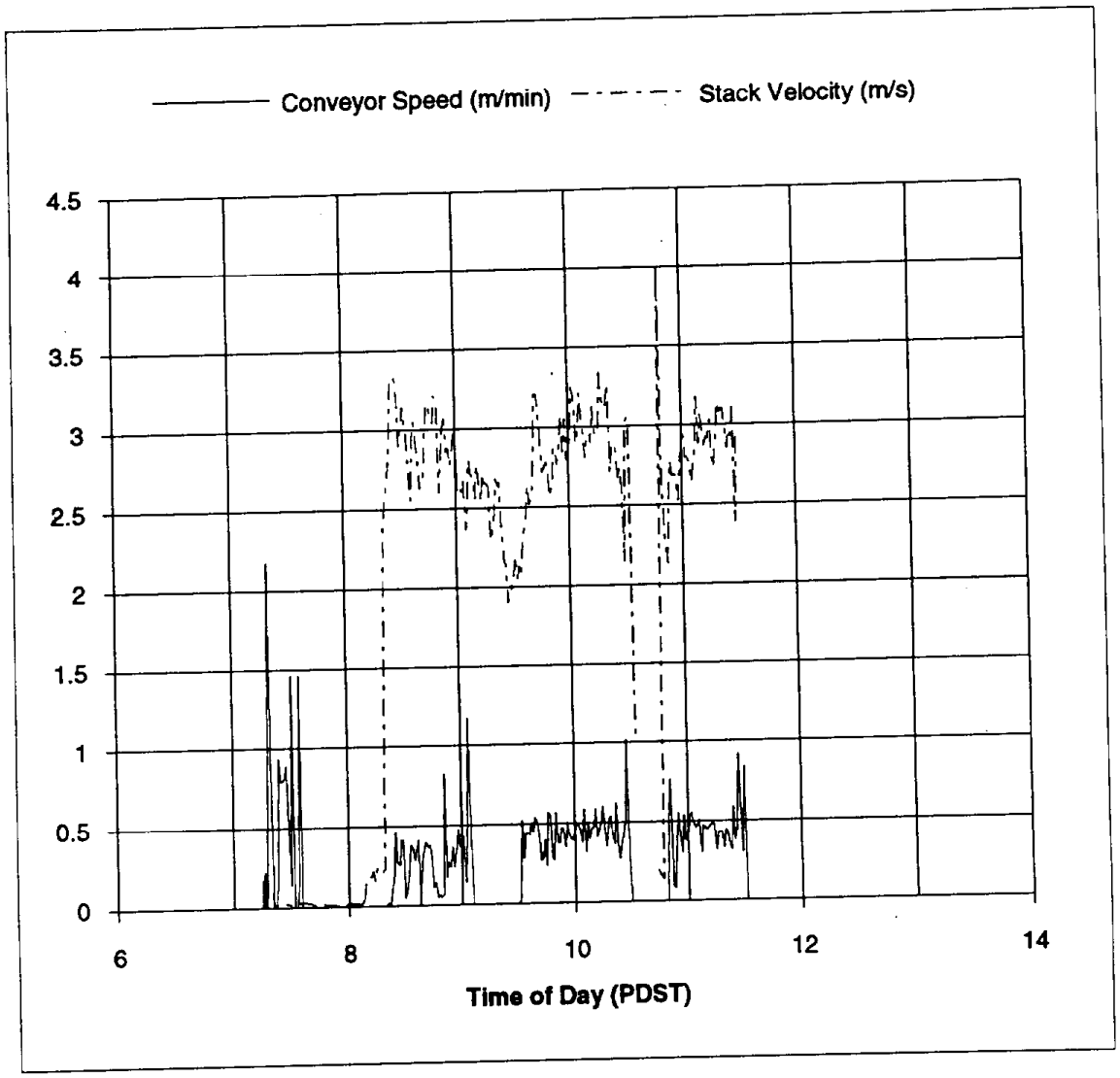

Figure 3.4.2.7. Conveyor speed with 10 min moving average, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF

