Volatile Organic Compound Survey and Summarization of Results

for

Canada Mortgage and Housing Corporation
OTTAWA, ON

by

Dr. Rob Dumont
Lawrence Snodgrass
Building Science Division

Technology Transfer and Business Development Branch

Saskatchewan Research Council
15 Innovation Boulevard
Saskatoon, Saskatchewan
S7N 2X8
Telephone: (306) 933-6138
Fax: (306) 933-6431

SRC Publication No.
I-4800-1-C-92
Revised April 1992

DISCLAIMER

ACKNOWLEDGEMENT

The authors would like to acknowledge the assistance of the following individuals:

1. Dara Bowser, of Bowser Technical Services, for providing all the data for the Tillsonburg homes.

2. Andrea Roach, of the Saskatchewan Research Council, for typing of the manuscript.

3. Virginia Solaris, of the Canada Mortgage and Housing Corporation, for her comments.

4. Rein Otson, of Health and Welfare Canada, for his comments.

The report, however, is the responsibility of the authors.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES
APPENDIX 1

EXECUTIVE SUMMARY

A survey was conducted on volatile organic compounds (VOCs) in residences in Saskatchewan and Ontario.

A sample of 44 homes in total was surveyed for 26 individual VOCs and also for total volatile organic compounds (TVOCs). Twenty-four houses in Tillsonburg, Ontario and 20 houses in Saskatchewan [Saskatoon (15), Regina (5)] were included in the sample.

Data from both the questionnaire and physical measurements include the following additional information:

1. Air change rates measured by the Perfluorocarbon Tracer Technique.

2. Relative humidity and temperature values.

3. Information on specific items in the houses that might contribute to VOC levels.

The survey found that only 10 of the 44 houses had TVOC readings less than 200 ug/m^3, with the remaining 34 houses reading 200 to 1913 ug/m^3. The average TVOC reading was 555 ug/m^3, and the standard deviation was 468 ug/m^3. The maximum value measured was 1913 ug/m^3.

RÉSUMÉ

Des maisons de la Saskatchewan et de l'Ontario ont fait l'objet d'un prélèvement de la concentration des composés organiques volatils.

L'échantillon de 44 maisons retenu visait à découvrir la présence possible de 26 composés individuels et à établir leur concentration totale. Ainsi, 24 maisons étaient situées à Tillsonburg (Ontario), 20 en Saskatchewan, dont 15 à Saskatoon et 5 à Regina.

Les questionnaires et les mesures prélevées ont permis de recueillir les informations suivantes :

1. le taux de renouvellement d'air établi selon la technique faisant appel à un gaz de traçage, l'hydrocarbure fluoré entièrement halogéné.

2. la température et le degré d'humidité relative.

3. Des renseignements sur des aspects précis de la maison risquant d'influer sur la concentration des composés organiques volatils.

L'enquête a révélé que seulement 10 des 44 maisons enregistraient une concentration totale de COV inférieure à 200 ug/m^3, alors que celle des 34 autres variait entre 200 et 1 913 ug/m^3. Le relevé moyen de la concentration totale de COV était de 555 ug/m^3 et l'écart moyen de 468 ug/m^3. La valeur maximale enregistrée se situait à 1 913 ug/m^3.

EXPOSÉ

Les conditions suivantes ont été constatées, d'une part, dans les maisons enregistrant une concentration totale élevée de COV (>750 ug/m^3) et d'autre part, dans celles en ayant enregistré une faible concentration totale (<200 ug/m^3) :

Humidité relative élevée	(34,9 % contre 32,7 %)
Température élevée	(21,4 % contre 20,8 %)
Faible taux de renouvellement d'air	(0,30 RA/heure contre 0,36 RA/h)
Maisons récentes	(1975 contre 1969)
Usage plus répandu de panneaux de particules	(40 % contre 20 %)
Usage moindre de la ventilation continue	(0 % contre 20 %)
Usage plus répandu de peinture dans les 30 jours précédents	(30 % contre 10 %)
Nombre plus élevé de fumeurs dans la maison	(0,6 contre 0,3)
Maison caractérisée par une qualité de l'air de beaucoup inférieure à la moyenne	(10 % contre 0 %)
Usage plus répandu de Pinesol	(30 % contre 0 %)
Usage plus répandu de parfums (nombre de fois par semaine)	(5,5 contre 4,0)

Le faible échantillon ne permet pas de tirer des conclusions générales. Par contre, l'association des concentrations totales élevées de VOC avec de nombreuses causes probables présente un intérêt.

Molhave (3) propose dans le tableau suivant les degrés d'inconfort découlant de l'exposition à des solvants comme les composés organiques volatils.

Concentration totale en microgrammes/m^3	Irritation et inconfort	Plage d'exposition
< 200	aucune irritation ni inconfort	plage de confort
de 200 à 3 000	possibilité d'irritation ou d'inconfort	plage d'exposition à facteurs multiples
de 3 000 à 25 000	effet d'exposition et possibilité de maux de tête en cas d'autre interaction	plage d'inconfort
> 25 000	possibilité d'autres effets neurotoxiques que les maux de tête	plage d'effets toxiques

Selon les indications du présent rapport, seulement 10 des 44 maisons enregistraient des concentrations totales de COV inférieures à 200 ug/m^3, alors que celle des 34 autres variait entre 200 et 3 000 ug/m^3.

Les valeurs relevées dans ces maisons étaient inférieures à celles qu'avaient enregistrées dans un environnement de bureau au Canada Tsuchiya (1) qui situe la plupart des concentrations totales de VOC dans la plage de 1 000 à 3 000 ug/m^3.

La valeur moyenne enregistrée pour les 44 maisons était de 555 ug/m^3.

CMHC SCHL

Helping to house Canadians

National Office

700 Montreal Road
Ottawa, Ontario
K1A 0P7

Question habitation, comptez sur nous

Bureau National

700 chemin Montréal
Ottawa (Ontario)
K1A 0P7

Puisqu'on prévoit une demande restreinte pour ce document de recherche, seul le sommaire a été traduit.

La SCHL fera traduire le document si la demande le justifie.

Pour nous aider à déterminer si la demande justifie que ce rapport soit traduit en français, veuillez remplir la partie ci-dessous et la retourner à l'adresse suivante :

Le Centre canadien de documentation sur l'habitation
La Société canadienne d'hypothèques et de logement
700, chemin de Montréal, bureau C1-200
Ottawa (Ontario)
K1A 0P7

TITRE DU RAPPORT : _____

_____

Je préférerais que ce rapport soit disponible en français.

NOM _____

ADRESSE _____
rue *app.*

_____
ville *province* *code postal*

No de téléphone ( ) _____

1946 CMHC SCHL 1991 45

TEL: (613) 748-2000
Canada Mortgage and Housing Corporation Société canadienne d'hypothèques et de logement

Canada

INTRODUCTION

Some volatile organic chemicals are known to be human irritants or carcinogens (Molhave, 1990).

In a recent paper by Tsuchiya(1), the total volatile organic compound (TVOC) levels in 100 Canadian non-residential buildings were found to vary from 100 to 100,000 ug/m^3, with most readings in the range of 1000 to 3000 ug/m^3, while outdoor total volatile organic compound levels were about 100 ug/m^3.

At the recent Indoor Air '90 Conference in Toronto (July-August, 1989), a level of 200 ug/m^3 for TVOC for human occupancies was suggested as a no effect level (Molhave, 1990). In addition, limits on the known irritant and carcinogenic volatile organic compounds were also recommended.

It is believed that the major contributors to VOC levels in houses include the following:

- Carpets
- Carpet underlays
- Vinyl flooring
- Paints (particularly paints that have recently been applied.)
- Household cleaning products and waxes
- Cooking odours
- Combustion gases
- Textiles
- Tobacco smoke
- Molds and fungi
- Human bioeffluents
- Hair spray
- Disinfectant spray
- Glues
- Wood products

In this report, VOC measurements are reported for a group of 20 houses in Saskatchewan and 24 houses in Ontario. The Saskatchewan houses were located in Saskatoon(15) and Regina(5). The 24 Ontario houses were all located in Tillsonburg.

In order to better define the physical characteristics of the houses in which the volatile organic chemical measurements were made, a group of Saskatchewan houses that were used in the 1989 Canadian Survey of Airtightness of New Merchant Builder Detached Homes were used again.

The houses in Tillsonburg, Ontario, were from an older housing stock, dating to the 1890's.

DESCRIPTION OF WORK

A. A questionnaire/information sheet for each house was developed. The questionnaire provided basic house information and occupant characterization. A copy of the questionnaire is provided in Appendix 2.

B. On-site Measurements

On-site measurements were taken in 20 Saskatchewan homes. The measurements included the following:

a. Passive Volatile Organic Compound (VOC) Sampler
b. Perfluorocarbon tracer gas air change rate samplers.
c. Temperature measurement inside the home.
d. Humidity measurement inside the home.
e. Description of pollutant sources contributing to VOC levels inside the home.

The on-site measurements were made over the period from January 14, 1991 to February 11, 1991.

C. The field data from the Saskatchewan houses was combined with the field data from the houses from Ontario, and the results tabulated.

RESULTS

A large amount of data were gathered in the project, both data from the questionnaires and physical measurements. Included in the data are the following:

A. Air Change Rates Measured By the Perfluorocarbon Tracer Technique

A histogram of the air change rates measured using the PFT's is shown in Figure 1. The PFT devices were placed in the houses for a one-week period. The average air change rate was 0.34 ac/h for the 44 houses, and the median rate was 0.31 ac/h. In Figure 2 there is a plot of the air change rate as a function of the year that the houses were constructed.

B. Total Volatile Organic Compound Levels

The Total Volatile Organic Compound (TVOC) Levels were measured using a 3M passive sampler placed in the houses for a 24-hour period. The passive samplers were analyzed for TVOC levels using a flame ionization detector.

A histogram of the TVOC levels for the 44 houses is given in Figure 3. The average and median values were 555 and 461 ug/m^3 respectively, and the standard deviation was equal to 468 ug/m^3.

A plot of the TVOC levels as a function of the air change rate for the 44 houses is presented in Figure 4. A linear least squares regression of TVOC levels versus the inverse of the air change rate was calculated. The following regression was developed:

$$TVOC = 686.7 - 382/ac$$

$$R^2 = 0.0215$$

Std error of y estimate = 475 ug/m^3

Number of points = 44

As can be seen, the index of determination (R^2) at 0.0215 was very low (a perfect correlation would have an R^2 value of 1.0). The index of determination is a measure of the ratio of the explained variation to the total variation.

The TVOC values were also plotted against the year of construction of the houses (Figure 5). As can be seen from the plot, only a very weak correlation between the two variables was found ($R^2 = 0.00790$).

C. Individual Volatile Organic Compound Levels

A total of 26 volatile organic compounds were individually measured using the passive samplers and a gas-chromatograph with a mass selective detector. The 26 compounds are listed in Table 1.

Table 1. 26 VOCs That Were Analyzed

n-hexane
dichloromethane
benzene
dodecane
trichloroethylene
chloroform
a-pinene
tetrachloroethylene
toluene
1,2-dichloroethane
ethylbenzene
p-xylene
m-xylene
o-xylene
d-limonene
1,3,5-trimethyl benzene
styrene
p-cymene
1,2,4-trimethyl benzene
1,3-dichlorobenzene
pentachloroethane
hexachloroethane
1,4-dichlorobenzene
1,1,2,2-tetrachlorobenzene
1,2,4-trichlorobenzene
naphthalene

The full description of the analysis procedures is contained in a report by Concord Environmental Services (5).

The analytical laboratory ran a number of duplicate samples of the above tests, and the results of the duplicates are shown in Figures 6, 7, and 8. The values plotted are the quantitative readings for the 26 individual compounds in the original sample plotted against the values from the analytical duplicate.

The standard error, slope value, and R^2 values for each of the 3 linear regressions of the analytical duplicates were as follows:

Table 2. Comparison of Analytical Duplicates

Figure	Standard Error ug/m^3	Slope Value	R^2
6	1.2	1.01	.96

7	6.2	0.71	.89
8	2.1	1.40	.96

As can be seen from the linear least squares regressions, the R^2 values are high (0.89 or greater), but the slope values range as high as 1.4. (Ideally, the slope value should be 1.0 and the R^2 should also be 1.0.) The one graph (Figure 8) with the slope of 1.4 also represented the sample with the lowest individual set of readings (<13 ug/m^3) of the three analytical duplicates. The highest standard error in the y estimates was 3.5 ug/m^3. These standard errors give a rough indication of the repeatability of the analytical technique. (In a normally distributed population, 95.5% of the readings should agree within plus or minus two standard error values.)

In addition to the above analytical duplicates, a further check of the consistency of the readings was done by placing side-by-side sensors in four of the houses. In Figures 9, 10, 11, and 12 the results of the side-by-side tests are done. Because of the high cost of the analysis (approximately $200 per sample), only 4 side-by-side tests were done.

The standard error, slope value, and R^2 values for each of the 4 linear regressions of the side-by-side samples were as follows:

Table 3. Comparison of Side-By-Side Samples

Figure	Standard Error ug/m^3	Slope Value	R^2
9	6.2	0.71	.89
10	10.6	1.2	.87
11	3.5	0.99	.46
12	6.2	1.5	.82

The following compounds were identified in the houses. The numbers shown are the averages, maximums, and standard deviations for each of the 26 compounds for the 44 houses that were tested.

Table 4. Average Values, Standard Deviations and Maximums for the 26 VOCs.

	Average ug/m^3	St.Dev. ug/m^3	Max ug/m^3
n-hexane	14.5	20.9	99.4
dichloromethane	13.7	21.0	129.0
benzene	15.0	9.3	42.3
dodecane	14.7	15.4	91.9
trichloroethylene	2.3	2.6	6.5
chloroform	4.5	5.6	23.6
a-pinene	29.7	30.7	169.5
tetrachloroethylene	8.2	4.6	30.0
toluene	23.9	29.7	110.5
1,2-dichloroethane	7.4	7.2	25.0
ethylbenzene	9.6	7.3	32.9
p-xylene	7.3	5.2	21.7
m-xylene	14.3	11.8	52.5
o-xylene	5.7	4.3	20.3
d-limonene	18.5	12.2	53.8
1,3,5-trimethyl benzene	5.1	4.0	15.0
styrene	4.1	3.5	11.3
p-cymene	6.0	4.8	19.1
1,2,4-trimethyl benzene	9.9	9.0	45.7
1,3-dichlorobenzene	3.0	3.2	8.5
pentachloroethane	2.2	3.1	12.3
hexachloroethane	1.7	3.1	8.4
1,4-dichlorobenzene	12.8	50.9	337.5
1,1,2,2-tetrachlorobenzene	3.0	3.4	9.8
1,2,4-trichlorobenzene	3.7	4.6	14.0
naphthalene	7.2	7.9	30.0

(The minimum values were all below the detection limit of 2 ug/m^3.)

The above 26 VOCs were ones that were chosen according to Health and Welfare Canada (HWC)(4) requirements and analytical limitations for a series of indoor air quality studies by HWC. In reference 4 the limitations of the technique are discussed. The naphthalene and styrene determinations are of limited value using this particular technique.

The VOC analysis was done by analyzing the passive samplers using a gas chromatograph/mass spectrometer.

A comparison of the average levels for the 26 VOCs with the American Conference of Government Industrial Hygienists(2) Threshold Limit Values (TLVs) is presented in Table 5.

