



Project Summary

Preparation and Evaluation of New Sorbents for Environmental Monitoring Volume I and Volume II

Edo Pellizzari, Barbu Demian, Anton Schindler, Kathy Lam, and Wanda Jeans

Sixty-one different polyimide sorbents were prepared for evaluation as sorbents for the collection of vapor-phase organics in ambient air. Laboratory tests were applied to assess their properties as sorbents and to develop a data base for examining the relationships between chemical structures and physical properties. A tiered level-of-effort testing was applied. The Level I procedure sorted the polymers according to specified desired properties. Level II testing provided information for selecting the most promising polymers for trapping of vapor-phase organics and generated the data base relating chemical and sorbent properties. Level III experiments provided a confirmation of the physio-chemical properties of the sorbent. Thermodynamic properties and correlations between chemical structures were determined for the four most promising polyimide sorbents and compared to Tenax GC[®], the reference sorbent.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

A wide variety of pollutants exists in the form of vaporized organics in our environment. The biological effects of amounts even as small as a few nanograms per cubic meter may constitute an indefinable

health hazard. Ambient air sampling involves the collection of low levels of organics that are contained in relatively high levels of water vapor. To detect such small amounts of compounds, pre-concentration of the sample is necessary. The most successful method for ambient air sampling of vaporized organics involves the use of porous polymers as solid sorbents in pre-concentration cartridges. The most widely used solid sorbent, Tenax GC[®], a porous polymer of 2,6-diphenylpara-phenylene oxide, has been found inadequate for organic compounds that have high volatility. Also, reactive gases such as ozone, nitrogen oxides, and sulfur oxides cause changes in the organic composition of the sorbent.

In this research, 61 polyimide sorbents were evaluated in a three-tiered scheme for their utility in collecting vapor-phase organics from ambient air. The primary objective in these tests was to develop a sorbent with good thermal properties, i.e., minimum background contribution to avoid sample contamination, low retentive volume for water vapor, and resistance to reactive inorganic gases. In the presence of such reactive compounds the ideal sorbent would yield minimal artifacts.

A number of sorbent materials previously have been tested by the Research Triangle Institute (Research Triangle Park, NC) under contract to the U.S. Environmental Protection Agency (EPA). Tenax GC[®], the reference sorbent, and other commercial sorbents display selectivity, but not enough specificity, in view of the number of closely related aromatic and aliphatic compounds present in ambient

air. Collection problems have been encountered in using commercial solid sorbents to sample those organic compounds not amenable to monitoring with Tenax GC®. For this reason, new polymers were synthesized for use in the screening review.

The screening system employed three evaluations, each increasingly more specific, to narrow down the field to the most selective sorbents. Also, part of the procedure as a secondary goal was the determination of empirical parameters that could provide correlations between the chemical structures and physical properties of sorbents. It was hypothesized that, through the identification of relationships between the solubility parameters and the retention volumes of sorbents, a model could be developed that would predict sorbent properties from polymer structures.

Procedure

Sixty-one polyimides with different chemical structures were synthesized for evaluation and screening. A list of the polyimides by their identifying numbers and the aromatic diamines used in preparation is presented in Table 1. The poly (amidic acid) precursor was formed by the heterogeneous reaction of a diamine (any of various commercially available diamines) in tetrahydrofuran with either of two dianhydrides, pyromellitic dianhydride (PMDA) or 2,2',4,4'-benzophenone tetracarboxylic dianhydride (BTDA), followed by cyclodehydration of the particles to form the polyimide.

For the three-tier screening process, gas chromatography measurements were used to monitor adherence to adsorbance criteria, which were more specific for each level. Laboratory and field applications were both considered, including, for example, artifact formation, shelf and storage life, and quality assurance parameters. Level I testing screened selected polymers according to desired characteristics. Of particular interest was their ability to adsorb volatile vapor-phase organics not adequately adsorbed by Tenax GC®, such as compounds with four or fewer carbons, polar neutral species, organic acids, organic bases, halocarbons, and halohydrocarbons.