Test Date 9-Oct-92

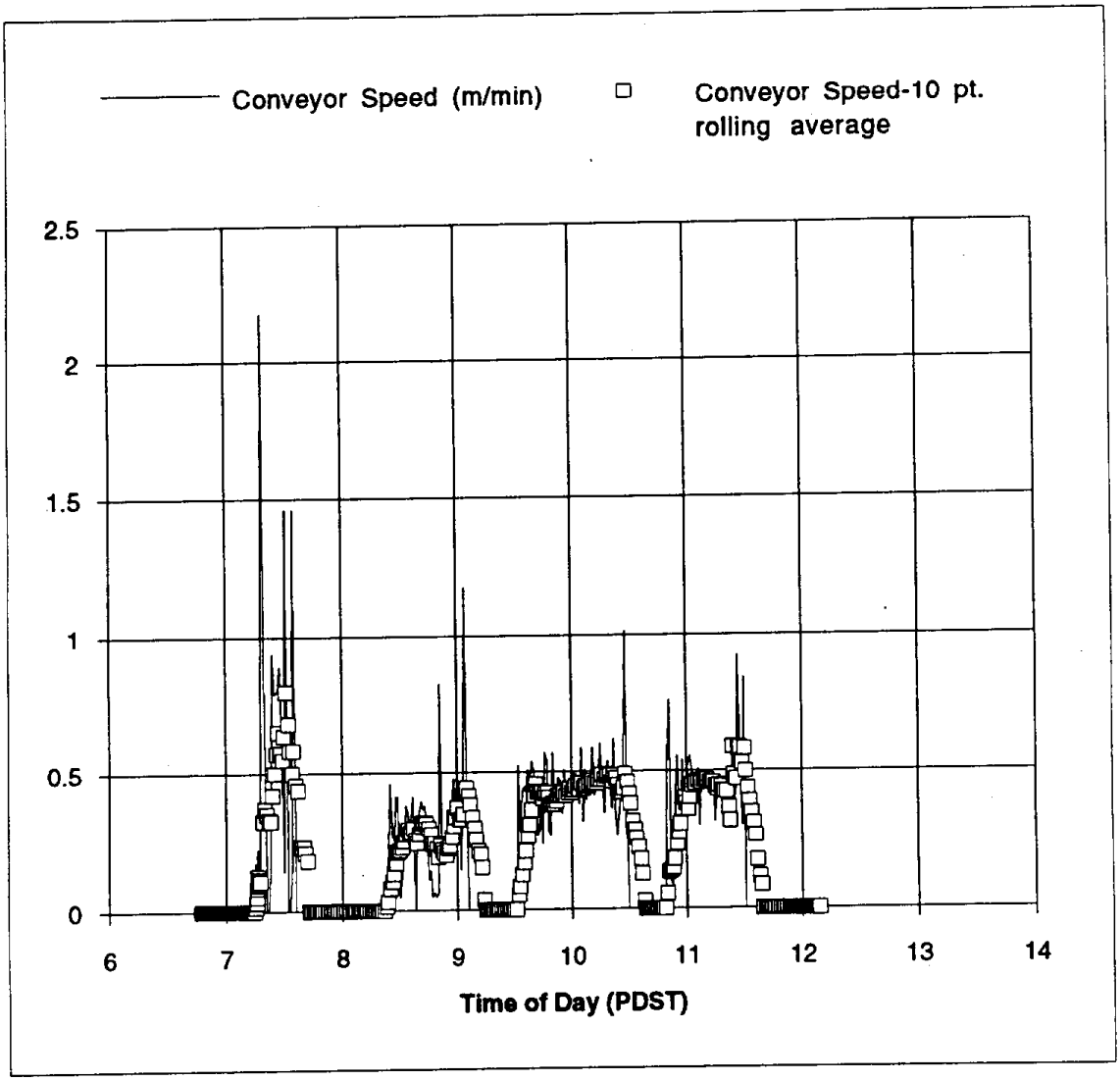

Figure 3.4.2.8. Conveyor travel, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF

Test Date 9-Oct-92

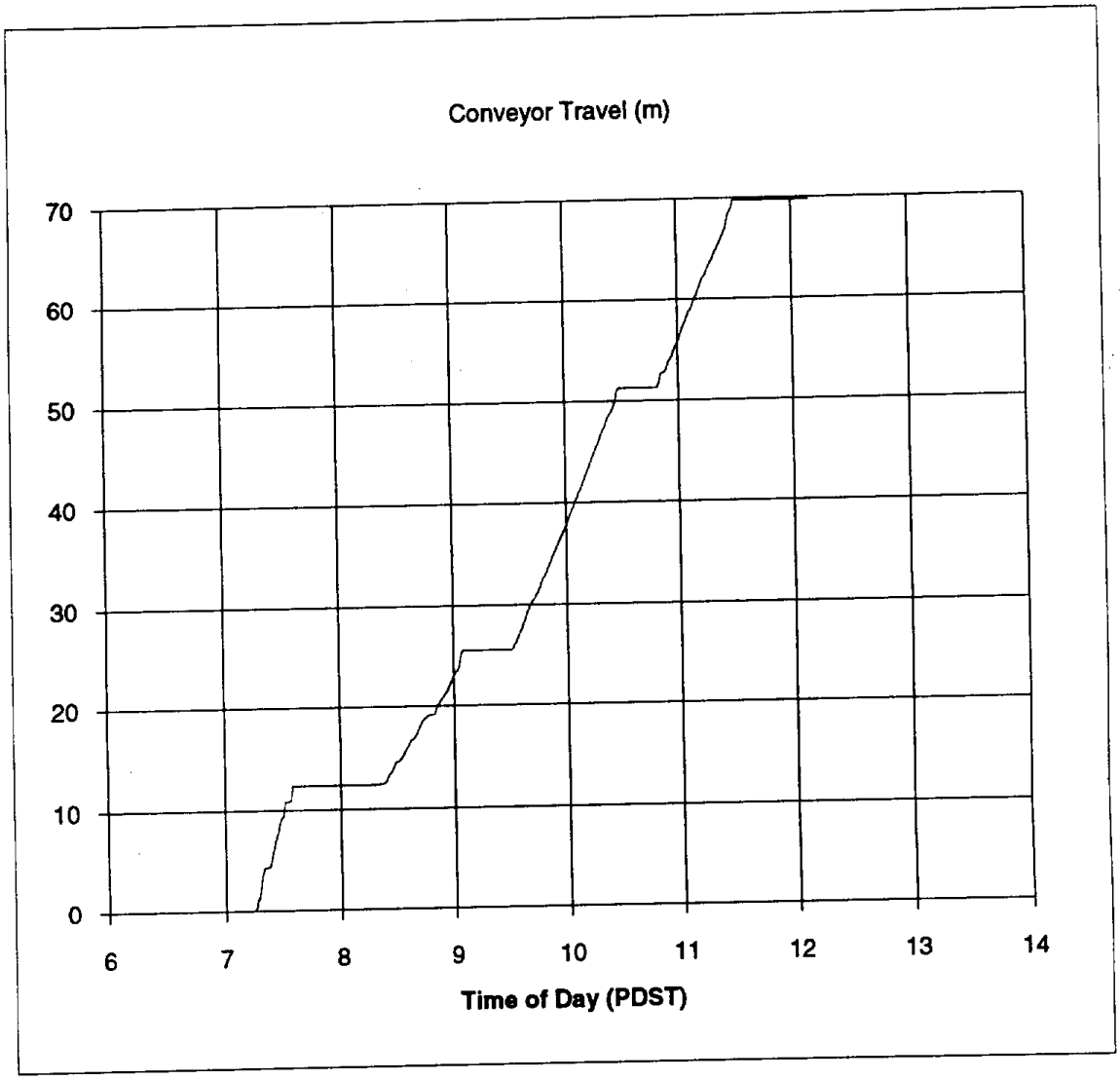

Figure 3.4.2.9. CO concentration in stack gas, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF
Test Date 9-Oct-92