Table 5. Comparison of the Average Values With the TLVs

	Average ug/m^3	TLV ug/m^3	Ratio
n-hexane	14.5	180,000	12,143
dichloromethane	13.7	175,000	12,773
benzene	15.0	30,000	2,000
dodecane	14.7	na	
trichloroethylene	2.3	270,000	117,391
chloroform	4.5	50,000	11,111
a-pinene	29.7	na	
tetrachloroethylene	8.2	335,000	40,854
toluene	23.9	375,000	15,690
1,2-dichloroethane	7.4	40,000	5,405
ethylbenzene	9.6	435,000	45,313
p-xylene	7.3	435,000	59,589
m-xylene	14.3	435,000	30,419
o-xylene	5.7	435,000	76,316
d-limonene	18.5	na	
1,3,5-trimethyl benzene	9.9	125,000	24,509
styrene	4.1	215,000	52,439
p-cymene	6.0	na	
1,2,4-trimethyl benzene	9.9	125,000	12,626
1,3-dichlorobenzene	3.0	na	
pentachloroethane	2.2	na	
hexachloroethane	1.7	100	59
1,4-dichlorobenzene	12.8	450,000	3,125
1,1,2,2-tetrachloroethane	3.0	7,000	2,333
1,2,4-trichlorobenzene	3.7	40,000	10,811
naphthalene	7.2	50,000	6,944
Sum of the 26 VOCs			

In order to get a quantitative overall number for each house, the sum of the individual VOCs listed above were calculated for each house. A histogram showing the sum of the above 26 VOCs for the 44 houses is given in Figure 13. The average of the sum of the 26 VOCs was 245 ug/m^3, while the median was 237 ug/m^3.

A plot of the sum of the 26 VOCs versus the TVOC level for each of the 44 houses is shown in Figure 14. As can be seen from the graph, the correlation between the two variables is low, with an R^2 value of only 0.275. On average, the TVOC levels were 554 ug/m^3, while the average of the sum of the VOCs measured was 247 ug/m^3. At the lower levels, the sum of the VOC readings in some instances exceeded the TVOC readings.

D. Relative Humidity

A plot of the relative humidity level measured in the living room of each house as a function of the air change rate is presented in Figure 15. The air change rate is presented on the horizontal axis. As can be seen, the correlation is weak. This is understandable, given the fact that houses from different climates are included. In addition, the houses had different numbers of occupants, and also some houses had humidifiers. If, however, a subset of the houses is plotted, namely, the houses in Tillsonburg that do not have humidifiers, a clearer relationship emerges. In Figure 16, the data is presented. As can be seen, for these 16 houses, the R^2 value for the linear least squares plot of relative humidity versus the inverse of the air change rate is 0.479.

E. Correlation Between TVOCs and Information in the Questionnaires

In this section of the report, the relationship between the TVOC readings and information gained from the house questionnaires will be analyzed. As mentioned earlier, the questionnaire is presented in Appendix 2.

In Appendix 1, the TVOC data for the 44 houses is presented along with data on the houses. Tables 1.1 through 1.14 in Appendix 1 present all the data recorded on the questionnaires. The houses are listed in ascending values of TVOC, ranging from <50 to 1913 ug/m^3. The first 10 houses in the table have TVOC levels less than 200 ug/m^3. The last 10 houses in the table have TVOC levels greater than 750 ug/m^3. The house codes used may be compared with the codes used in the Concord Report using the cross-reference table presented in Appendix 3.

In response to Question 1, the houses with TVOC levels less than 200 ug/m^3 had an average year of construction of 1969, while the houses with TVOC levels exceeding 750 ug/m^3 had an average year of construction of 1975.
The breakdown of TVOC levels according to the number of storeys was as follows:

Table 6. TVOC Levels Compared with the Type of House

TVOC Level (ug/m^3)	1 Storey	2 Storey	Other
< 200	3	4	3

> 750	5	2	3

The air change rate for the low TVOC group was 0.36 ac/h; the air change rate was 0.30 ac/h for the higher group.

In response to Question 4, the type of basements were as follows:

Table 7. TVOC Levels Compared With the Type of Basement

TVOC Level (ug/m^3)	Cast Concrete	Concrete Block	Other
< 200	7	0	4
> 750	7	3	0

In response to Question 5, the TVOC levels are presented in ascending order along with information on the type of exterior finish (Brick, Aluminum Siding, Vinyl Siding, Wood Siding, Stucco, and Other).

Table 8. TVOC Levels Compared With the Type of Siding

TVOC Level (ug/m^3)	Brick	Alum.	Vinyl	Stucco
< 200	6	2	3	0
> 750	3	0	3	5

In response to Question 6, the presence of any unusual exterior pollution sources is noted. For homes <200 ug/m^3, 4 of the houses reported that there were such sources, all of which were agriculture related. For homes >750 ug/m^3, only one house reported such an exterior pollution source.

In reply to Question 7 regarding odours from exterior pollution sources, 7 of the houses with TVOCs <200 ug/m^3 reported such sources, and 6 of the 10 houses with TVOCs >750 also reported such sources. The most commonly mentioned source was manure.

In reply to Question 8, almost all the houses reported that the land which was used for the house was agricultural.

In reply to Question 9, the vast majority of houses used

spruce lumber for wall framing. Only 4 houses out of 44 used fir lumber.
In reply to Question 10 regarding floor joist material, the breakdown according to TVOC readings was as follows:

Table 9. TVOC Levels Related to Type of Floor Joists

TVOC Level (ug/m^3)	Spruce Joists	Fir Joists	Pine Joists	Other Don't Know
< 200	1	2	3	4
> 750	2	3	0	5

In reply to Question 11 regarding subfloor materials, the breakdown was as follows:

Table 10. TVOC Levels Related To the Type of Subfloor Materials

TVOC Level (ug/m^3)	Spruce	Fir	Pine	Waferboard	Other Don't know
<200	1	5	0	0	4
>750	5	2	0	1	2

In reply to Question 12 regarding the type of wood underlay, the breakdown was as follows:

Table 11. TVOC Levels Related To the Type of Wood Underlay on the Floors.

TVOC Level (ug/m^3)	Particle Board	Spruce Plywood	Fir Ply.	Wafer Board	None	Other
<200	2	1	0	0	4	2
>750	4	2	0	2	3	0

In reply to Question 14, the dominant structural material for the kitchen cabinets for the houses was particle board.

In reply to Question 16 regarding the use of ventilation equipment on a continuous basis, only 4 out of the 44 houses

had continuously running ventilation. Two of the ten houses in the low TVOC range (<200 ug/m^3) had continuously running ventilation. None of the houses in the >750 ug/m^3 range had continuous ventilation.

In response to Question 17, only 1 house in the low TVOC category had a central humidifier on the warm air furnace. Four houses in the >750 ug/m^3 range had central humidifiers. The average humidity level measured in the low TVOC houses was 32.7%; the average humidity level in the high TVOC houses was 34.0%. The average air temperature in the low TVOC group was 20.8°C; the average temperature in the high TVOC group was 21.4°C.

In response to Question 20, the following chemicals were stored in the houses in the two TVOC categories:

Table 12. TVOC Levels Related to Storage of Chemicals Under the Houses

TVOC Level (ug/m^3)	Paint	Solvents	Insect-icides	Fertil-izer	Paint Strip	Other
< 200	8	3	2	1	2	2
> 750	7	4	2	0	2	1

In response to Question 21 regarding the use of paints, etc. inside the house in the 30-day period prior to the placement of the VOC badges, the response was as follows:

Table 13. TVOC Levels Related To Use of Products In the Previous 30 Days

TVOC Level (ug/m^3)	Paint	Floor Wax	Paint Strip	Insect-icides	Furn. Polish	Rug Shamp.	Other
< 200	1	1	0	0	7	2	1
> 750	3	1	1	0	5	1	4

In Question 22, the effect of the number of smokers is investigated. The TVOC relationship to the number of smokers is presented in the following table:

Table 14. TVOC Levels Related To Smoking Inside the House

TVOC Level (ug/m^3)	Number of Smokers (average)	Number of Cigarettes/Day (average)
< 200	0.3	4.0
> 750	0.6	5.4

In Question 23, the presence of wood stoves or fireplaces is investigated. The response was as follows:

Table 15. TVOC Levels Related To Wood Stove or Fireplace Use

TVOC Level (ug/m^3)	Wood Stoves/ Fireplaces	Use Per Week (average)
< 200	5	1.55
> 750	5	1.33

In response to Question 24 regarding significant renovations since the house was completed, 5 of the low TVOC houses reported such renovations, as did 5 of the high TVOC houses.

In response to Question 25, the TVOC levels are related to the judgment of the person doing the questionnaire regarding the air quality in the house.

Table 16. TVOC Levels Related To Air Quality Assessment

TVOC Level (ug/m^3)	Much Worse Than Avg.	Worse Than Avg.	Average	Better Than Avg.	Much Better
< 200	0	1	3	6	0
> 750	1	1	3	5	0

In response to the question regarding dishwasher use, the TVOC levels related to the uses per week of dishwashers were as follows:

Table 17. TVOC Levels Related To Dishwasher Use and Detergent Type

TVOC Level (ug/m^3)	Dishwasher Use Per Week (average)	Most Popular Dishwasher Detergent
< 200	5.4	Sunlight (4)
> 750	5.2	Cascade (5)

In response to the question regarding the type of laundry detergent, the responses were as follows:

Table 18. TVOC Levels Related To Laundry Detergent Use

TVOC Level (ug/m^3)	Detergent Use Per Week (average)	Most Popular Clothes Detergent
< 200	8.9	Tide (7)
> 750	8.7	Tide (6)

In response to questions regarding the type of general purpose cleaner that was used, the responses were as follows:

Table 19. TVOC Levels Related To Use of General Purpose Cleaner

TVOC Level (ug/m^3)	General Purpose Cleaner Used Per Week (average)	Most Popular General Purpose Cleaner
< 200	2.3	Comet (3) Mr. Clean (3)
> 750	1.9	Pinesol(3) Mr. Clean(3)

In Question 28, the type of hair spray and the number of uses per week are listed. The breakdown was as follows:

Table 20. TVOC Levels Related To Hair Spray Use

TVOC Level (ug/m^3)	Hair Spray Uses Per Week (average)	Most Popular Hair Spray
< 200	9.4	Silkience(2)
> 750	7	Alberto(3)

In Question 28, the use of perfume is also listed. The breakdown was as follows:

TVOC Level (ug/m^3)	Perfume Uses per week	Most Popular Perfume
< 200	4.0	No one brand
> 750	5.5	Alfred Sung

DISCUSSION

The following conditions were associated with the group of houses with the high (>750 ug/m^3) TVOC readings as compared with the low (<200 ug/m^3) TVOC readings:

Higher Relative Humidity	(34.0% vs 32.7%)
Higher Temperature	(21.4°C vs 20.8°C)
Lower Air Change	(0.30 ac/h vs 0.36 ac/h)
Newer Homes	(1975 vs 1969)
Higher Use of Particle Board Underlay	(40% vs 20%)
Lower Use of Continuous Ventilation	(0% vs 20%)
Higher Use of Paint In Previous 30 Days	(30% vs 10%)
Higher Number of Smokers per House	(0.6 vs 0.3)
House With Much Worse Than Average Air Quality Assessment	(10% vs 0%)
Higher Use of Pinesol	(30% vs 0%)
Higher Use of Perfume (times/week)	(5.5 vs 4.0)

Because of the small sample size involved, one cannot generalize from the results. However, the association of higher TVOC levels with many likely causative factors is of interest.

Molhave(3), has suggested the following table for discomfort resulting from exposure to solvent like volatile organic compounds.

Total Concentration micrograms/m^3	Irritation and Discomfort	Exposure Range
< 200	no irritation or discomfort	the comfort range

200 to 3000	irritation and discomfort possible	the multifactorial exposure range
3000 to 25000	exposure effect & probable headache possible if other exposures interact	the discomfort range
> 25000	additional neurotoxic effects other than headache may occur	the toxic range

As you can see from the TVOC data in this report, only 10 of the 44 houses had TVOC readings less than 200 ug/m^3, with 34 of the houses in the 200 to 3000 ug/m^3 range.

Values measured for these houses were lower than those measured in the Canadian office environment as reported by Tsuchiya(1) who found most of the TVOC readings in the 1000 to 3000 ug/m^3 range.

The average TVOC value for the 44 houses was 555 ug/m^3.

LIST OF REFERENCES

1. Tsuchiya, Y. and Kanabus-Kaminska, M., Volatile Organic Compounds in the Canadian Indoor Air, Institute for Research in Construction, National Research Council of Canada, 1990

2. American Conference of Government Industrial Hygienists, Threshold Limit Values, 1989

3. Molhave, L., Volatile Organic Compounds, Indoor Air Quality and Health, Plenary Talk, The Fifth International Conference on Indoor Air Quality and Climate, Volume 5, pp 15-33, Canada, 1990

4. Otson, R., A Health and Welfare Canada Program to develop personal exposure monitors for airborne organics at ug/m^3. Proceedings, EPA/A&WMA International Symposium, 1990

5. Concord Environmental Corporation, Data Report on Indoor VOC's, Final Report CEC L2524, May 1991

APPENDIX 1

Table 1.1 Responses to Questions 1 Through 4

1S = 1 Storey 1.5S = 1.5 Storeys 2S = 2 Storey
SL = Split Level BL = Bi-Level O = Other
SG - Slab on Grade CS = Crawl Space CC = Cast Concrete
CB = Concrete Block PW = Preserved Wood

House Code	TVOC ug/m3	1 DATE COM.	2 FLOOR AREA	3 1 S	3 1.5 S	3 2 S	3 S L	3 B L	3 O	4 S G	4 C S	4 C C	4 C B	4 P W	4 O
GL8170	<50	1974	130	1						1					
GL7827	<50	1990	362	1								1			
GL7658	<50	1935	298			1						1			
GL8372	55	1900	226			1									STNE RBL
SRC19	56	1985	174					1				1			
GL8058	83	1980	197	1								1			
GL8249	150	1978	155			1					1				RBL WLS
GL7637	158	1974	211				1					1			
SRC9	159	1988	263			1						1			
SRC26	198	1989	186				1					1			
s7817	231	1974	221	1								1			
s7968	236	1957	178	1									1		
s8235	278	1962	197		1								1		
SRC23	291	1988	262			1						1			
s8386	298	1891	218			1									RUBBLE
GL8224	308	1952	179	1									1		
SRC10	328	1989	182					1				1			
s8331	332	1962	183	1									1		
SRC5	334	1989	245			1						1			
SRC13	361	1988	247	1								1			
SRC20	406	1990	335			1						1			
SRC17	415	1984	277					1				1			
GL8389	461	1920	203			1						1	1		
SRC6	468	1984	200		1							1			
GL8271	488	1985	168	1								1			
GL8070	499		136	1								1			
SRC8	507	1989	255			1						1			
SRC-R7	544	1989	311			1						1			
s8287	602	1976	168	1								1			
GL8257	618	1978	142	1								1			
GL7906	638	1978	216	1									1		
SRC11	654	1989	159				1					1			
SRC16	727	1986	300				1					1			
SRC-R1	749	1989	242	1								1			
SRC-R9	755	1989	223	1								1			
GL8402	850	1967	174	1									1		
SRC-R5	1009	1989	279			1						1			WD FLR
GL8151	1174	1950	193	1									1		
s8163	1187	1973	202			1						1			
SRC12	1340	1989	218				1					1			
SRC-R3	1387	1989	280	1								1			
GL8272	1478	1975	163	1								1			
SRC1	1678	1989	270		1							1			
s8229	1913	1936	162		1								1		