In Level II tests, the best sorbents from Level I were selected and reproduced. The empirical parameters on which to base correlations between the polymer's chemical and sorbent qualities were defined. They included peak asymmetry factors for selected test compounds; dependence of retention volumes on analyte quantity; effect of temperature on retention volume;

Table 1. Polyimide Sorbents Prepared from Pyromellitic Dianhydrides and Different Aromatic Diamines*

Polyimide Number	Diamine
PI-101	Tetra fluoro- <i>m</i> -phenylene diamine
PI-102	α, α' -Diaminotetrachloro- <i>p</i> -xylene
PI-103	4-Chloro- <i>m</i> -phenylene diamine
PI-104	Bis(4-amino-3-chlorophenyl)methane
PI-105	2,6-Diaminotoluene
PI-106	4-Azo-dianiline
PI-107	2,2',5,5'-Tetrachlorodiphenyldiamine
PI-108	Bis(4-amino-3-chlorophenyl)methane
PI-109	3,3',5,5'-Tetramethylbenzidine
PI-110	Octafluorobenzidine
PI-111	2,6-Diaminopyridine
PI-112	Bis(4-aminophenyl)sulfide
PI-113	2,2',5,5'-Tetrachlorodiphenyl
PI-114	Tetrafluoro- <i>m</i> -phenylene diamine
PI-115	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-116	Bis(3-aminophenyl)sulfone
PI-117	2,6-Diaminopyridine
PI-118	Tetrafluoro- <i>p</i> -phenylene diamine
PI-119	Bis(4-aminophenyl)sulfone
PI-120	Bis(4-aminophenyl)ether
PI-121	4,4'-Diamino-3,3'-dichlorodiphenyl
PI-122	1,5-Diminoanthalene
PI-123	1,2-Bis(4-aminophenyl)ethane
PI-124	2-Chloro- <i>p</i> -phenylene diamine
PI-125	4,4'-Diaminodiphenylmethane-2,2'-sulfone
PI-126	3-Trifluoromethyl- <i>m</i> -phenylene diamine
PI-127	3,6-Diamino-2,7-dimethylacridine
PI-128	Tetramethyl- <i>p</i> -phenylene diamine
PI-129	2,5-Diaminopyridine
PI-130	4,6-Diaminopyrimidine
PI-131	3,3'-Diaminobenzophenone
PI-132	3,6-Diaminoacridine
PI-133	1,4-Diaminoanthraquinone
PI-134	<i>o</i> -Toluidine
PI-135	2,6-Diaminoanthraquinone
PI-136	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-137	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-138	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-139	2-Chloro- <i>p</i> -phenylene diamine
PI-140	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-141	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-142	4,4'-Ethylene- <i>m</i> -toluidine
PI-143	<i>p</i> -Phenylene diamine
PI-144	<i>m</i> -Phenylene diamine
PI-145	2-Chloro- <i>p</i> -phenylene diamine
PI-146	2,4-Diaminotoluene
PI-147	2,4-Diaminocumene
PI-148	Bis(2-aminophenyl)disulfide
PI-149	Bis(4-aminophenyl)methane
PI-150	Bis(3-aminophenyl)methane
PI-151	Octafluorobenzidine
PI-152	2,5-Diaminotoluene
PI-153	4,4'-Diaminostilbene
PI-154	Bis(4-aminophenyl)sulfone
PI-155	α, α' -Diamino- <i>m</i> -xylene
PI-156	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-157	Bis(4-aminophenyl)sulfone
PI-158	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-159	Bis(4-aminophenyl)sulfone
PI-160	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-161	2-Chloro- <i>p</i> -phenylene diamine
PI-162	2-Chloro- <i>p</i> -phenylene diamine
PI-163	2,6-Dichloro- <i>p</i> -phenylene diamine
PI-164	3,3',5,5'-Tetramethylbenzidine
PI-165	4-Azo-dianiline
PI-166	3,3',5,5'-Tetramethylbenzidine