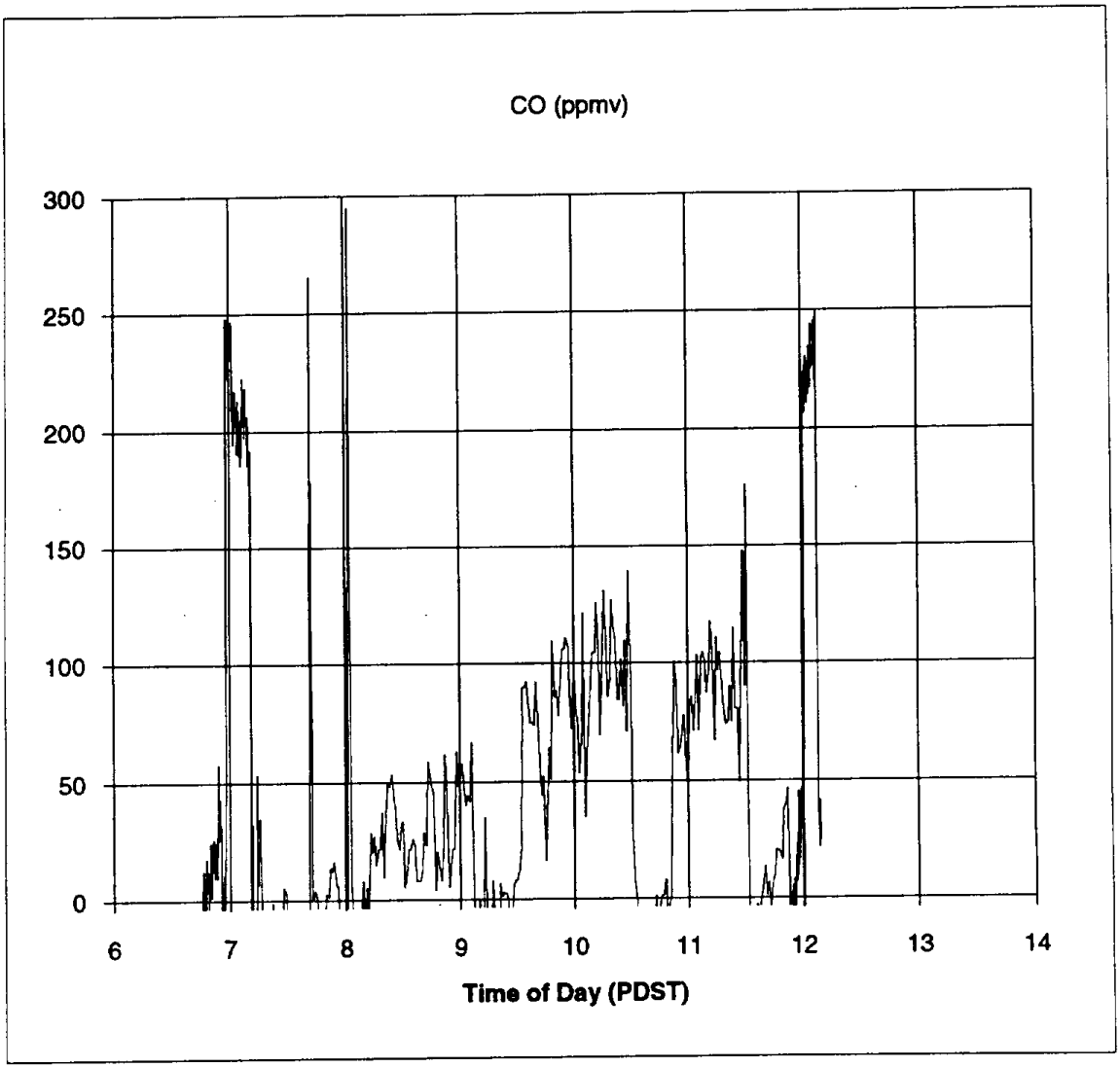

Figure 3.4.2.10. NO and NOx concentrations in stack gas, 9 October 92.