Table 1.2 Responses to Questions 5 Through 7

B = Brick AS = Aluminum Siding VS = Vinyl Siding
WS = Wood Siding S = Stucco O = Other
Y = Yes N = No T = Type
TO = Type of Odour F = Frequency D = Duration

House Code	TVOC ug/m3	5 B	5 AS	5 VS	5 WS	5 S	5 O	6 Y	6 N	6 T	7 TO	7 F	7 D
GL8170	<50	1							1		LQD MNRE, WD SMKE	3-4/YR,1/WK	
GL7827	<50	1	1					1		DAIRY FARM	LQD MNRE	1-2/YR	2DY
GL7658	<50	1							1		VEHICLE EXH,WD SMKE	OFTEN,OCC	
GL8372	55	1						1		RYE,CORN TBACO,FMS	SPRAY	2/YR	7DY
SRC19	56			1					1		0		
GL8058	83	1							1		WD SMKE, NEIGHBOURS	NOT OFTEN	EVNG
GL8249	150		1					1		PIG FNSHNG FRM	PIG ODOR	DPNS WND DR	
GL7637	158	1						1		PIG FARM,TBCO FRM	LQD MNURE,TOBCO PLNT SPRY	2/YR,1/YR	1DY
SRC9	159			1					1		0		
SRC26	198			1					1		0		
s7817	231	1							1		0		
s7968	236	1							1		0		
s8235	278			1					1		FIELD SPRAY	1/yr	
SRC23	291			1					1		0		
s8386	298		1						1		0		
GL8224	308	1	1					1		HOOVER,FOAM RUBBER	FOAM RUBBER	2/WK	OV/NT
SRC10	328		1						1		0		
s8331	332	1							1		0		
SRC5	334					1			1		0		
SRC13	361			1					1		GAS	WINTER BSMT	OCC
SRC20	406		1						1		0		
SRC17	415					1			1		0		
GL8389	461					1			1		WD SMK,AUTO EXH (SUMR)	1-2/yr	1hr
SRC6	468				1				1		0		
GL8271	488				1			1		LQD MNRE SPR	AUTO EXH,KEROSENE HTR	1-2/yr	1/4hr
GL8070	499		1					1		SEWAGE PLANT	SEWAGE	1-2/YR	1HR
SRC8	507			1					1		0		
SRC-R7	544					1			1		0		
s8287	602	1			1				1		WOOD SMOKE,MANURE	1-2/yr	1day
GL8257	618	1						1		CONSTRUCTION DUST	LQD MNRE SPRG &FL,WD SMKE	1-2/YR	
GL7906	638	1						1		PIG FARM	LQD MNRE	2/YR	2DY
SRC11	654			1					1		0		
SRC16	727			1					1		0		
SRC-R1	749					1			1		0		
SRC-R9	755					1			1		AUTO OFTEN		
GL8402	850	1						1		PIG FARM	LIQUID MANURE	2/YR	3DYS
SRC-R5	1009					1			1		0		
GL8151	1174					1			1		WOOD SMOKE	1-2/yr	1hr
s8163	1187	1							1		MANURE SMELL	1-2/yr	
SRC12	1340					1			1		0		
SRC-R3	1387			1		1			1		0		
GL8272	1478	1							1		HORSE BARN IBLK AWAY	6/YR	1DY
SRC1	1678			1					1				
s8229	1913			1					1		WD SMKE NEIGBRS,LQD MNRE	LQD MNRE2/yr	

Table 1.3 Responses to Questions 8 Through 10

8A = Agricultural
8F = Forest
8AH = Another House
8FS = Factory Site
8O = Other
8DK = Don't Know
9S = Spruce
9F = Fir
9P = Pine
9O = Other
9DK = Don't Know
10S = Spruce
10F = Fir
10P = Pine
10H = Hemlock
10O = Other

House Code	TVOC ug/m3	8 A	8 F	8 AH	8 FS	8 O	8 DK	9 S	9 F	9 P	9 O	9 DK	10 S	10 F	10 P	10 H	10 O
GL8170	<50	1				TOBC FRM						1					1
GL7827	<50					STRPD FLD		1							1		
GL7658	<50						1										
GL8372	55	1										1					
SRC19	56	1						1					1				
GL8058	83					GRVL PIT						1			1		
GL8249	150	1							1								1
GL7637	158	1										1			1		
SRC9	159	1						1						1			
SRC26	198	1						1						1			
s7817	231	1										1					
s7968	236	1										1					
s8235	278	1										1					
SRC23	291	1						1						1			
s8386	298	1										1					
GL8224	308		1									1					
SRC10	328	1						1								1	
s8331	332	1										1					
SRC5	334	1						1					1				
SRC13	361	1						1					1				
SRC20	406	1						1						1			
SRC17	415	1						1						1			
GL8389	461						1					1		1			
SRC6	468	1						1						1			
GL8271	488	1						1	1						1		
GL8070	499	1							1					1			
SRC8	507	1						1					1				
SRC-R7	544	1							1					1			
s8287	602	1										1					
GL8257	618	1						1							1		
GL7906	638			1				1							1		
SRC11	654	1						1					1				
SRC16	727	1						1								1	
SRC-R1	749	1						1						1			
SRC-R9	755	1						1					1				
GL8402	850	1										1					
SRC-R5	1009	1						1					1				
GL8151	1174	1										1					
s8163	1187	1										1					
SRC12	1340	1						1						1			
SRC-R3	1387	1						1						1			
GL8272	1478	1				TBCO FRM		1									
SRC1	1678	1						1						1			
s8229	1913	1										1					

Table 1.4 Responses to Questions 11 Through 12

S = Spruce
WB = Waferboard
PB = Particle Board
FP = Fir Plywood
F = Fir
O = Other
SP = Spruce Plywood
N = None
P = Pine
DK = Don't Know

House Code	TVOC ug/m3	11 S	11 F	11 P	11 WB	11 O	11 DK	12 PB	12 SP	12 FP	12 WB	12 N	12 O
GL8170	<50					1							1
GL7827	<50		1										1
GL7658	<50												
GL8372	55						1		1				
SRC19	56	1										1	
GL8058	83		1				1					1	
GL8249	150						1					1	
GL7637	158		1									1	
SRC9	159		1					1					
SRC26	198		1					1					
s7817	231					1	1						1
s7968	236						1						
s8235	278						1						1
SRC23	291				1			1					
s8386	298						1						1
GL8224	308		1							1			1
SRC10	328	1						1					
s8331	332						1					1	
SRC5	334		1					1					
SRC13	361		1					1					
SRC20	406	1						1					
SRC17	415		1					1					
GL8389	461					1							1
SRC6	468		1								1		
GL8271	488		1										1
GL8070	499			1					1				
SRC8	507	1						1					
SRC-R7	544				1			1					
s8287	602						1						1
GL8257	618		1									1	
GL7906	638		1										1
SRC11	654	1										1	
SRC16	727	1						1					
SRC-R1	749				1			1					
SRC-R9	755	1						1					
GL8402	850		1									1	
SRC-R5	1009	1							1		1		
GL8151	1174		1									1	
s8163	1187						1					1	
SRC12	1340	1						1					
SRC-R3	1387				1						1		
GL8272	1478	1											
SRC1	1678	1						1					
s8229	1913						1	1	1				

Table 1.5 Responses to Question 13

LR = Living Room DR = Dining Room MB = Master Bedroom
BR2 = Bedroom 2 BR3 = Bedroom 3 BR4 = Bedroom 4
F = Floor W = Wall C = Ceiling

House Code	TVOC ug/m3	13 LR F	W	C	13 DR F	W	C	13 MB F	W	C	13 BR2 F	W	C	13 BR3 F	W	C	13 BR4 F	W	C
GL8170	<50	1	10	21	2	11	20	1	11	21	1	11	21	1	11	21			
GL7827	<50	1	10	10				1	10	10	1	11	10	1	10	10	1	10	10
GL7658	<50	5	15	25				1											
GL8372	55	2	10	21	2	10	21	2	11	21	2	11	21	2	11	21	2	11	21
SRC19	56	1	10	21	1	10	21	1	10	21	1	10	21	2	10	20			
GL8058	83	1	10	21	1	10	21	1	10	21	2	11	21	2	10	21			
GL8249	150	1	11&12	21	5	11	21	1	11	20	1	11	21	1	11	21			
GL7637	158	1	10	21	4	11	21	1	11	20	1	11	20	1	10	20	2	10	21
SRC9	159	3	10	21	3	10	21	3	10	21	3	10	21	3	10	21			
SRC26	198	1	11	21				1	10	21	1	10	21	1	10	20	1	10	21
s7817	231	1	15	25	1	15	25	1	15	25	1	10	20	1	10	20			
s7968	236	5	15	25	5	15	25	4	15	25	1	15	25	1	15	25			
s8235	278	1	15	25	5	11&15	25	5	15	25	5	15	25	5	15	25			
SRC23	291	1	11	21	1	11	21	1	10	21	1	10	21	1	10	20			20
s8386	298	1	10&11	20	1	10&11	20	1	10&11	20	1	11	25	1	11	25	1	11	25
GL8224	308	1	11	20	1	10,11,12	20	1	11	24	1	11	20	2	11&12	24	2	12	24
SRC10	328	1	10	21	4	10	21	1	10	21	1	10	21	1	10	21			
s8331	332	4	10	20	4	10	20	5	10	20	1	10	20	1	10	20	6	12	24
SRC5	334	1	10	21	1	10	21	1	10	21	1	10	21	1	10	23	1	10	23
SRC13	361	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21			
SRC20	406	1	10	20	1	10	20	1	10	20	1	10	20	1	10	20	1	10	20
SRC17	415	1	10	21	4	10	21	1	11	21	1	11	21	1	10	21	1	10	23
GL8389	461	1	15	25	1	15	25	1	15	25	1	15	25	1	15	25	1	15	25
SRC6	468	5	10	21	5	10	21	1	10	21	1	10	21	2	10	21	2	10	20
GL8271	488	1	10	10	1	10	10	1	10	10	2	10	10	1	10	10			
GL8070	499	1	12	25				9	12	24	9	12	24	5	10	20	1	10	21
SRC8	507	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21			
SRC-R7	544	1	10	21	4	10&11	21	1	10	21	1	10	21	1	10	21	1	10	21
s8287	602	4	10	21				2	10	21	2	10	21	2	11	21			
GL8257	618	1	10&11	21	1	11&15	21	1	11	21	1	10&11	21	1	10&11	21	2	10	21
GL7906	638	1	10	21	4	10&11	21	1	10	21	1	10	21	1	10	21			
SRC11	654	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21			
SRC16	727	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21	2	10	23
SRC-R1	749	1	10	20	1	10	20	1	10	20	1	10	20	1	10	20			
SRC-R9	755	1	10	21				1	10	21	1	10	21	1	10	21			
GL8402	850	1	12	24				1	12	24	1	12	24	2	11	24			
SRC-R5	1009	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21			
GL8151	1174	1	15	25				1	10	25	1	15	25	2	10&15	24			
s8163	1187	2	11	20	2	11	20	1	11	20	2	11	20	2	11	20	2	11	20
SRC12	1340	1	10	21	4	11	21	1	10	21	1	10	21	1	10	21	1	10	21
SRC-R3	1387	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21
GL8272	1478	1	10	21	2	11	21	1	10	21	1	11	21	1	10	21			
SRC1	1678	1	10	21	1	10	21	1	10	21	1	10	21	1	10	21			
s8229	1913	4	12	23				1	12	23	4	15	23						

Table 1.6 Responses to Question 13 - con't

BTH1 = Bathroom 1 BTH2 = Bathroom 2 KIT = Kitchen
FR = Family Room RR = Recreation Room LDRY = Laundry
F = Floor W = Wall C = Ceiling

House Code	TVOC ug/m3	13 BTH1 F	W	C	13 BTH2 F	W	C	13 KIT F	W	C	13 FR F	W	C	13 RR F	W	C	13 LDRY F	W	C
GL8170	<50	4	11	20	4	10	20	2	11	20	2	12&21	21				2	10	21
GL7827	<50	4	10	10	4	10	10	4	10	10							4	10	10
GL7658	<50				4														
GL8372	55	4	11	20	4	11	20	4	11&14	20	2	11	21				4	12	12
SRC19	56	4	10	20	4	10	20	4	10	21	2	10	21				6	13	22
GL8058	83	4	15	20	4	11	23	4	11	20	2	10&14	24				4	10	20
GL8249	150				6	15	22	4	11	24	1	10	21						
GL7637	158				4	11	20	4	11	20	1	12	21	2	12	22	4	10	20
SRC9	159	4	10	21	4	10	21	4	10	21	1	10	21				4	10	21
SRC26	198	4	10	21	4	10	21	4	11	21	1	11	21						
s7817	231	4	10	20	4	11	20	8	10	20	5	12	21	1	10	21	4	10	21
s7968	236	4	15	25				8	15	25	1	15	24						
s8235	278	8	11&15	25				4	15	25	1	12	24	4	12	24			
SRC23	291	4	10	21	4	10	21	4	10	21	1	10	21						
s8386	298	4	10&11	20	4	10&11	20	4	10&11	20	2	12	24				4	10	23
GL8224	308	2	15	20				4	11&15	24	2	11	22				1	11	20
SRC10	328	4	10	21				4	10	21									
s8331	332	4	10	20	7	15	22	4	10	20				1&7	10	24	5	10	22
SRC5	334	4	10	21	4	10	21	4	10	21	1	10	21	1	10	23	4	10	21
SRC13	361	4	10	21	4	10	21	4	10	21	1	10	21				7	10	22
SRC20	406	4	10	20	4	10	20	4	10	20	1	10	20	1	10	21	4	10	20
SRC17	415	4	10	21	4	10	21	4	10	21				9	10	25	4	10	23
GL8389	461	4	15	25	4	15	25	4	15	15							7	15	22
SRC6	468	4	10	21	5	10	20	4	10	21	2&5	10	25				6	10	22
GL8271	488	4	10	10	4	10	22	4	10	10	2	10&11	22	2	15	22	7	15	22
GL8070	499	4	11	24				4	11	24									
SRC8	507	4	10	20	4	10	20	4	10	21	1	10	21				4	10	21
SRC-R7	544	4	10	21	4	10	21	4	10&11	21	1	10	21				4	10	21
s8287	602	4	10	20				4	10&11	20									
GL8257	618	4	10	20	4	10	20	4	10	20	2	14&15	24	4	10	21	4	10	22
GL7906	638	4	10	20				4	10&11	20									
SRC11	654	4	10	20	4	10	20	4	10	20	1	10	23				6	15	22
SRC16	727	4	10	21	4	10	23	4	10	21	1	12	23	2	12	23	4	10	21
SRC-R1	749	4	10	20	4	10	20	4	10	20							4	10	20
SRC-R9	755	4	10	21	4	10	21	4	10	21	1	10	21						
GL8402	850	4	8	24				4	11	24	7	12	22						
SRC-R5	1009	4	10	21	4	10	21	4	10	21	1	10	21				4	10	21
GL8151	1174	4	15	20	2	10&15	25	4	15	20	2	12	21				2	10	24
s8163	1187	4	11	20	4	10	20	4	11	20	2	11	21	2	14	21			
SRC12	1340	4	11	21	4	11	21	4	11	21	1&8	11	21				4	11	21
SRC-R3	1387	4	10	21	4	10	21	4	10	21	1	10	21				4	10	21
GL8272	1478	4	11	20				2	11	20	1	12	24	2	15	22	1	15	22
SRC1	1678	4	10	21	4	10	20	4	10	21	1	10-12	21				4	10	21
s8229	1913	2	12&10	23				4	11	23	2	12	23	4	15	23			