Table 1. (Continued)

Polyimide Number	Diamine
PI-167	4-Azo-dianiline
PI-168	4-Azo-dianiline
PI-169	4,6-Diaminopyrimidine
PI-170	3,3',5,5'-Tetramethylbenzidine
PI-171	4,6-Diaminopyrimidine
PI-172	4,6-Diaminopyrimidine
PI-173	4,6-Diaminopyrimidine

*Sixty-one different polyimides were prepared in 73 batches.

surface area measurement; background assessment from thermal desorption; and potential artifact products from inorganic gases reacting with the polyimide sorbents.

In Level III, the rating of the best sorbents was reconfirmed for each of the selected polyimides. In addition, the chromatography model was used for multiple, independent assessments to confirm the physical and chemical correlations of the sorbent. This model established a function between specific retention volumes at a specific temperature and the solubility parameters of the solute. Two regression analyses were used in making the correlations: 1) intercepts of retention volumes versus temperature regressions, and 2) slopes of the lines.

Results

The utility of the screening system devised for these sorbents was demonstrated. Following Level III screening, four sorbents, PI-109, PI-115, PI-119, PI-149 (shown in Figure 1), were selected for further studies. In these studies, breakthrough data from chromatographic experiments on these sorbents proved to be reproducible. Finally, the retention volumes of selected organics were one to two orders of magnitude greater for the four polyimides than for Tenax GC®.

Conclusions and Recommendations

Several new solid sorbents have been synthesized that have the potential of either replacing or complementing Tenax GC®.

Additional characterization of these new polyimides is necessary in the area of density, surface area, pore volume, and pore size, etc. Further studies on collection-desorption efficiencies, artifact formation, shelf life, humidity, and the effects of inorganic species such as ozone, nitrogen oxides, and sulfur oxides are also planned. In order to perform these additional studies, larger batches of the four most promising polyimides will have to be prepared. They will be prepared in such a way as to determine batch-to-batch variability, which

has been shown to be a problem in commercially available sorbents.

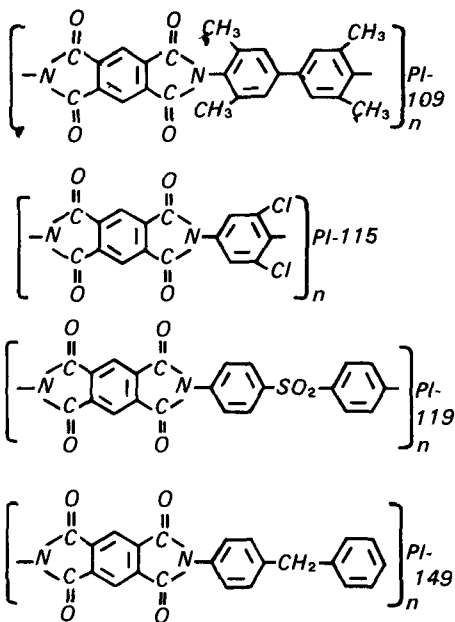


Figure 1. Chemical Structures of the Four Polyimide Sorbents, PI-109, PI-115, PI-119, and PI-149

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James D. Mulik is the EPA Project Officer (see below).

The complete report consists of two volumes, entitled "Preparation and Evaluation of New Sorbents for Environmental Monitoring:"

"Volume I," (Order No. PB 83-195 974; Cost: \$25.00, subject to change)

"Volume II. Synthesis and Quality Control Testing of Sorbents for Air Monitoring," (Order No. PB 83-195 982; Cost: \$7.00, subject to change)

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Project Summary

Evaluation of a Passive Monitor for Volatile Organics

Robert W. Coutant

A laboratory investigation was conducted to determine the potential utility of a commercially available passive dosimeter for monitoring toxic volatile organic compounds at ambient levels. Test compounds included: chloroform, methylchloroform, carbon tetrachloride, trichloroethylene, tetrachloroethylene, benzene, and chlorobenzene.