Fuel Type:	Corn Stover	Test Date	9-Oct-92
Configuration:	CEWF		

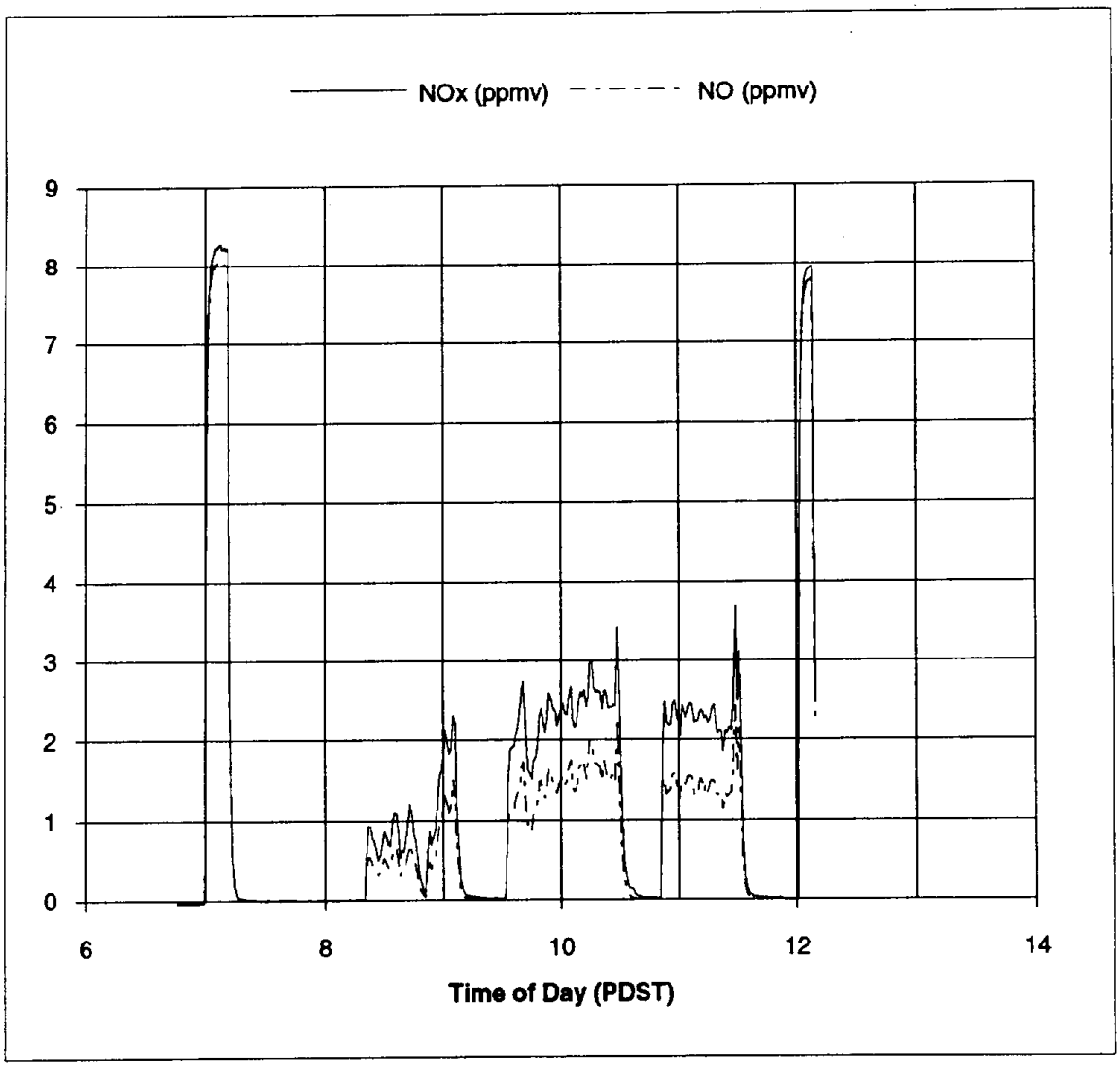

Figure 3.4.2.11. SO2 concentration in stack gas, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF

Test Date 9-Oct-92

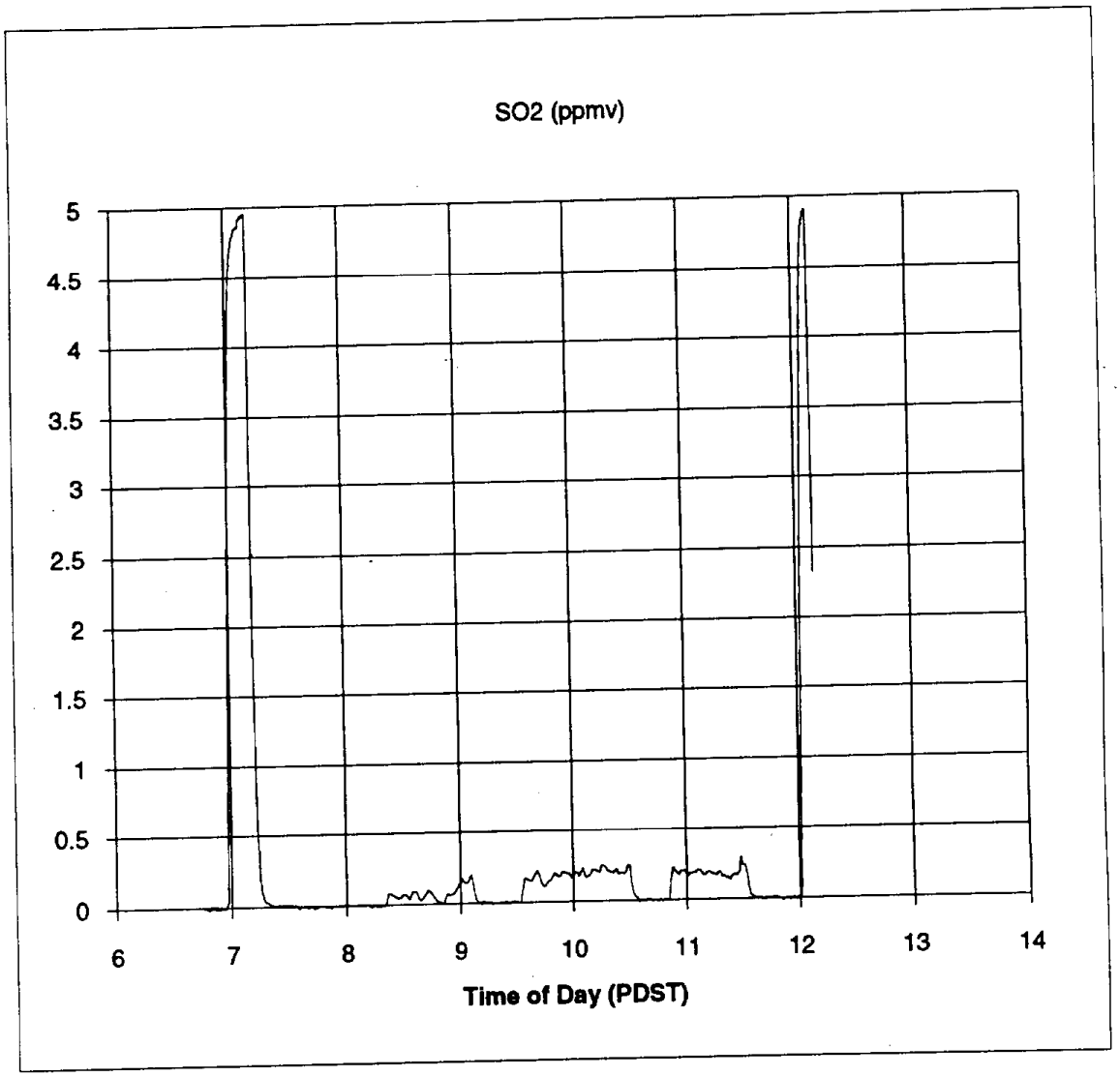

Figure 3.4.2.12. Total sulfur concentration in stack gas, 9 October 92.