Table 1.7 Responses to Questions 14 Through 16

PB = Particle Board PW = Plywood O = Other
PPB = Painted Particle Board
MCPB = Melamine Covered Particle Board
SW = Solid Wood
SWPW = Mixture of Solid Wood and Plywood
VENTCOM = Ventilation Components
Y = Yes N = No
PARTHRS = Partial Hours/Day

House Code	TVOC ug/m3	14 P B	14 P W	14 O	15 P PB	15 MC PB	15 S W	15 SW PW	15 O	16 VENT CON	Y	N	PART HRS
GL8170	<50	1				1						1	
GL7827	<50		1					1			1		
GL7658	<50											1	
GL8372	55		1						1			1	
SRC19	56	1						1			1		
GL8058	83	1						1				1	
GL8249	150	1							1			1	
GL7637	158		1		1							1	
SRC9	159	1		OAK			1					1	
SRC26	198	1					1					1	
s7817	231	1					1					1	
s7968	236		1					1				1	
s8235	278	1					1	1				1	
SRC23	291	1					1					1	
s8386	298	1					1					1	
GL8224	308		1						1			1	
SRC10	328		1					1				1	
s8331	332	1		1	1			1				1	
SRC5	334	1					1					1	
SRC13	361	1					1					1	
SRC20	406	1					1					1	
SRC17	415	1					1				1		
GL8389	461	1			1							1	
SRC6	468		1						1		1		
GL8271	488		1					1				1	
GL8070	499			1					1			1	
SRC8	507	1					1					1	
SRC-R7	544		1				1					1	
s8287	602	1							1			1	
GL8257	618	1				1						1	
GL7906	638		1		1							1	
SRC11	654	1					1					1	
SRC16	727	1					1					1	
SRC-R1	749	1					1					1	
SRC-R9	755	1					1					1	
GL8402	850	1			1							1	
SRC-R5	1009	1					1					1	
GL8151	1174	1			1							1	
s8163	1187	1							1			1	
SRC12	1340	1					1					1	
SRC-R3	1387	1					1					1	
GL8272	1478	1							1			1	
SRC1	1678	1					1					1	
s8229	1913		1					1				1	

Table 1.8 Responses to Questions 17 Through 19

CHDWAF = Central Humidifier on a Warm Air Furnace
RH = Room Humidifiers
NH = No Humidifiers
RH = Relative Humidity
V1 = First Visit
V2 = Second Visit
O = Other
T = Temperature
V1D = First Visit Date
V2D = Second Visit Date

House Code	TVOC ug/m3	17 CHD WAF	17 R H	17 N H	17 O	18 RH V1	18 RH V1D	18 RH V2	18 RH V2D	19 T V1	19 T V2
GL8170	<50			1		31	910211	31	910212	21.5	22
GL7827	<50		1			32	910204	35.6	910205	22	20.3
GL7658	<50	1	1			26	910211	27	910212	21.6	23
GL8372	55					39	910311	40	910312	21	19.5
SRC19	56		1			21	910130	20	910131	21.5	21
GL8058	83		1			42	910211	43	910212	20.1	19
GL8249	150		1			32	910218	50	910219	23.5	19
GL7637	158			1		45	910225	45.5	910226	19	18.5
SRC9	159			1		17	910130	25	910131	23.5	18
SRC26	198			1		26	910214	26	910215	21.5	22
s7817	231		1			37	910121	32	910122	22	20.5
s7968	236		1			36	910128	34	910129	21.5	21.5
s8235	278		1			34	910114	32	910115	23	22.5
SRC23	291			1		24	910214	22	910215	23.5	22.5
s8386	298	1				14	910121	20	910122	21	21
GL8224	308		1			38.4	910225	30	910226	21.7	21.5
SRC10	328					26	910131	26	910201	22	22
s8331	332	1				34	910121	31	910122	22	20.5
SRC5	334		1			33	910130	28	910131	17	18.7
SRC13	361			1		22	910131	29	910201	23.7	20
SRC20	406	1				24	910214	23	910215	22	21.7
SRC17	415			1		31	910131	34	910201	18.3	19
GL8389	461	1				39	910325	39	910326	21	21
SRC6	468			1		43	910130	41	910131	23	22
GL8271	488			1		43	910204	46	910204	19.2	19.2
GL8070	499			1		33.5	910218	38	910219	23.5	22.5
SRC8	507			1		22	910130	24	910131	20	19.5
SRC-R7	544	1				30	910211	33	910212	22	22
s8287	602		1			56	910114	46	910115	20.5	20.5
GL8257	618	1				44	910318	55	910319	20	17
GL7906	638					65	910225	59	910226	18	17
SRC11	654			1		26	910131	26	910201	19.5	22.5
SRC16	727			1		39	910131	42	910201	20	20
SRC-R1	749	1				44	910211	43	910212	22.3	22.2
SRC-R9	755			1		30	910211	34	910212	22.2	21.7
GL8402	850			1		48.5	910318	45	910319	20.5	20.5
SRC-R5	1009	1				25	910211	26	910212	22	22
GL8151	1174		1			51	910325	47	910326	20	19.5
s8163	1187	1	1			28	910128	34	910129	18.3	18.5
SRC12	1340				1	22	910131	22	910201	23.6	22
SRC-R3	1387	1				25	910211	26	910212	21	21.5
GL8272	1478			1		51	910311	44	910312	23	22
SRC1	1678	1				23	910130	34	910131	24	21
s8229	1913			1		33	910128	32	910129	23	22.5

Table 1.9 Responses to Questions 20 Through 21

P = Paint S = Solvents I = Insecticides
F = Fertilier PS = Paint Stripper O = Other
PIH = Paint Inside House FW = Floor Wax
FP = Furniture Polish RS = Rug Shampoo

House Code	TVOC ug/m3	20 P	20 S	20 I	20 F	20 PS	20 O	21 PIH	21 FW	21 PS	21 I	21 FP	21 RS	21 O
GL8170	<50	1		1	1		CONTACT CEMENT						1	
GL7827	<50	1										1		
GL7658	<50	1	1			1	N.P.RMVR,HT TB CHMLS					1		
GL8372	55	1							1			1		
SRC19	56	1	1			1								SHOE POLISH
GL8058	83	1	1					1				1	1	
GL8249	150											1		
GL7637	158	1		1								1		
SRC9	159													
SRC26	198	1										1		
s7817	231	1	1											
s7968	236	1	1									1		
s8235	278							1				1		
SRC23	291	1				1								
s8386	298	1	1	1		1						1		
GL8224	308	1									1			
SRC10	328	1	1						1			1		
s8331	332	1												
SRC5	334	1										1		
SRC13	361	1												
SRC20	406											1		
SRC17	415	1												
GL8389	461	1			1									
SRC6	468	1												
GL8271	488	1	1	1										
GL8070	499	1	1	1								1		GLAS-PLUS WNDW CLNR
SRC8	507											1		
SRC-R7	544	1												
s8287	602	1	1		1		POOL CHEMICALS	1				1		
GL8257	618	1		1							1	1		TILE GROUT
GL7906	638	1	1	1								1		SANI FOAM
SRC11	654							1						
SRC16	727	1	1											
SRC-R1	749	1										1		
SRC-R9	755											1		
GL8402	850	1							1			1		1 DD7 CLEANER
SRC-R5	1009	1												
GL8151	1174	1	1	1		1	HR DRES. PERMS	1		1		1		HR DRES. PERMS 1/WK
s8163	1187	1	1					1				1		
SRC12	1340	1												
SRC-R3	1387													
GL8272	1478	1	1	1		1						1		TILEX IN BTHRM
SRC1	1678	1	1					1						VARSOL,CARPET ADH
s8229	1913													

Table 1.10 Responses to Questions 22 Through 24

NO.SMK = Number of Smokers
NO.C/D = Number of Cigarettes Smoked Per Day in House
WSFP = Woodstove or Fireplace
Y = Yes N = No
U/WK = Number of Times Used Per Week
RENOV = Renovations Since House Originally Completed

House Code	TVOC ug/m3	22 NO. SMK	22 NO. C/D	23 WS FP			24 RENOV			WHAT DONE
					Y	N	U/WK	Y	N	
GL8170	<50	0				1		1		GS FRNCE,DUCT WK,DRYWL LVG RM,CNTRL AIR
GL7827	<50	1	20			1			1	
GL7658	<50	0			1		0.25	1		NW WNDWS,NW KTN,NW KTN FLR,HRDWD FLRS REDN
GL8372	55	0				1		1		DRYWL,WD TRIM,UNDERLAY,FLRNG,CARPET
SRC19	56	0				1		1		BSMT FMLY RM 1987,BSMT SEW RM 1986
GL8058	83	0			1		0	1		BSMT OVER LAST 5 YRS
GL8249	150	1	5		1		14		1	
GL7637	158	1	15		1		0.25		1	
SRC9	159	0			1		1		1	
SRC26	198	0				1			1	CENTRAL AIR INSTALLED
s7817	231	0			1			1		KITCHEN ON GOING,BEDROOM WINDOWS
s7968	236	0			1			1		BASEMENT REFINISHED & DRAINAGE IMPROVED
s8235	278	0			1		5	1		CARPET,VINYL FLR,NW KTN CABINETS
SRC23	291	0			1		0.5	1		INSLTD & GYPROC BSMT WALLS
s8386	298	0			1		0.1	1		KITCHEN CBNTS,FLRNG,DRY WALL & PAINT
GL8224	308	0			1	GAS		1		ADDTN89-90 250FT2,CRPT,VIN FLR,F PLCE,CBNT
SRC10	328	1	10/15			1			1	
s8331	332	0			1		1	1		FNSHED BSMT,NEW KITCHEN CABINETS
SRC5	334	0			1					BSMT & BSMT REC ROOM & ADDT BSMT BDRM
SRC13	361	0				1			1	
SRC20	406	0			1		1		1	
SRC17	415	0				1		1		BSMT DVLPD WITHIN 2 YRS
GL8389	461	0			1		0	1		8 YRS AGO, BTH/KIT REWIRE NOW
SRC6	468	0			1		0.5		1	
GL8271	488	0			1		14	1		BASEMENT SLOWLY BEING FNSHED
GL8070	499	0				1			1	
SRC8	507	0			1		0.25		1	
SRC-R7	544	0			1		0.1		1	
s8287	602	2	20-25			1			1	
GL8257	618	1	3			1		1		BSMT FNSHD 1983,BTH RM INSTLD 1986
GL7906	638	2	16		1		0		1	
SRC11	654	0				1		1		THIRD LEVEL CMPLTD JAN 91
SRC16	727	1	5			1			1	
SRC-R1	749	1	20		1		0		1	
SRC-R9	755	0				1			1	
GL8402	850	1	10			1		1		NEW KIT CABINETS & VINYL FLR,BSMT PANELING
SRC-R5	1009	2	30		1	GAS	7		1	
GL8151	1174	2	12			1		1		ONGOING PAST 8YRS + ADDTN.
s8163	1187	0			1		5	1		ADDITION AT REAR PLUS WOOD STOVE
SRC12	1340	0			1		0.25		1	
SRC-R3	1387	0			1		1		1	
GL8272	1478	0				1		1		REC ROOM 5 YRS AGO
SRC1	1678	0			1		0	1		BSMT FSHD, BSMT RUG INSTLD,GAR DR MVD
s8229	1913	1	2			1			1	

Table 1.11 Responses to Questions 25 Through 26

AIRQ = Air Quality
WTA = Worse Than Average
BTAV = Better Than Average
CM = Comment
MWTA = Much Worse Than Average
AV = Average
MBTA = Much Better Than Average
AQCM = Air Quality Comment

House Code	TVOC ug/m3	25 AIR Q	MW TA	WT A	AV	BT AV	MB TA	CM	26 AQ CM
GL8170	<50				1				0
GL7827	<50					1			DRY IN VERY COLD WEATHER
GL7658	<50				1				SMLLS FROM FPLCE WHN HT&HMD,SUS OF FNCE
GL8372	55					1			OCC MUSTY BSMT ODORS
SRC19	56					1			FRLY DRY IN WNTER,HUMIDIFY EACH NGHT
GL8058	83					1			DRY IN WINTER
GL8249	150				1				DRY IN WNTR IF HMDFR OFF
GL7637	158			1				CIGARETTE ODOR	0
SRC9	159					1			0
SRC26	198					1			0
s7817	231				1				0
s7968	236				1				GRND WATER ODOR AFTER HEAVY RAIN
s8235	278				1				0
SRC23	291					1			DRY SOMETIMES
s8386	298					1		DRY	GD SINCE ELECTRONIC AIR CLEANER INSTLLD
GL8224	308					1			BRNT DST SML WHN FRNCE STRT AFTR 6-7HRS
SRC10	328				1				0
s8331	332				1				ALLERGIES(DUST)
SRC5	334						1		VERY GOOD
SRC13	361					1			0
SRC20	406					1			0
SRC17	415					1			BSMT MUSTY ODORS IN WNTR
GL8389	461				1				A LITTLE DRY IN WINTER
SRC6	468					1			MORE MOIST THAN AVERAGE
GL8271	488			1				MSTR BDM HIGH HMDTY	FEEL DRAGGY,ARE CONCERNED
GL8070	499				1				DAMP IN SUMMER
SRC8	507					1			DRY
SRC-R7	544					1			0
s8287	602			1					POOR CIRCULATION
GL8257	618				1				WHT DUST,FMLY HAS ALLERGIES
GL7906	638			1				VERY DAMP	MOULD, 5 YOUNG CHILDREN(3.5TO 13)
SRC11	654		1					STRONG ODOR, RECENT	DRY,WNDWS CRCKD OPEN
SRC16	727				1				0
SRC-R1	749					1			0
SRC-R9	755					1			CLEANED AIR DUCTS, IMPROVED AIR QLTY
GL8402	850				1				0
SRC-R5	1009					1			
GL8151	1174				1			W.THN AV.HR DRES.RM	GD UPSTR,DN STRS MSTY IN SUM.(DEHFDY OK)
s8163	1187			1					0
SRC12	1340					1			0
SRC-R3	1387					1			0
GL8272	1478				1			MOIST &HUMID	MOULD IN CEILNG CLD CRNRS & CLSTS
SRC1	1678					1			0
s8229	1913		1						0

Table 1.12 Responses to Questions 27 Through 28

UNAQ = Unique Air Quality
BN = Brand Name
FW = Floor Wax
DWDT = Dishwasher Detergent
U/WK = Number of Times Used/Week