Feasibility for reduction in device blanks was demonstrated and improvements were made in the analytical procedures. Chamber tests of device performance showed generally good performance at ambient levels, but indicated a severe limitation in sampling ability at relative humidities greater than about 80 percent. Also, generally low results were obtained with carbon tetrachloride. The cause of the observed effect of air velocity on sampling rates was examined on a theoretical basis, and it is recommended that these devices not be employed without adequate ventilation.

It is concluded that at least one currently available passive dosimeter could be useful for monitoring of ambient levels of toxic organic chemicals, and appropriate precautions are indicated.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In recent years an increased awareness of the need for monitoring of individual or personal exposures to pollutants and toxic chemicals of various types has evolved.

This awareness has prompted the development of a variety of personal sampling devices including battery driven pump systems (active systems), passive systems having high specificity for individual compounds, and generalized passive systems intended for collection of volatile organic compounds. Initial applications of these various devices have been concerned with the relatively high concentrations of contaminants found in industrial workplaces. In an earlier program conducted for the Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (RTP), Battelle's Columbus Laboratories (BCL) explored the problems and limitations associated with the potential use of passive devices for monitoring ambient level toxic organic chemicals (1). This current Work Assignment was concerned with the alleviation of some of the problems associated with this application of passive monitors and with a laboratory level evaluation of the performance of passive monitors at ambient concentrations.

The objective of this task was to evaluate the utility of selected passive monitors for their applicability to 24-hour monitoring of volatile organic compounds at typical ambient concentration levels. Seven target compounds that are representative of volatile toxic chemicals relevant to EPA monitoring requirements were considered. These included chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, tetrachloroethylene, benzene, and chlorobenzene.

Procedures

Analytical Methodology

Analyses of exposed badges were performed by solvent extraction of the collectors followed by gas chromatographic

quantitation of sample aliquots. The use of fused-silica capillary column techniques was compared with previously employed packed-column procedures. An in-series combination of electron capture and photoionization detectors was used for quantitation. Reference levels of chemicals used in the exposures were determined by direct gas sampling, using the same chromatographic system.

Device Blanks

Discussions were held with representatives of manufacturers of passive organic samplers for the purpose of determining potential solutions to the problem of high blank levels associated with these devices. One manufacturer, DuPont, supplied several series of devices that were prepared under a variety of conditions. These were then analyzed to determine the most effective means for minimization of blank levels.

Chamber Tests

Triplicate sets of DuPont badges were exposed to the test chemicals at concentrations of 10^{-1} to 10^2 ppbv under well-controlled conditions in a 200 L chamber. Test variables included concentration, relative humidity, and exposure time.

Comparison Basis

The rate of collection of a volatile substance by a passive sampler is determined by the product of the intrinsic sampling rate, a function of the physical characteristics of the device and the diffusion coefficient for each substance, and the exposure concentration. Inasmuch as the effects of these two variables cannot be separated in any given experiment, it must be assumed that one or the other is known. In the current work, it was assumed that the intrinsic sampling rates specified by the manufacturer were correct, and performance comparisons were made relative to the apparent concentrations indicated by the analyses.

Results

Analytical Methodology

Fused-silica capillary column techniques have been used to improve the overall quality of the analytical procedures for passive device analysis. Thermal desorption was shown not to be a viable approach for analysis of the carbon-based collectors used in these devices.

Device Blanks

The problem of high and variable blanks for these devices was discussed with manufacturers, and one manufacturer, DuPont, was able to demonstrate capa-

bility for production of devices having satisfactorily low blank levels, without adding undue cost to the production of the devices. Blanks for the "clean" DuPont badges were close to or below detection limits for the test chemicals.