Fuel Type:	Corn Stover	Test Date	9-Oct-92
Configuration:	CEWF		

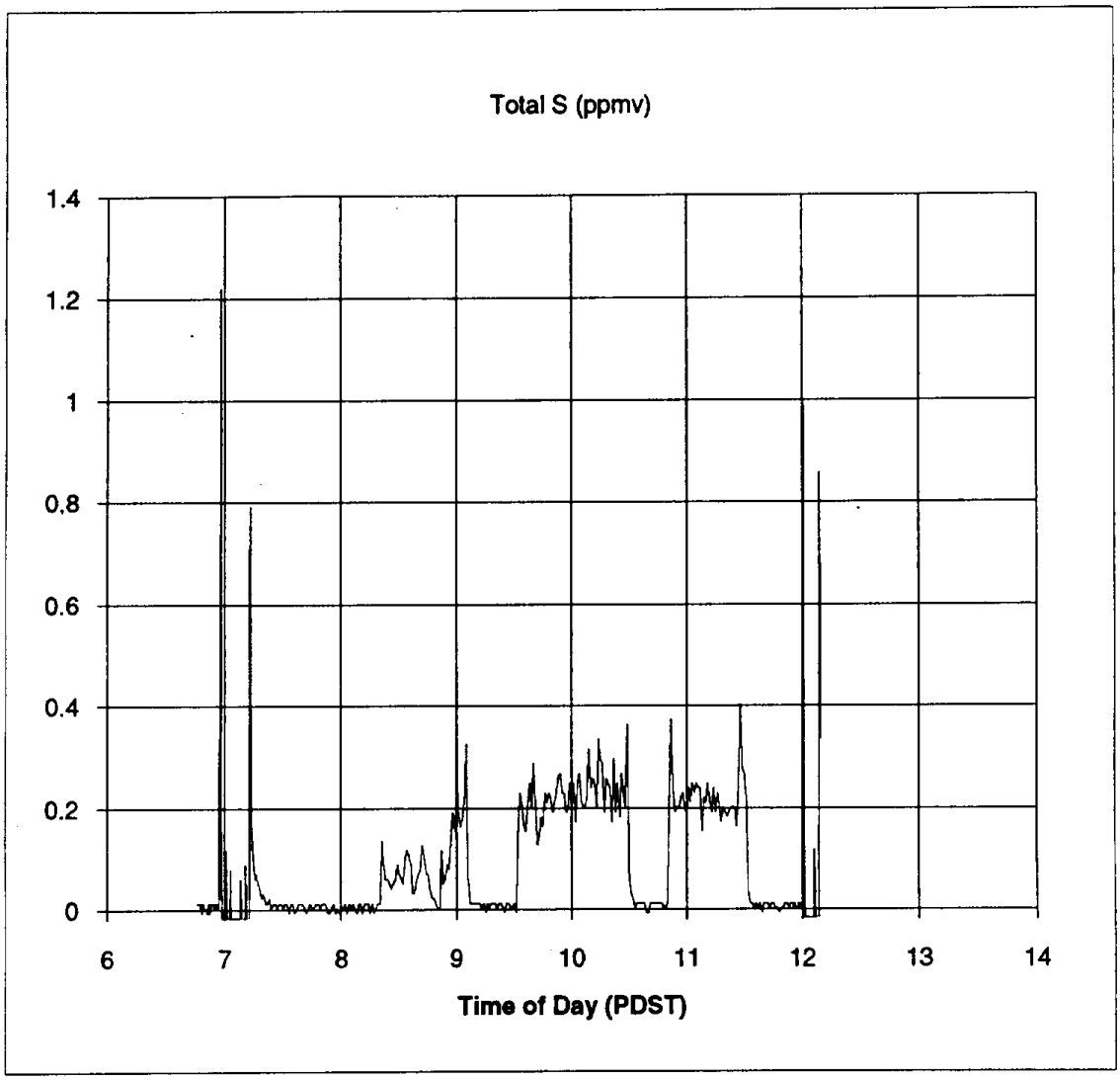

Figure 3.4.2.13. THC concentration in stack gas, 9 October 92.