House Code	TVOC ug/m3	27 UNAQ	28 DWDT BN	28 DWDT U/WK	28 FW BN	28 FW U/WK
GL8170	<50	0	ALL	7		
GL7827	<50					
GL7658	<50	SMLLS LK BRNT DST,(FRNCE CYC ON LMT ?)	SUNLIGHT	7		
GL8372	55	DAMP BSMT MOULDY	SUNLIGHT	5	JOHSN,FNSTIK	0.5
SRC19	56	0	CASCADE	7		
GL8058	83		SUNLIGHT	7		
GL8249	150	KEROSENE HEATER UP LVL CLD WTHR	SUNLIGHT	7		
GL7637	158	BAD HOUSE KPNG,MOIST BSMT	PALMOLIVE	10		
SRC9	159	0	BASIC H			
SRC26	198	0	ELECTRA SO	4		
s7817	231	EXCESS CONDNSTN ON WNDWS,MOLD ON WNDWS	CASCD,OTHR	7		
s7968	236	PREV MOULD/MILDEW,STOP BY DRANGE IMPR				
s8235	278	GDN WATER FLOODING NOW REPAIRED	CASCADE	7		
SRC23	291	0	PALMOLIVE	7		
s8386	298	LKY AT BSMT FLR SL & HTG DCTS IN ATTIC	ALL	7		
GL8224	308	GAS RANGE NO HOOD				
SRC10	328	0	PRES CHOIC	7	FUTURE	0.25
s8331	332	0	PALMOLIVE	7		
SRC5	334	0	CASCADE	4		
SRC13	361	0	CASCADE	14		
SRC20	406	0	SUNLIGHT	7	PINE	1-2
SRC17	415	CONDTN ON WNDWS CLD WHTR	SUNLIGHT	14		
GL8389	461	DAMP BASEMENT (NOT WET)	ALL	7	FUTURE	0.5
SRC6	468	CONDTN STNS ON WNDWS	BRAND X	7		
GL8271	488	STAINS ON WNDWS & WALLS	ELECTROSOL	5		
GL8070	499	WTR IN BSMT,BUT HSE DRY,CARPORT MLDY				
SRC8	507	0	CASCADE	2		
SRC-R7	544	FINE BLUE LINT ON SURFACES	ALL	6		
s8287	602	QUITE AIR TIGHT	ALL	4		
GL8257	618		CASCADE	5		
GL7906	638	VERY MOIST,BAR DMPER STK ON OIL FRNCE	ALL	7	MOP'NGLO	2/YR
SRC11	654	0				
SRC16	727	TXDERMY,CNDSN BTH WNDWS CLD DYS	ALL	7		
SRC-R1	749	CONDTN ON WNDWS,LOTS CLD WTHR	ALL,SNLGHT	14		
SRC-R9	755	0	ALL	7		
GL8402	850	MORE DR & WNDW OPNGS THAN USUAL			CLEAR	2/YR
SRC-R5	1009	CLD UPSTRS & ABOVE GRGE IN CLD WTHR	CASCADE	6		
GL8151	1174	ACRYLIC PNTG BSMT(HOBBY), SEE 26	CASCADE	7		
s8163	1187	WOOD STOVE BACK PUFFS	CASCADE	7		
SRC12	1340	0	CASCADE	6		
SRC-R3	1387	0	All	3.5		
GL8272	1478	MOULD IN CEILING COLD CORNERS &CLOSETS	ELECTROSOL	7		
SRC1	1678	0	CASCADE	8.5		
s8229	1913	SOIL CRAWL SP,WTR HTR PRLY VNTD			FUTURE	0.5

Table 1.13 Responses to Questions 28 - con't

LD = Laundry Detergent
U/WK = Number of Times Used/Week
GPCL = General Purpose Cleaners

BN = Brand Name

House Code	TVOC ug/m3	28 LD BN	U/WK	28 GPCL BN	U/WK
GL8170	<50	SUNLIGHT	15	COMET,VIM,FANTASTIK	3.5
GL7827	<50	TIDE	7	COMET,PINESOL	2,1
GL7658	<50	TIDE	5	MURPHYS/FANTASTIC	1
GL8372	55	CHEER	7	PINESOL,GLASSPLUS,LYSOL	0.5
SRC19	56	TIDE	10	VIM	1
GL8058	83	TIDE	10	MURPHYS OIL	2.5
GL8249	150	TIDE	7	MR CLEAN,LESTOIL	7
GL7637	158	TIDE	25	GLASS PLUS,JAVEX,MR CLEAN	2
SRC9	159	BASIC L		BASIC L	
SRC26	198	TIDE	3	COMET,MR CLEAN,SPIC&SPAN	3
s7817	231	WHISK	21	LESTOIL	1
s7968	236	TIDE/SUNLIGHT	5/10	WINDEX,FANTASTIC,MURPHYS OIL SOAP	0.5
s8235	278	CHEER	14	LYSOL	1
SRC23	291	CHEER	6	MR CLN ,SPRY NINE,FULLER	
s8386	298	TIDE	4	MURPHYS,MR.CLEAN	2,0.5
GL8224	308	WHISK	15	NUTRI CLN,VINEGAR,AMMONIA	0.5
SRC10	328	ABC	5	COMET,PRES CHOICE	4
s8331	332	TIDE	14	SPIC & SPAN,VIM,CARPET FRESH	1
SRC5	334	SUNLIGHT	6	PINESOL	2
SRC13	361	CHEER	28	VIM MR CLEAN	
SRC20	406	ALL	7	PINE	1.5
SRC17	415	SUNLIGHT	4	WNDEX, SUPVAL GRN,SPC&SPN	
GL8389	461	SUNLIGHT	14	WINDEX,AJAX	
SRC6	468	SUNLIGHT & IVORY	10	GLASS PLUS &COOP ALL PURPose	1
GL8271	488	TIDE	3	SPIC & SPAN	0.5
GL8070	499	TIDE	16	PINESOL	2
SRC8	507	SUNLIGHT	6	PINESOL	2
SRC-R7	544	TIDE	14	MR. CLN,WNDX,MURPHYS OIL SOAP	7
s8287	602	SUNLIGHT	6	WINDEX,SPIC & SPAN	7
GL8257	618	TIDE & CHEER	32	GREEN,HAWES LMN OIL,VIM,MPYS OIL SP	7
GL7906	638	TIDE	20	SANI FOAM,SPIC & SPAN,SONUBN'SHNE	1,.1,.1
SRC11	654	TIDE	3	NO-NAME	
SRC16	727	TIDE		MR. CLEAN	1
SRC-R1	749	CHEER,SUNLIGHT,NO NAME	5	MR CLEAN,NO NAME	1
SRC-R9	755	SUNLIGHT	7	PLDGE,PINE SOL,VIM	1.5
GL8402	850	TIDE	10	AJAX,WINDEX,VINEGAR & BK SDA	
SRC-R5	1009	OXYDOL	6	SANI	1
GL8151	1174	TIDE	7	LYSOL,MR CLEAN,PINE SOL	3
s8163	1187	TIDE	8	LYSOL & LYSOL TUB AND TILE	1&0.25
SRC12	1340	TIDE	4	MR. CLEAN	1
SRC-R3	1387	TIDE,CHEER	3.5	SPIC & SPAN	1
GL8272	1478	SUNLIGHT	14	MR CLN,MURPHS OIL SOAP	1
SRC1	1678	TIDE	6.5	PINESOL,VIM	2.5
s8229	1913	SUNLIGHT	21	SIMPLE GREEN	7

Table 1.14 Responses to Question 28 - cont'd

HS = Hair Spray BN = Brand Name
U/WK = Number of Times Used/Week PF = Perfume

House Code	TVOC ug/m3	28 HS BN	U/WK	28 PF BN	U/WK
GL7827	<50	SILKIENCE	7	AMBIANCE NIGHT MUSK	7
GL8170	<50	ADORN	17		0
GL7658	<50	QUANTAM	7	MANY KINDS	
GL8372	55	TILESSA	7	ESTIE LAUDER	7
SRC19	56	JOICO	7	0	
GL8058	83	ALBERTO,FINAL NET	20	AVON	7
GL8249	150	SILKIENCE	7	CHARLIE,CHANEL #5	2
GL7637	158				
SRC9	159			?	
SRC26	198	JHIRMACK	3	OSCAR DELARENTA	1
s7817	231			OSCAR DELARENTA	7
s7968	236	FINAL NET	0.5	OSCAR DELARENTA	1
s8235	278			OSCAR DELARENTA	7
SRC23	291				
s8386	298	ALBERTO	7	WHTE SHLDR,EXCLAMATION	2,7
GL8224	308	AQUA NET	0.5	EXCLAMATION,MOON WIND	7
SRC10	328			WILD MUSH	9
s8331	332				
SRC5	334			OPIUM	6
SRC13	361				
SRC20	406			GUCCI 3,RED,GIORGIO	7
SRC17	415				
GL8389	461	FRENCH FORMULA	4	A.ASHLEY,VERVG,POLO,BRUTE	4
SRC6	468	BRAND X	7	0	
GL8271	488	JAZZING	7		
GL8070	499	ALBERTO	7		
SRC8	507			OPIUM	6
SRC-R7	544	SALOON SELECTIVES	25	VARIOUS	25
s8287	602	ALBERTO	7	OLD SPICE,AIR FRESHENER	3&1
GL8257	618	HALSA	2		2
GL7906	638	FINESSE	21	AVON	7
SRC11	654	JOYCO ICE-MIST	7	CHLOE	7
SRC16	727	FINESS	7	AVON	7
SRC-R1	749	VARIOUS KINDS	7	OSCAR,ALFD SUNG,COLORS	7
SRC-R9	755			AVON	
GL8402	850	ALBERTO ,SALON SLTNG	7	CHANEL,ESTIE LAUDOR	1
SRC-R5	1009	ALBERTA	7	POISON	7
GL8151	1174	FOCUS, OUSSI.NOGA	7	OSCAR DELA RENTA,STETSON	7
s8163	1187			BRUTE	7
SRC12	1340	VAVOOM	7	OSCAR DELARENTA	5
SRC-R3	1387			ALFRED SUNG	7
GL8272	1478	ALBERTO,ADORN,FNL NT	7	EXCLAMATION,RED DOOR	7
SRC1	1678	TRES	7	ALFRED SUNG	7
s8229	1913	FLEX WET	7	MUGUET DES BOIS	7

APPENDIX 2

APPENDIX 3

Cross-reference Table for House Codes in Tillsonburg

Concord and This Report	Bowser House Code
GL8170	99
GL7827	126
GL7658	43-1
GL8372	114-1
GL8058	86
GL8249	76-1
GL7637	98
s7817	20
S7968	110
s8235	56
s8386	127
GL8224	131
s8331	14
GL8389	6-1
GL8271	32-1
GL8070	129
s8287	3
GL8257	35
GL7906	101
GL8402	96-1
GL8151	1-1
s8163	119
GL8272	139-1
s8229	95

VOC HOUSE QUESTIONNAIRE (Note: this questionnaire is to be filled out by the person testing the house. Answer all questions; if the answer is unknown, please state "Don't know".)

Name of House Owner or Occupier_____

Address_____

City_____

Postal Code_____

Telephone_____

House information:

1. Date that the house was completed (Year and Month)_____
   Date that the house was first occupied (Year and Month)_____

2. House floor area including basement (m^2)_____

3. Type of house

   1 story ☐

   1 & 1/2 story ☐

   2 story ☐

   split level ☐

   bilevel ☐

   other (please specify)_____

4. Type of foundation

   slab on grade ☐

   crawl space ☐

   cast concrete basement ☐

   concrete block basement ☐

   preserved wood foundation ☐

   other (please specify)_____

5. Type of exterior finish.

- brick ☐
- aluminum siding ☐
- vinyl siding ☐
- wood siding ☐
- stucco ☐
- other (please specify)_____

6. Are there any unusual pollution sources within 1 kilometre of the house? (For instance, a paint factory, furniture plant, chemical factory, oil refinery, animal feed lot, etc.) Please specify.

_____

7. Do the house occupants notice any odours entering the house from exterior pollution sources? (For instance, wood smoke, exhaust from automobiles and trucks, chemical smells from factories, etc?) Please specify the type of odour, and the frequency and duration.

Type of odour _____

_____

Frequency _____

Duration _____

8. What was the use of the land before the house was built on it?

- Agricultural ☐
- Forest ☐
- Another house ☐
- Factory site ☐
- Other (Please specify.)_____
- Don't know ☐

9. What was the main wood framing material used in the walls of the house?

- Spruce ☐
- Fir ☐
- Pine ☐
- Other (Please specify)_____
- Don't know ☐

10. What was the main wood framing material used for the floor joists in the house?

- Spruce ☐
- Fir ☐
- Pine ☐
- Hemlock ☐
- Other (Please specify)_____
- Don't know ☐

11. What type of wood or plywood was used as the subfloor?
(Note: Removal of a floor register will allow access to the subfloor and the underlay.)

- Spruce ☐
- Fir ☐
- Pine ☐
- Waferboard ☐
- Other (Please specify)_____
- Don't know ☐

12.What type of material was used as the underlay?

- Particle board ☐
- Spruce plywood ☐
- Fir plywood ☐
- Waferboard ☐
- None ☐
- Other (Please specify)_____

13. For each of the following rooms, specify the type of floor, wall and ceiling finish. (Please use the following code;

FLOOR:
1 synthetic carpet with separate foam rubber underlay
2 synthetic carpet with integral foam rubber underlay
3 wool carpet
4 vinyl flooring
5 wood flooring
6 unpainted concrete floor
7 painted concrete floor
8 ceramic tile or marble
9 other

WALL:
10 painted gypsum board
11 wallpaper on gypsum board
12 interior grade plywood (birch, mahogany, oak etc)
13 painted particle board
14 wood boards
15 other

CEILING:
20 painted gypsum board
21 stippled gypsum board
22 unfinished (floor joists exposed)
23 acoustic ceiling using glass-fibre based tiles
24 acoustic ceiling using wood fibre based tiles
25 other

	Floor	Wall	Ceiling
Living Room	_____	_____	_____
Dining Room	_____	_____	_____
Master Bedroom	_____	_____	_____
Bedroom 2	_____	_____	_____
Bedroom 3	_____	_____	_____
Bedroom 4	_____	_____	_____
Bathroom 1	_____	_____	_____
Bathroom 2	_____	_____	_____
Kitchen	_____	_____	_____
Family room	_____	_____	_____
Recreation room	_____	_____	_____
Laundry	_____	_____	_____
Basement	_____	_____	_____

14. What is the material used for the structural part of the kitchen cabinets?

Particle board ☐

Plywood ☐

Other(Please specify) _____

15. What is the material used for the doors of the kitchen cabinets?

Painted particle board ☐

Melamine covered particle board ☐

Solid wood ☐

Mixture of solid wood and plywood ☐

Other _____

16. Is the ventilation system or ventilation components run continuously?

Yes ☐

No ☐

Partial (State no of hours per day.)_____

17. What type of humidifier does the house have?

Central humidifier on a warm air furnace ☐

Individual room humidifiers ☐

No humidifier ☐

Other (Please specify)

18. What was the humidity in the house on the two occasions you were in the house? (Measure in the living room.)

First visit Relative Humidity = _____

Date = _____

Second visit Relative Humidity = _____

Date = _____

19. What was the temperature in the house on the two occasions you were in the house? (Measure in the living room.)

First visit Temperature =_____

Second visit Temperature = _____

20. Do the occupants store the following in the house?

Paint ☐

Solvents ☐

Insecticides ☐

Fertilizer ☐

Paint stripper ☐

Other high volatile materials (Please specify)

_____

21. Have the occupants used any of the following in the 30 day period prior to the placement of the VOC badges?

Paint inside the house ☐

Floor wax ☐

Paint stripper ☐

Insecticides ☐

Furniture polish ☐

Rug shampoo ☐

Other high volatile materials (Please specify)

_____

_____

22. Do any of the occupants in the house smoke?

Please specify the number and the amount smoked.

Number of smokers _____

Total number of cigarettes smoked each day in the house _____

23. Is there a wood stove or fireplace in the house?

Yes ☐

No ☐

If the answer is Yes, please specify the number of times per week the wood stove or fireplace is used.
Number of times _____

24. Were there any significant renovations in the house since the house was originally completed?

Please specify_____

_____

_____

25. How do you (the interviewer) rate the air quality in this house?

Much worse than average ☐

Worse than average ☐

Average ☐

Better than average ☐

Much better than average ☐

Comments:_____

26. Do the occupants have any comments about the air quality in their home?

_____

_____

_____

_____

27. Are there any unique air quality aspects of the house that should be mentioned? (For instance, unusual odours, condensation stains on windows or walls, exceptionally good or bad housekeeping, hobby activities, etc.)