Chamber Tests

Examples of the DuPont badge were exposed in triplicate sets to concentrations of 10^{-1} to 10^2 ppbv of the test chemicals under controlled chamber conditions. No effect of concentration in this range was discernible. The apparent responses to all of the chemicals were, however, diminished at relative humidities of 80 percent and higher. Relative responses (observed apparent concentration/actual concentration) for a given chemical were strongly correlated to responses for other chemicals with the same badge, i.e., when the response for one chemical was high, responses for all other chemicals on the same badge also tended to be high. This observation suggests that differences from one badge to the next were due largely to variations in physical parameters of the individual badges. In some cases, this was believed to have been caused by faulty seals between the diffusor plates and the collector chambers. One approach to illustrate the potential magnitude of the variability due to badge construction problems is to normalize the responses for each badge with respect to the mean response for that badge. The standard deviations in response for a given chemical can be compared for the raw data and normalized data to yield a measure of the effect. A summary of average responses obtained for each chemical studied and the standard deviations before and after normalization is shown in Table 1. These data suggest that approximately one-half of the variation observed in the raw data may be due to physical differences between the individual devices. The remaining variation is consistent with the total analytical uncertainty associated with the procedures that were used.

Table 1. Average Response Ratios

Chemical	Raw Data		Normalized Data	
	R	SDev	R	SDev
Chloroform	0.94	0.29	0.96	0.12
Methylchloroform	1.19	0.31	1.19	0.18
Carbon tetrachloride	0.73	0.26	0.71	0.11
Trichloroethylene	1.07	0.32	1.05	0.13
Tetrachloroethylene	0.98	0.33	0.96	0.11
Benzene ^(a)	(0.97)	(0.45)	(0.94)	(0.17)
Chlorobenzene ^(a)	(0.96)	(0.34)	(1.07)	(0.28)

^(a) Limited data (indicated by parentheses).

Conclusions and Recommendations

It is concluded that the blank and analytical problems previously identified for the use of passive monitors at ambient levels of toxic volatile organic compounds can be minimized satisfactorily. The use of thermal desorption for the analysis of carbon-based collectors used in these devices is not recommended. Chamber tests of the performance of the DuPont badge indicate that reasonably accurate sampling can be achieved at concentrations of 10^{-1} to 10^2 ppbv as long as the relative humidity is below approximately 80 percent. However, at relative humidities higher than about 80 percent the apparent sampling rates are reduced by about 50 percent. The available list of sampling rates need to be extended and validated, but this aspect is being pursued independently by the manufacturer. Sources of occasional high apparent sampling rates are believed to be related to variations in manufacturing quality control and this too is being investigated by DuPont.

It is recommended that further consideration be given to the performance of passive devices under field conditions. In these tests, passive monitors should be compared with currently used active devices and with direct sampling and analysis methodology where possible.

References

1. Coutant, R. W., and D. R. Scott, "Applicability of Passive Dosimeters for Ambient Air Monitoring of Toxic Organic Compounds." *Environ. Sci. Technol.*, 16 410-413 (1982).

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*The complete report, entitled "Evaluation of a Passive Monitor for Volatile
Organics," (Order No. PB 83-194 464; Cost: \$10.00, subject to change) will be
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Project Summary

Ambient Acrylonitrile Levels Near Major Acrylonitrile Production and Use Facilities

Stephen J. Howie and Eugene W. Koesters

This summary describes a study undertaken to determine the acrylonitrile (AN) levels near selected manufacturing plants that are either major users or producers of AN, and also to measure the difference, if any, in the concentration levels near the two types of facilities. Data gathering was done over a four-month period, and involved taking 24-h air samples on charcoal tubes for 10-12 consecutive days near the selected plant sites.

Results show that many factors affect the recorded AN levels, including meteorological conditions, distance of sampling site from plant, and certain geographical elements (such as bodies of water). Although study results point to higher AN concentration levels near user facilities than producers, the study did not provide an adequate data base from which to draw definite conclusions.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report describes a study in which data were gathered to verify the presence of ambient acrylonitrile (AN) in the vicinity of industrial plants that are major users or producers of AN. This study was also to determine the difference, if any, of AN concentration levels near user and producer facilities.