Fuel Type: Corn Stover
Configuration: CEWF
Test Date 9-Oct-92

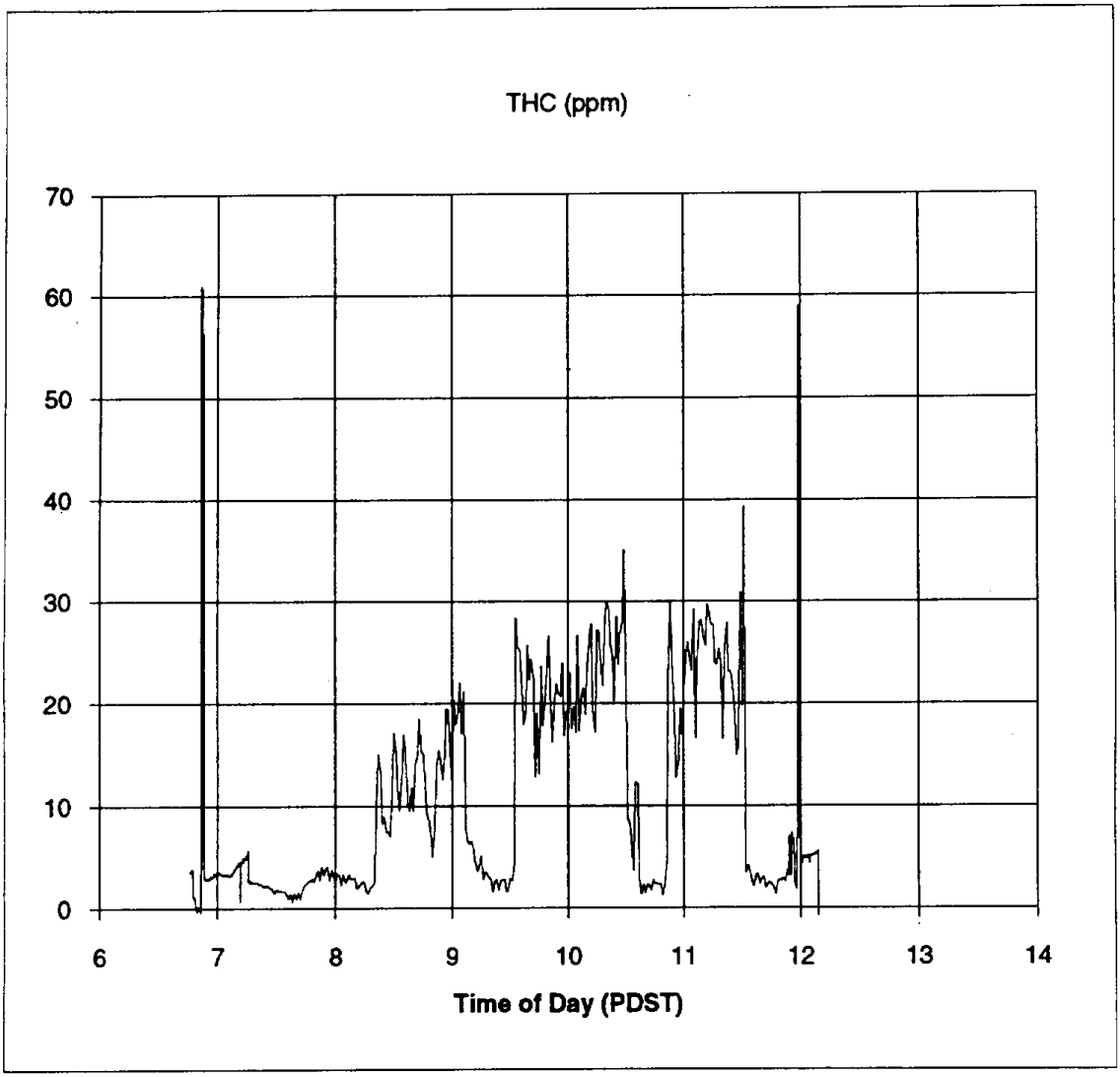

Figure 3.4.2.14. Particle size distribution, traverse 1, 9 October 92.

Fuel: Corn Stover

Date of Test: 9-Oct-92
Configuration: CEWF

Particle Size Distribution
Traverse 1:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.96	0.07	3.39	1.000
2	7.82	0.05	3.32	0.979
3	4.17	0.04	3.27	0.965
4	2.21	0.07	3.23	0.953
5	1.27	0.08	3.16	0.932
6	0.75	0.21	3.08	0.909
7	0.39	0.27	2.87	0.847
filter	0.00	2.60	2.60	0.767

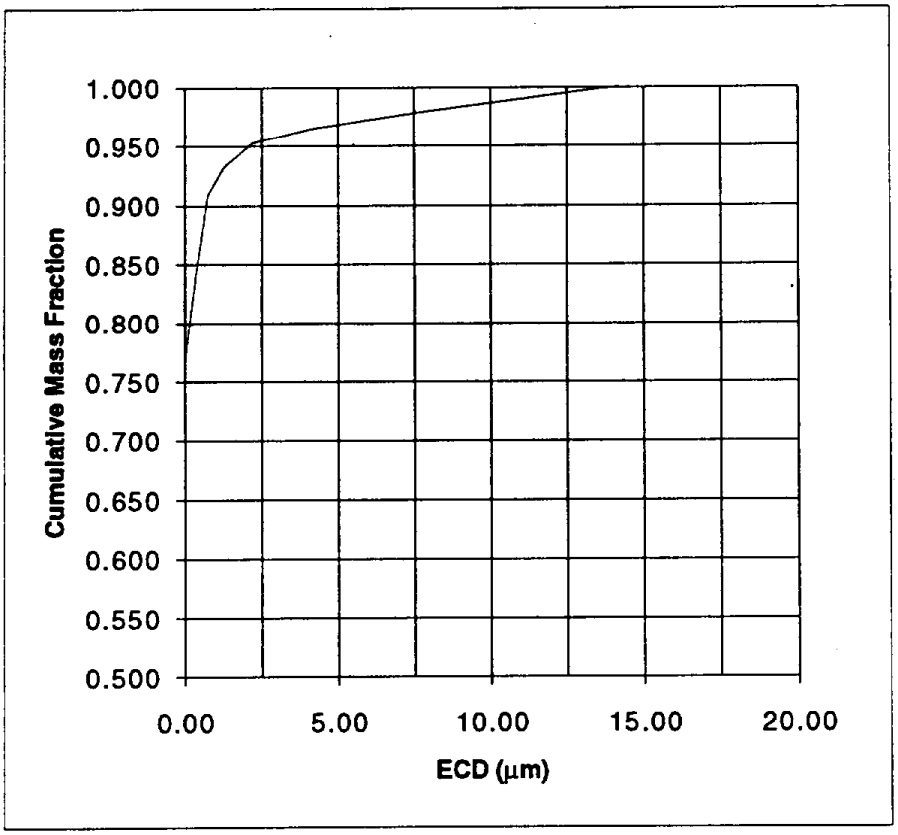

Figure 3.4.2.15. Particle size distribution, traverse 2, 9 October 92.