_____

_____

_____

_____

28. What is the brand name and frequency of use of the following products used inside the house?

	Brand Name	Number of times used per week
Dishwasher detergent	_____	_____
Floor wax	_____	_____
Laundry Detergent	_____	_____
General purpose cleaner Mr. Clean, etc.)	_____	_____
Hair spray	_____	_____
Perfume	_____	_____

****

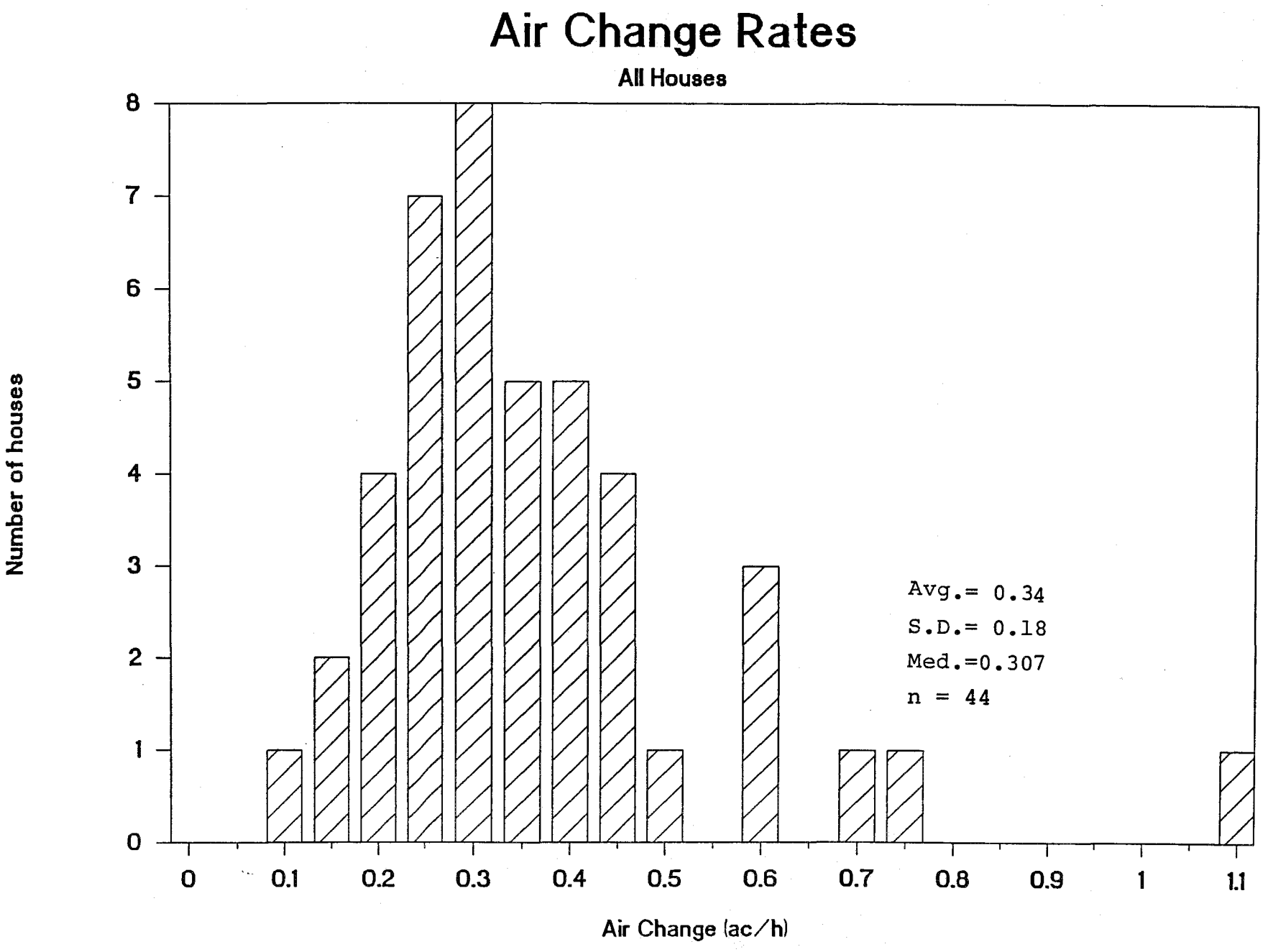

Figure 1. Histogram of air change rates

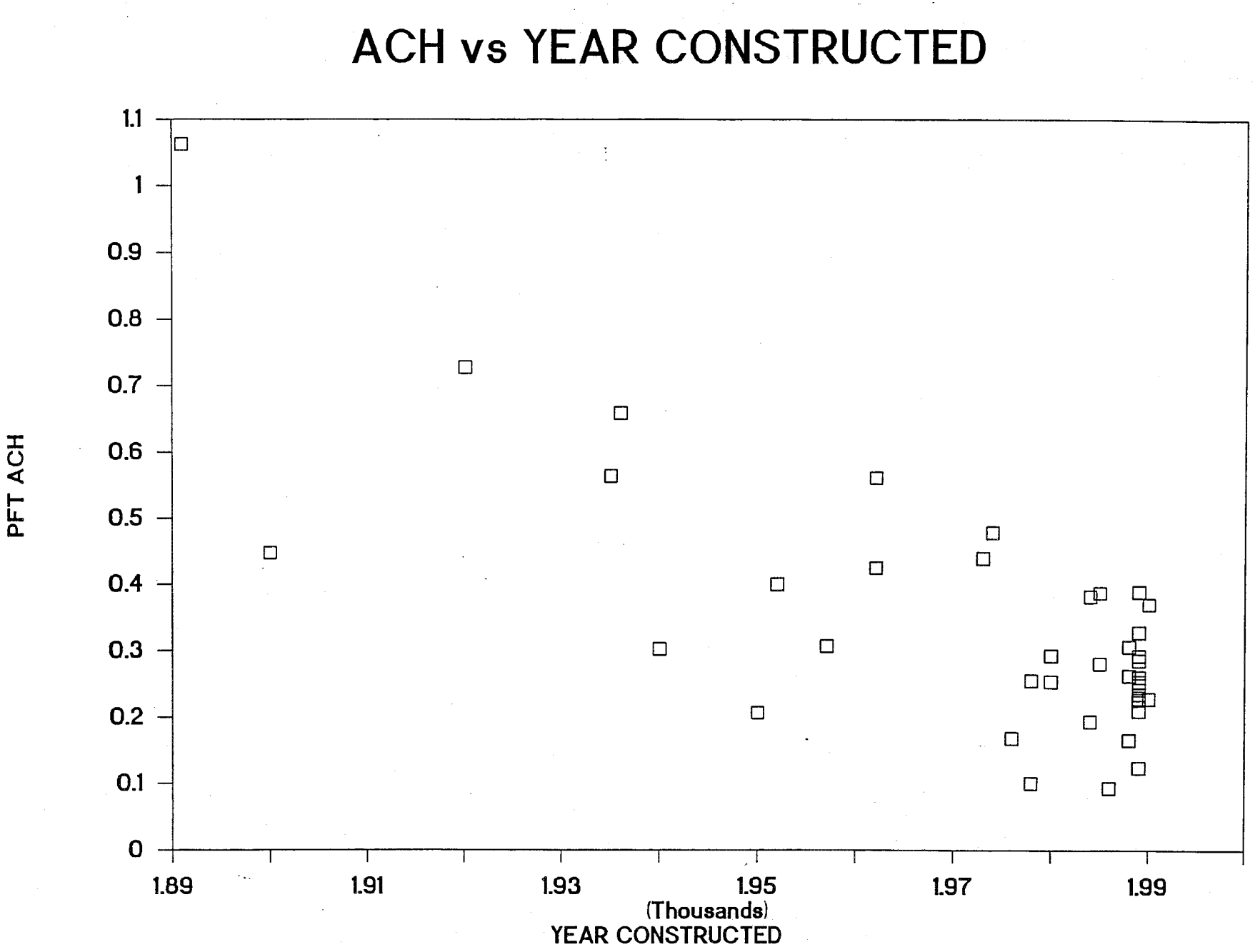

Figure 2. Air change rate vs. year constructed.

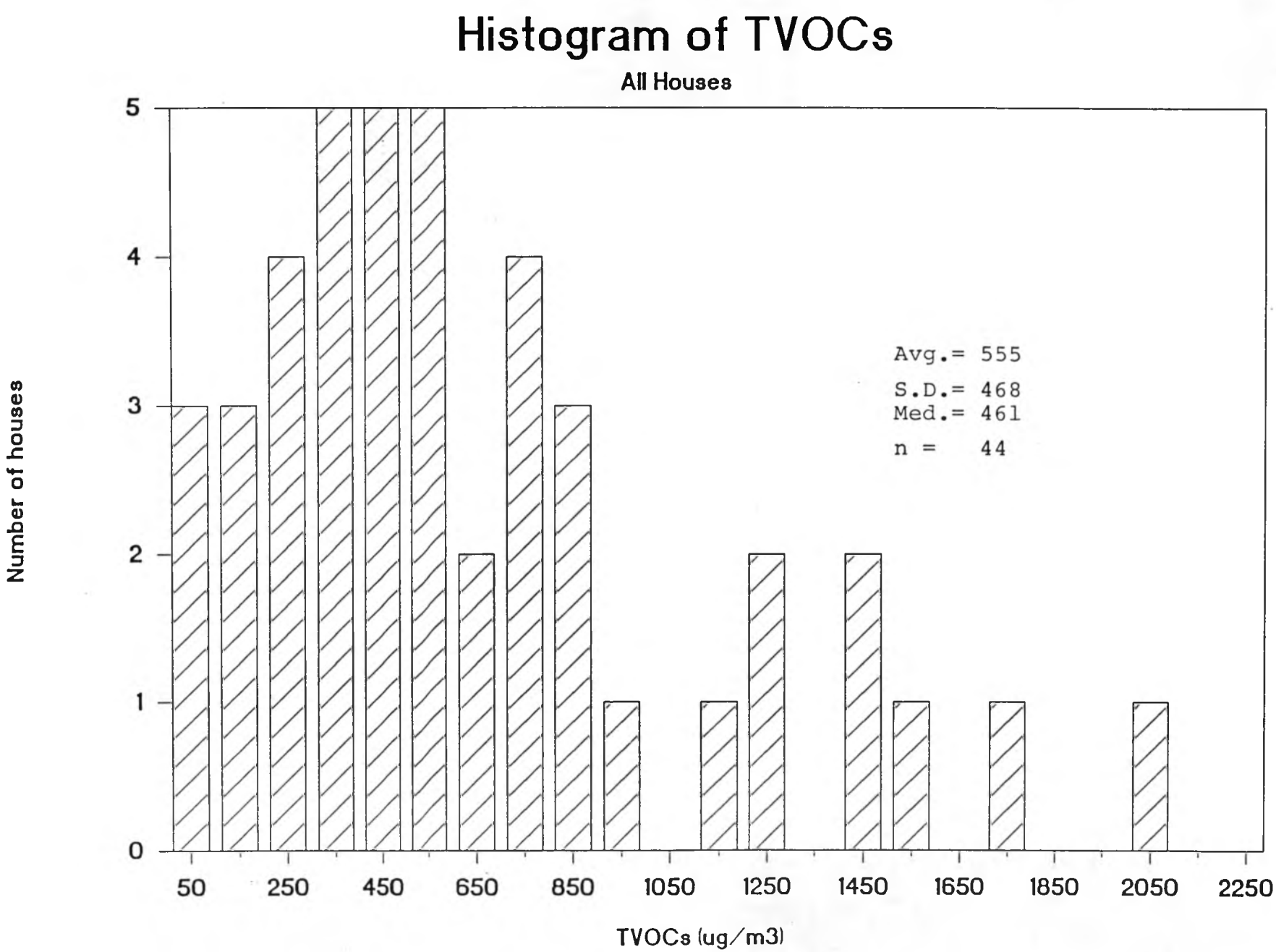

Figure 3. Histogram of TVOCs

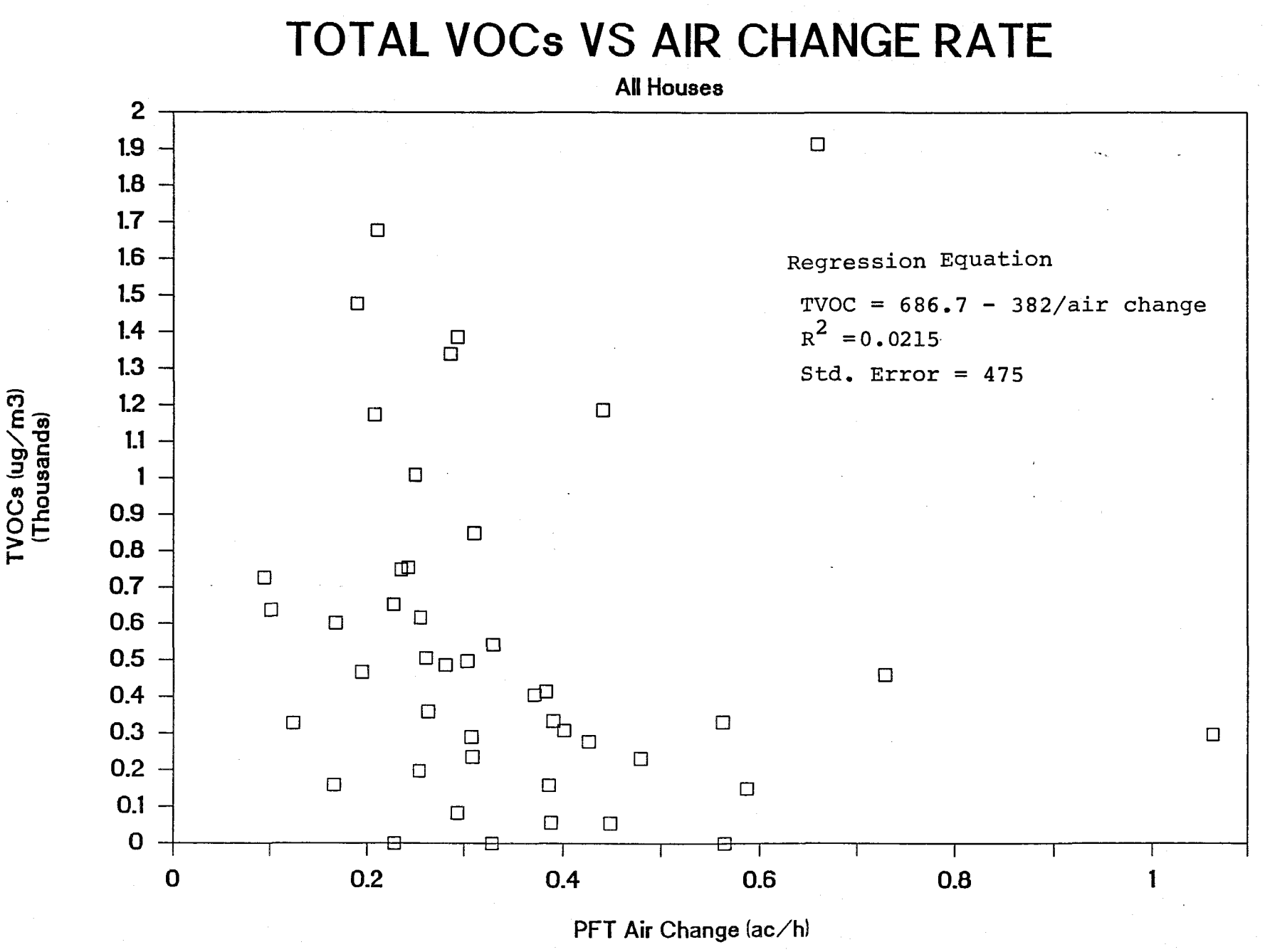

Figure 4. Total VOCs vs Air Change Rate.