PEDCo Environmental, Inc., performed the field work, which involved taking 24-h

air samples on charcoal tubes for 10 to 12 consecutive days at sampling stations near the selected plants. Data gathering took place from June through September 1981 at the following facilities:

- Monsanto in Texas City, Texas
- Monsanto in Decatur, Alabama
- Borg-Warner in Washington, West Virginia
- Vistron (SOHIO) in Lima, Ohio

Procedure

A preliminary one-day pilot test was conducted in the vicinity of each plant to evaluate the performance of two different size adsorbing tubes. Based on the pilot test results, 150-mg standard charcoal sorption tubes were used during this study.

After samples were taken, tubes were stored on dry ice before shipment to the two analysis laboratories (PEDCo, Cincinnati, Ohio and Research Triangle Institute [RTI], Research Triangle Park, North Carolina). Samples were shipped in insulated boxes containing an ice substitute chilled before shipment to the temperature of dry ice. Quality control and field samples between the two laboratories were shipped in insulated boxes containing dry ice. During the pilot test, samples were split evenly between RTI and PEDCo for analysis. During the actual data gathering test, PEDCo was the primary analysis laboratory, and a designated portion of replicate field samples was sent to RTI to determine interlaboratory method precision.

In evaluating the data presented in this report, the following factors must be considered:

- Location of sampling stations was influenced by the practicality of ob-

taining access permission to many areas, and by the presence of physical barriers, such as bodies of water, near plants to be tested.

- "Normal" plant operations were verified with Monsanto, Borg-Warner, and Vistron personnel during testing, but recording day-to-day events affecting potential AN emissions (such as production and use or process upsets) was beyond the scope of this project.
- Month-to-month and seasonal variations in AN levels are not accounted for.

The report presents details of the techniques used for sampling and for analysis by gas chromatography. Because of the small number of measurements involved, precision and accuracy assessments were not made during the pilot test. During the actual data gathering efforts the following precision and accuracy assessments were made:

- Charcoal tubes were spiked with AN. These tubes were prepared in quadruplicate and divided evenly between PEDCo and RTI for analysis.
- Samples were analyzed in duplicate to assess laboratory method precision.
- Collocated field samples were divided between PEDCo and RTI to determine interlaboratory method precision.
- Samples were analyzed by gas chromatography/mass spectrometry (GC/MS) to confirm the presence of AN.
- Sample flow rates were set and checked by a flow measurement device (proven linear and accurate to ± 5 percent throughout the flow measurement range used). Initial and final sample flow rates were recorded to correct sample volume error due to changes in sample flow rate over time.

In cases where wind speed and direction information was gathered, the following operation checks were made daily to ensure collection of accurate data:

- Check of wind zero accuracy
- Check of wind direction accuracy
- Data inspection to spot trends

Results

Various levels of AN were found in the vicinity of each plant tested. Table 1 presents the results of the highest AN levels found in each sample day, the distance from the AN use or production areas at which the sample was collected, and the average values for each plant. This table indicates that the facilities that use AN (Monsanto--Decatur, AL and Borg-Warner--Washington, WV) generally are associated with higher ambient AN concentrations than the producer facilities (Monsanto--Texas City, TX and Vistron--Lima, OH). However, it is not clear from these limited data whether the higher fenceline levels found at the producer facilities were due to higher AN emissions or other factors, such as sampler proximity to the AN sources.

Listed below are the results of interlaboratory bias (IB) assessments based on analyses of charcoal tubes spiked with AN. IB assessments showed a greater probability of error at the Texas City Monsanto plants than at the other three plants. An analytical inconsistency was discovered following analysis of this plant's samples; but after remedial steps were taken these tests showed a marked improvement.

SITE	IB (%)
Texas City, TX	34.1
Decatur, AL	26.8
Washington, WV	7.4
Lima, OH	6.0

(Based on pooling all data, the overall IB was 10.6%.)