Fuel: Corn Stover

Date of Test: 9-Oct-92

Configuration: CEWF

Particle Size Distribution
Traverse 2:

Stage	ECD (μm)	Weight (mg)	Cum. Wt (mg)	Cum. Fraction
1	13.96	0.11	6.27	1.000
2	7.82	0.19	6.16	0.982
3	4.17	0.19	5.97	0.952
4	2.21	0.21	5.78	0.922
5	1.27	0.27	5.57	0.888
6	0.75	0.80	5.3	0.845
7	0.39	0.84	4.50	0.718
filter	0.00	3.66	3.66	0.584

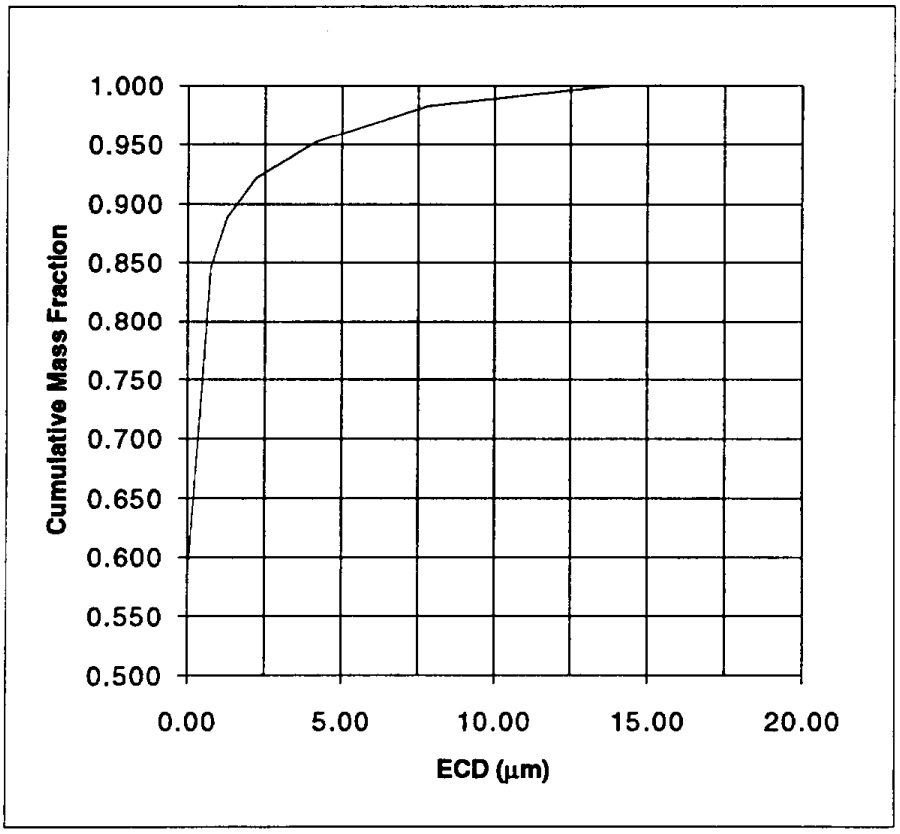