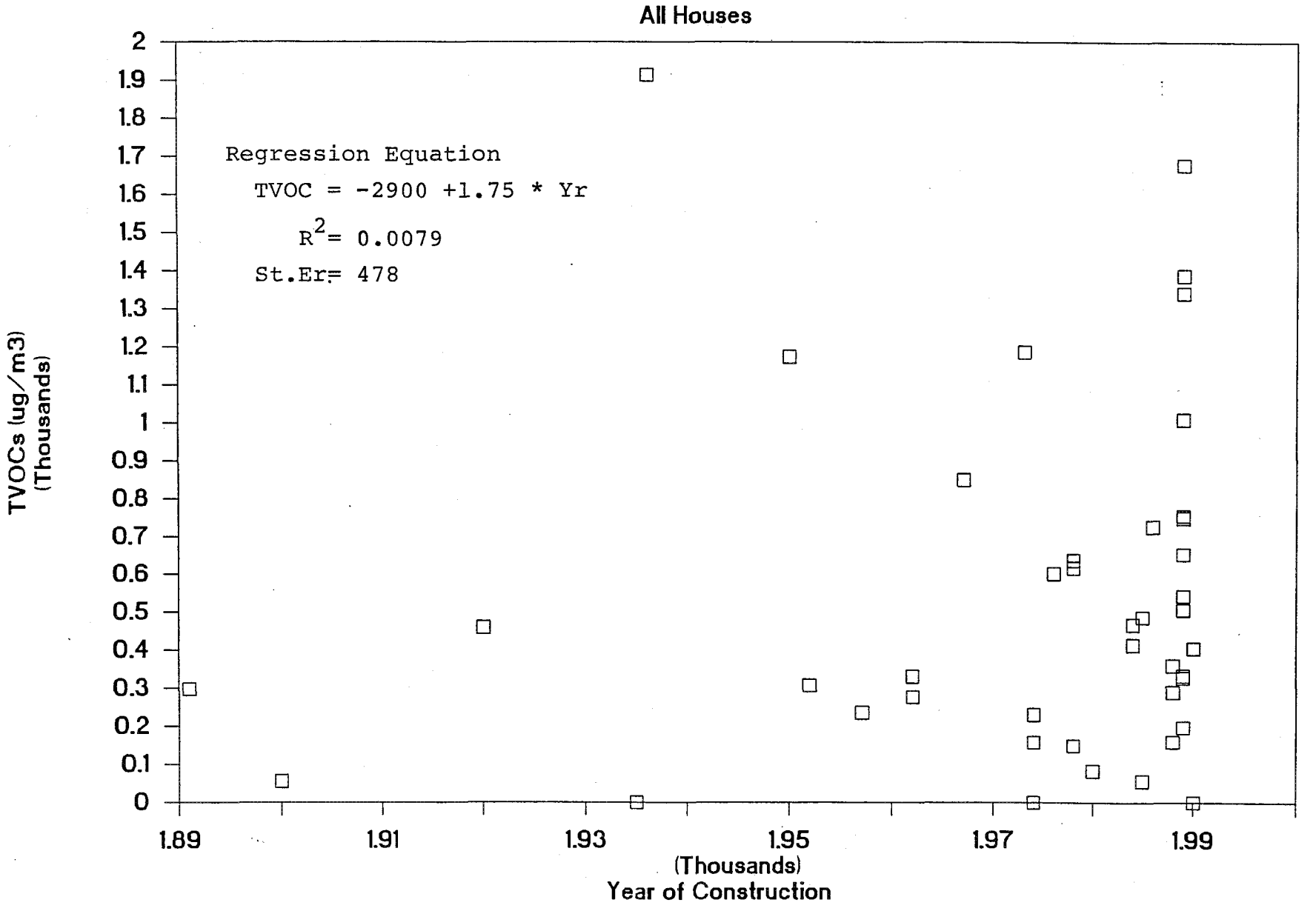

Figure 5. Total VOCs vs Year of Construction

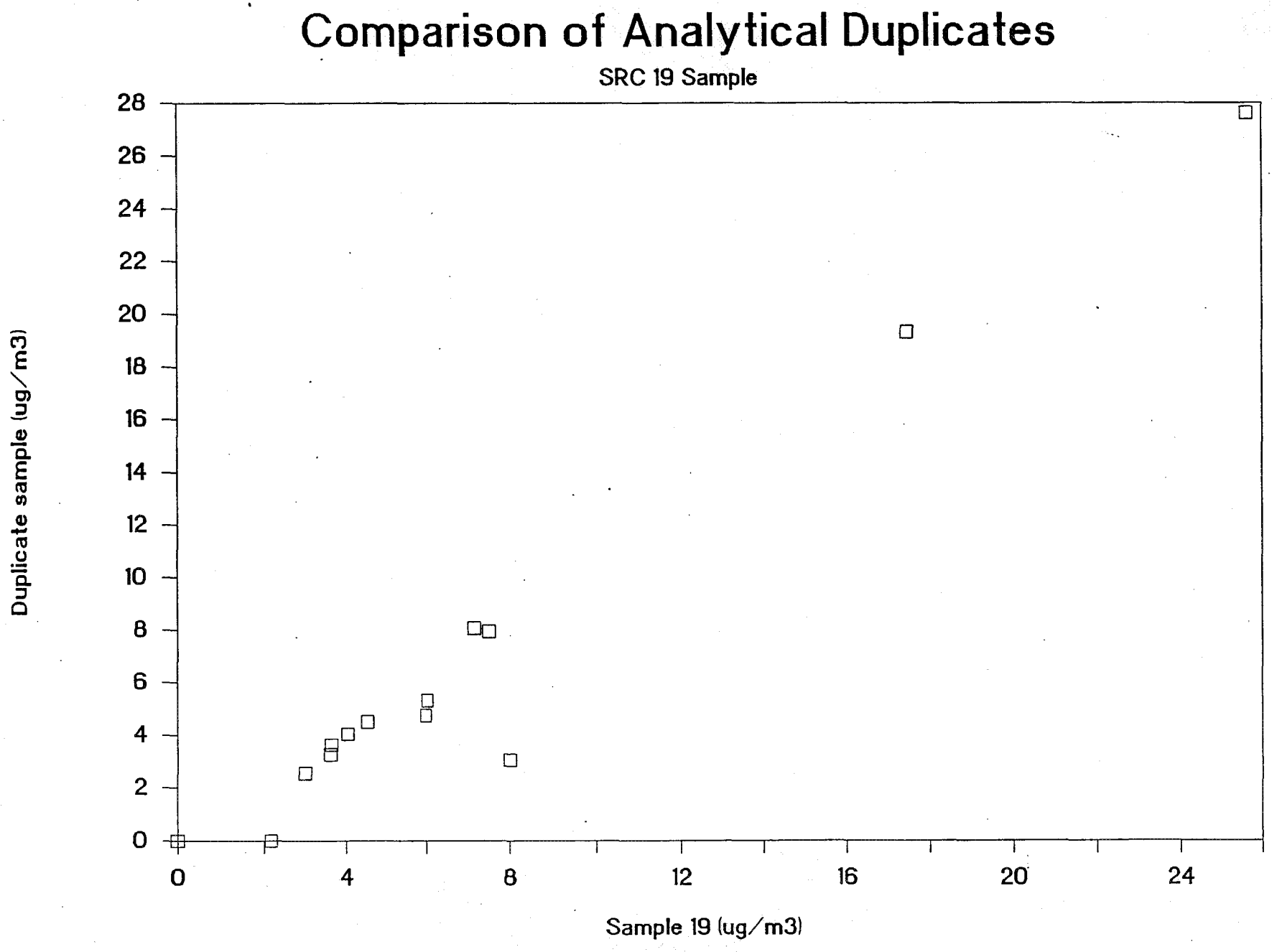

Figure 6. Comparison of Analytical Duplicates

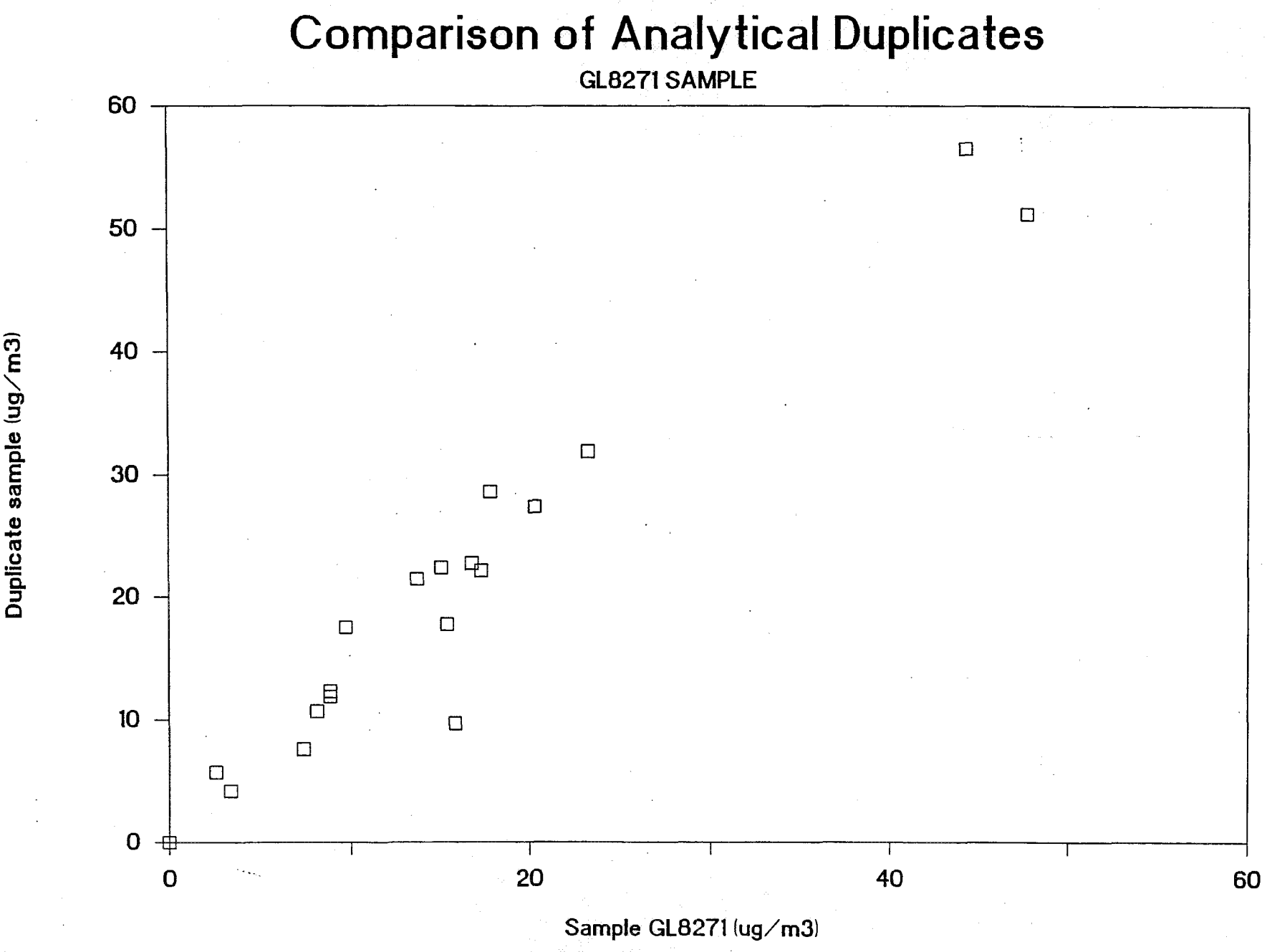

Figure 7. Comparison of Analytical Duplicates

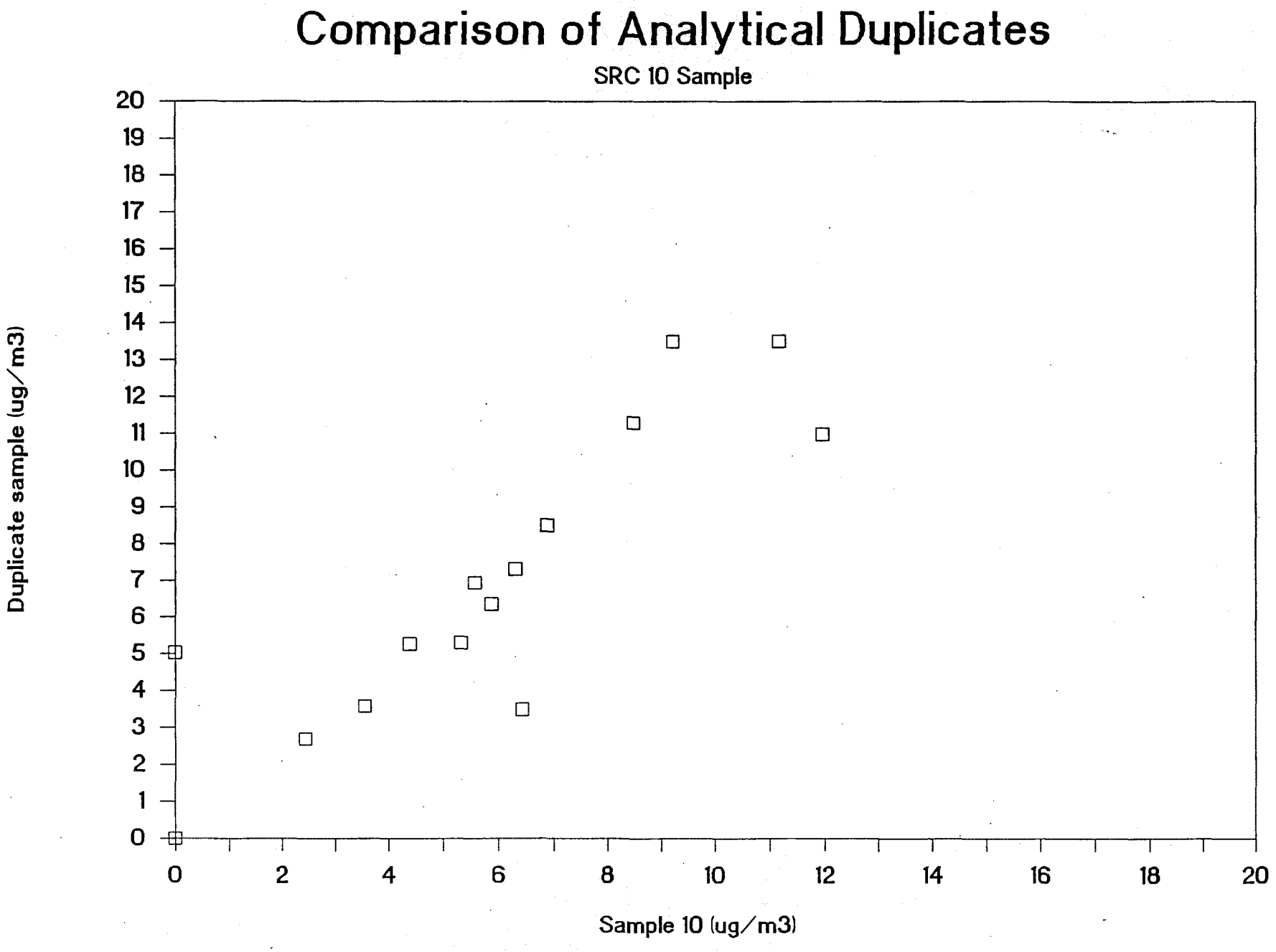

Figure 8. Comparison of Analytical Duplicates

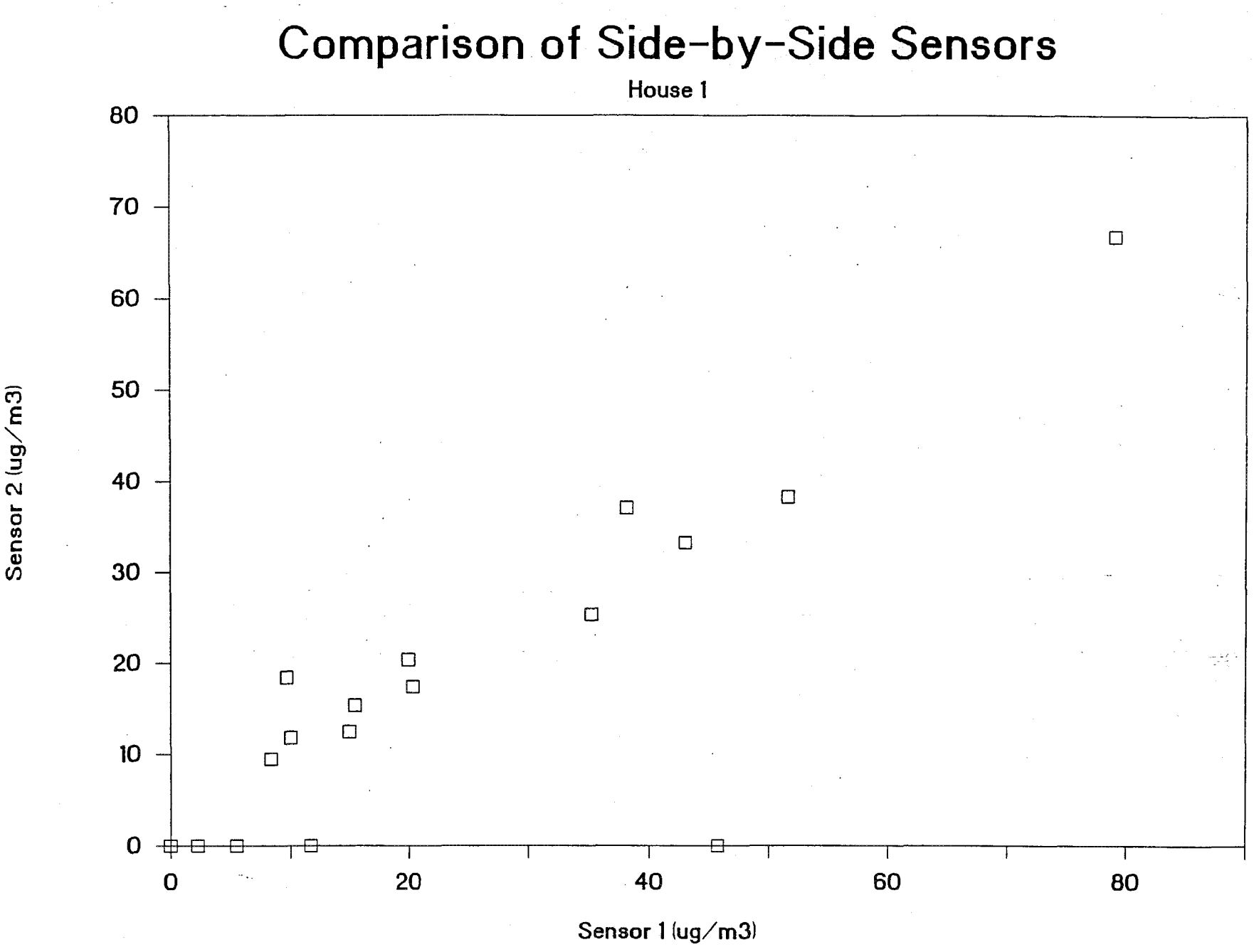