Table 2 presents the results of additional precision and accuracy assessments. Interlaboratory total method precision, based on dividing collocated field samples between analysis laboratories, is the assessment showing the "worst case" precision error encountered. The precision estimates obtained using interlaboratory analysis of collocated field samples showed a variation coefficient of 14.6 percent at levels above 10 ppb. Below 10 ppb, precision data showed a variation coefficient of 22.8 percent. (Since this type of precision error showed different characteristics above and below 10 ppb, different computation methods were used.) Other precision assessments presented in Table 2 indicate that collocated field samples analyzed by only one laboratory (intra-laboratory total method precision) showed improved reproducibility, and that analytical precision (repeat analyses of desorbed samples) was not a significant source of error in either of the analysis laboratories. Breakthrough determinations demonstrated that AN was efficiently collected by the charcoal sampling tubes, as approximately 90 percent of the AN found was contained in the first sections of charcoal.

Conclusions and Recommendations

Confirmation GC/MS analyses of selected samples (samples showing AN by GC/FID analysis) showed positive identification of AN in all cases which indicates that interfering compounds were not causing erroneous measurement of AN.

Dispersion modeling consideration, typically used to support monitoring activities as well as the regulatory decision-making process, indicate a decrease of pollutant concentration with distance from the AN use or production area. This decrease can be substantial in distance ranges of, for example, 0.1 to 2.0 km, and may be

Table 1. Highest AN Values on Each Sample Day
Values are in parts per billion (ppb)

	Sample day												Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Monsanto TX (prod)	11.	24.	5.4	4.7	8.1	15.	13.	6.6	5.2	5.2	-	-	9.8
distance (km)	0.5	0.3	0.7	0.5	0.5	0.5	0.3	0.3	0.5	0.3			0.44
Monsanto AL (use)	20.	36.	57.	15.	10.	11.	50.	37.	52.	130.	97.	14.	44.1
distance (km)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Borg-Warner WV (use)	8.1	20.	83.	29 ^a	11.	17.	33.	30.	55.	11.	-	-	29.7
distance (km)	1.0	0.8	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5			0.6
Vistron (SOHIO) OH (prod)	TR ^b	TR ^b	4.0	4.1	TR ^b	8.4	6.1	6.0	TR ^b	TR ^b	-	-	>4.1
distance (km)	2.0	2.0	2.0	2.0	0.8	0.8	0.8	0.8	1.0	0.6			1.3

^aProperty enclosed by Borg-Warner fenceline on all sides.

^bTR is less than 2.5 ppb; assumed to be 2.5 for averaging.

Table 2. Summary of Quality Assurance Precision and Breakthrough Tests

	Total method precision		Analytical Precision		Breakthrough	
	Interlaboratory	Intralaboratory	RTI	PEDCo	RTI	PEDCo
Below 10 ppb, %	22.8	8.9	N/A ^a	N/A ^a	N/A ^a	N/A ^a
Above 10 ppb, %	14.6	6.5	N/A ^a	N/A ^a	N/A ^a	N/A ^a
Combined, %	N/A ^b	N/A ^b	2.2	1.9	10.5	12.3

^aData below and above 100 ppb were combined since different measured levels appeared to have little effect on results.

^bData could not be combined due to different characteristics at different ranges.

partially responsible for the lower AN levels found near the producer facilities.

A more detailed sensitivity analysis is necessary to investigate and identify those factors contributing to maximum concentrations at each plant. The results at hand suggest that AN concentrations near user facilities are higher than near producers, but do not necessarily provide an adequate data base from which to draw definite conclusions.

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The complete report, entitled "Ambient Acrylonitrile Levels Near Major Acrylonitrile Production and Use Facilities," (Order No. PB 83-196 154; Cost: \$16.00, subject to change) will be available only from:

National Technical Information Service
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The EPA Project Officer can be contacted at:

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