Figure 3.4.2.16. Nitrogen balance.
Date of Test: 9-Oct-92
Fuel Corn Stover

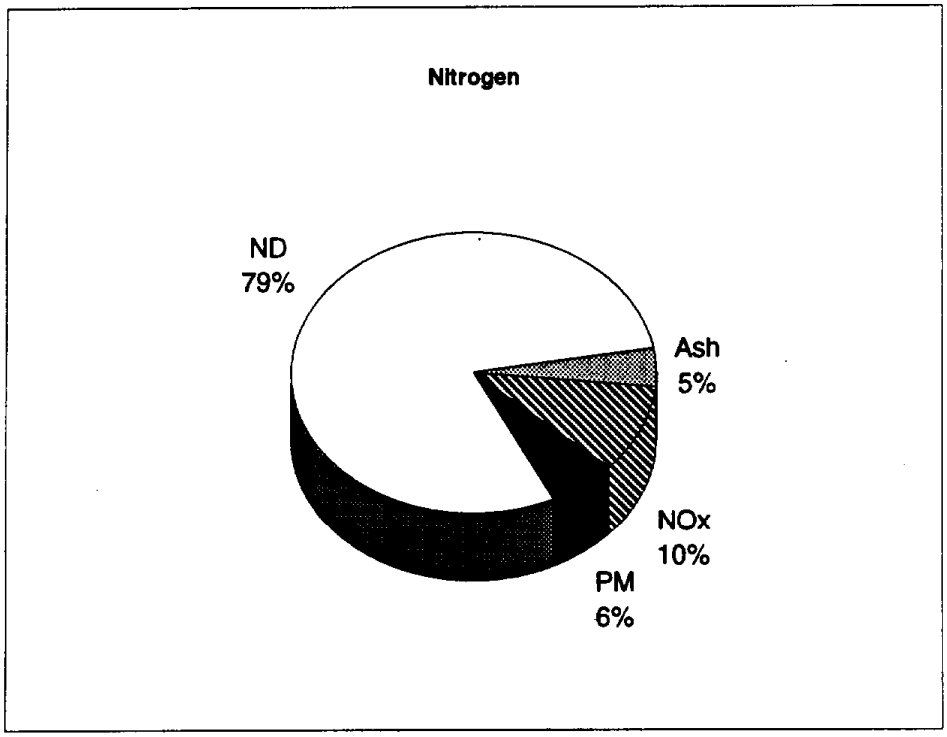

Figure 3.4.2.17. Sulfur balance.
Date of Test: 9-Oct-92
Fuel Corn Stover

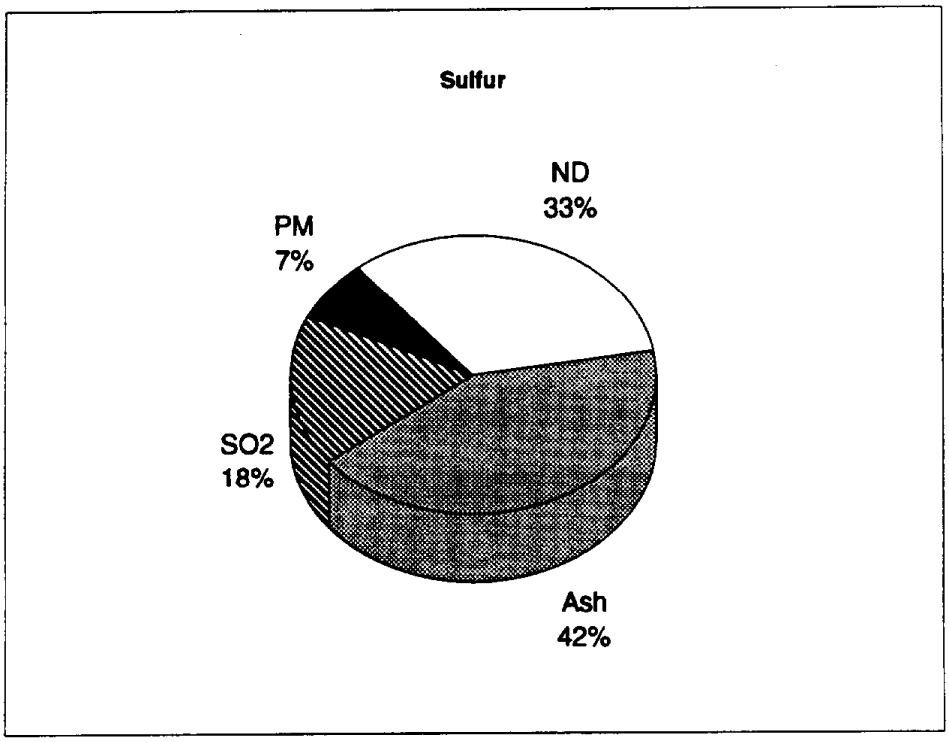
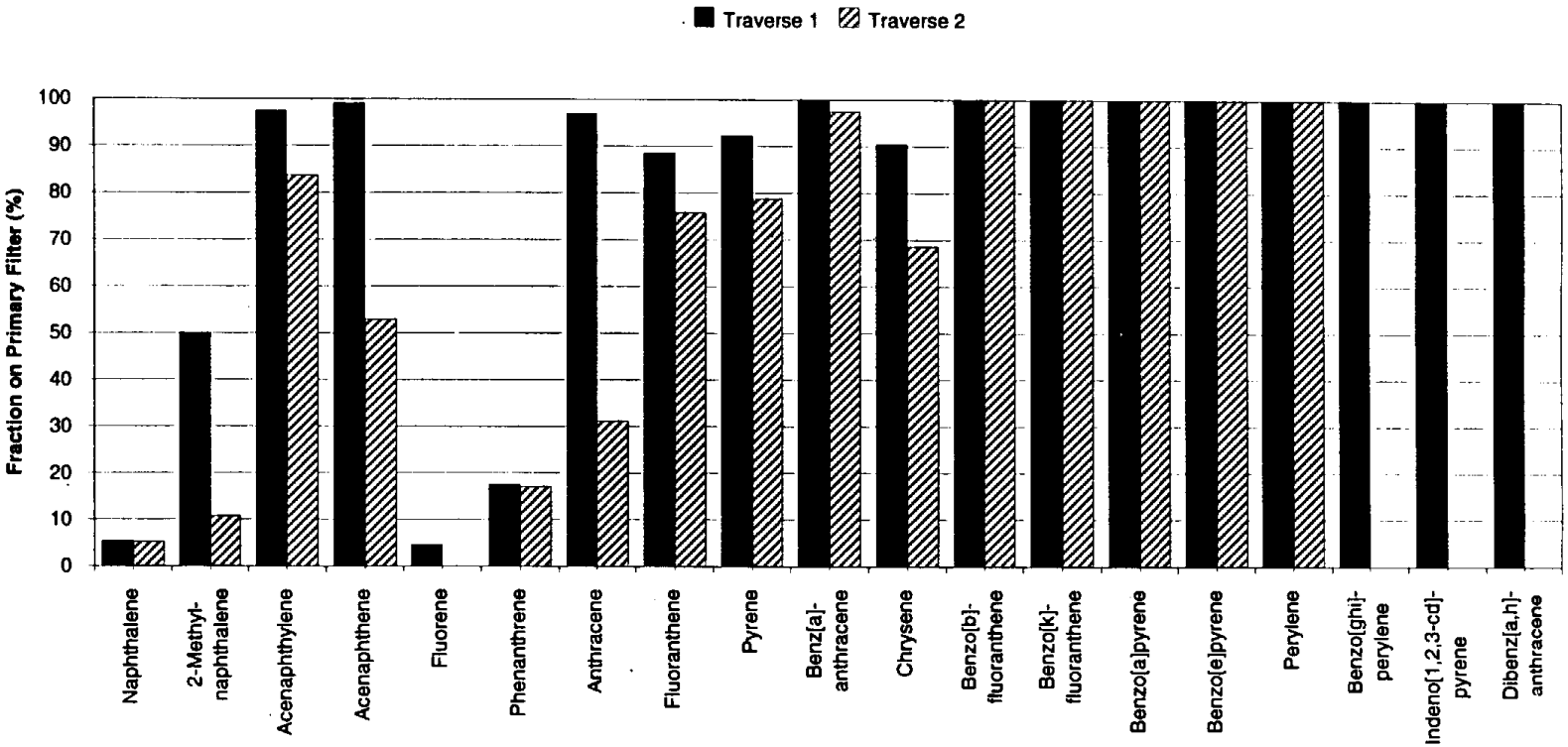
Figure 3.4.2.18. Mass fraction of PAH on primary filter samples, 9 October 1992, corn stover.