Figure 9. Comparison of side-by-side sensors (SRC6,Src7)

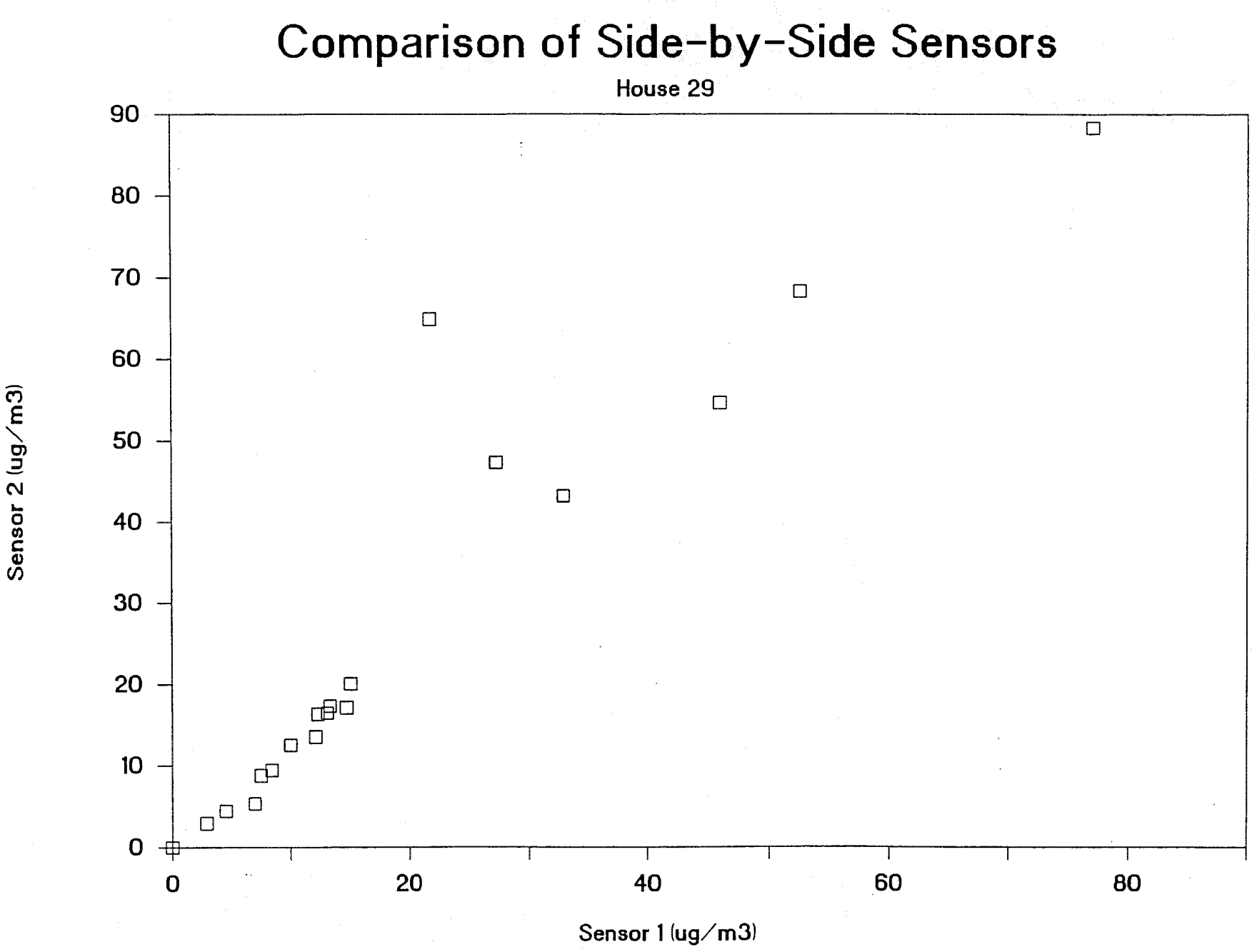

Figure 10. Comparison of side-by-side sensors (SRC1,SRC2)

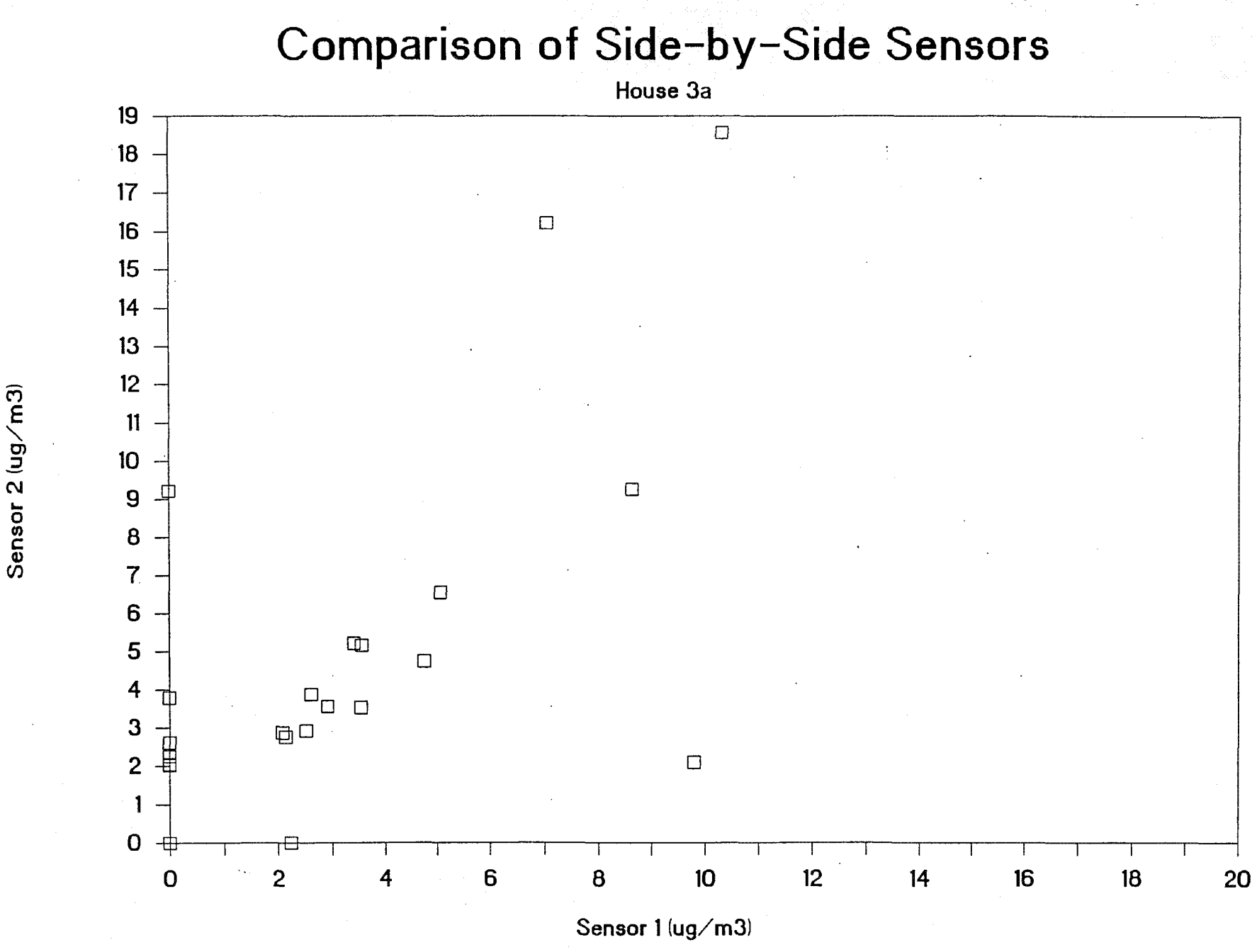

Figure 11. Comparison of side-by-side sensors (SRC14,SRC15)

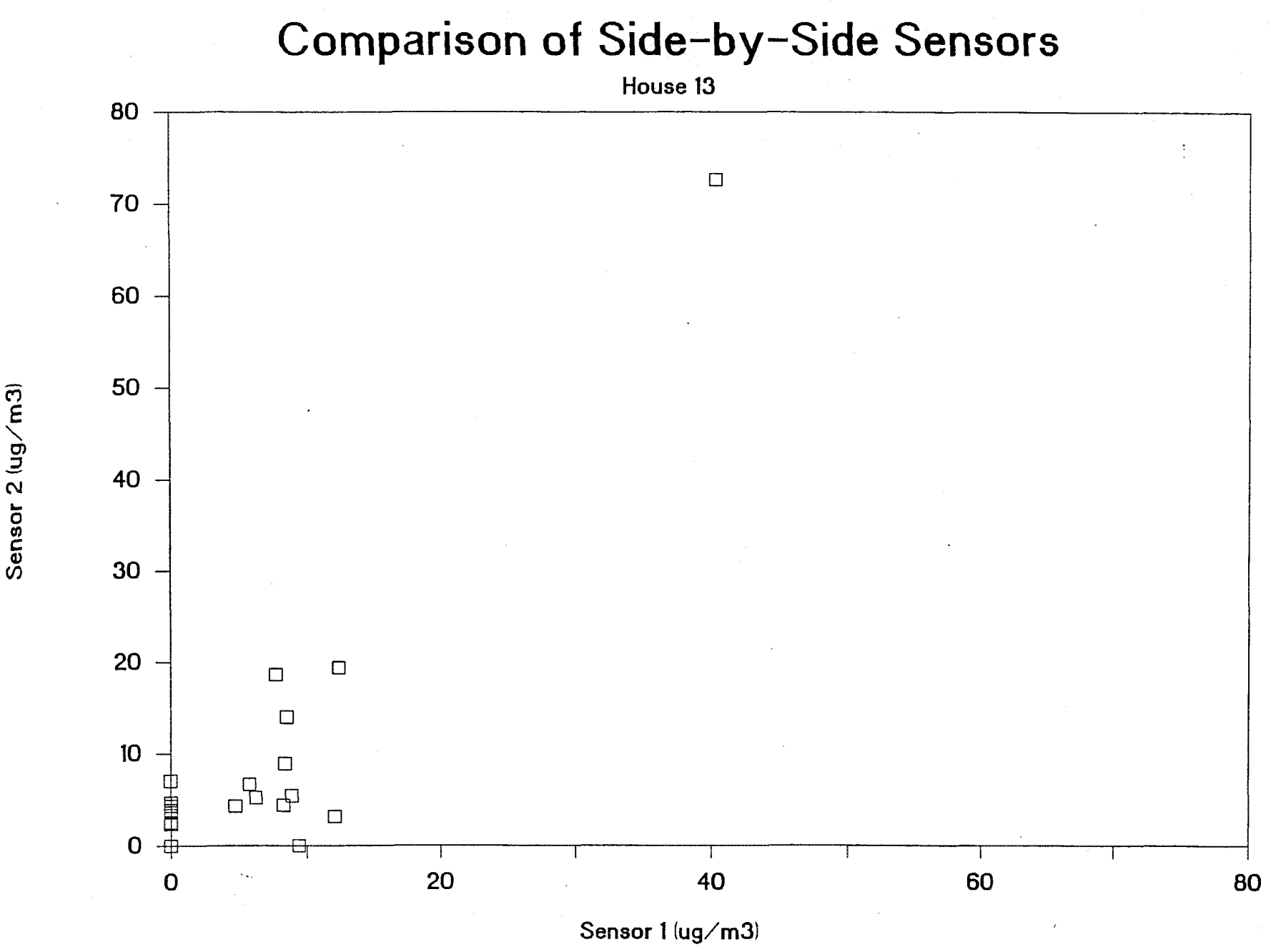

Figure 12. Comparison of side-by-side sensors (SRC3, SRC4)

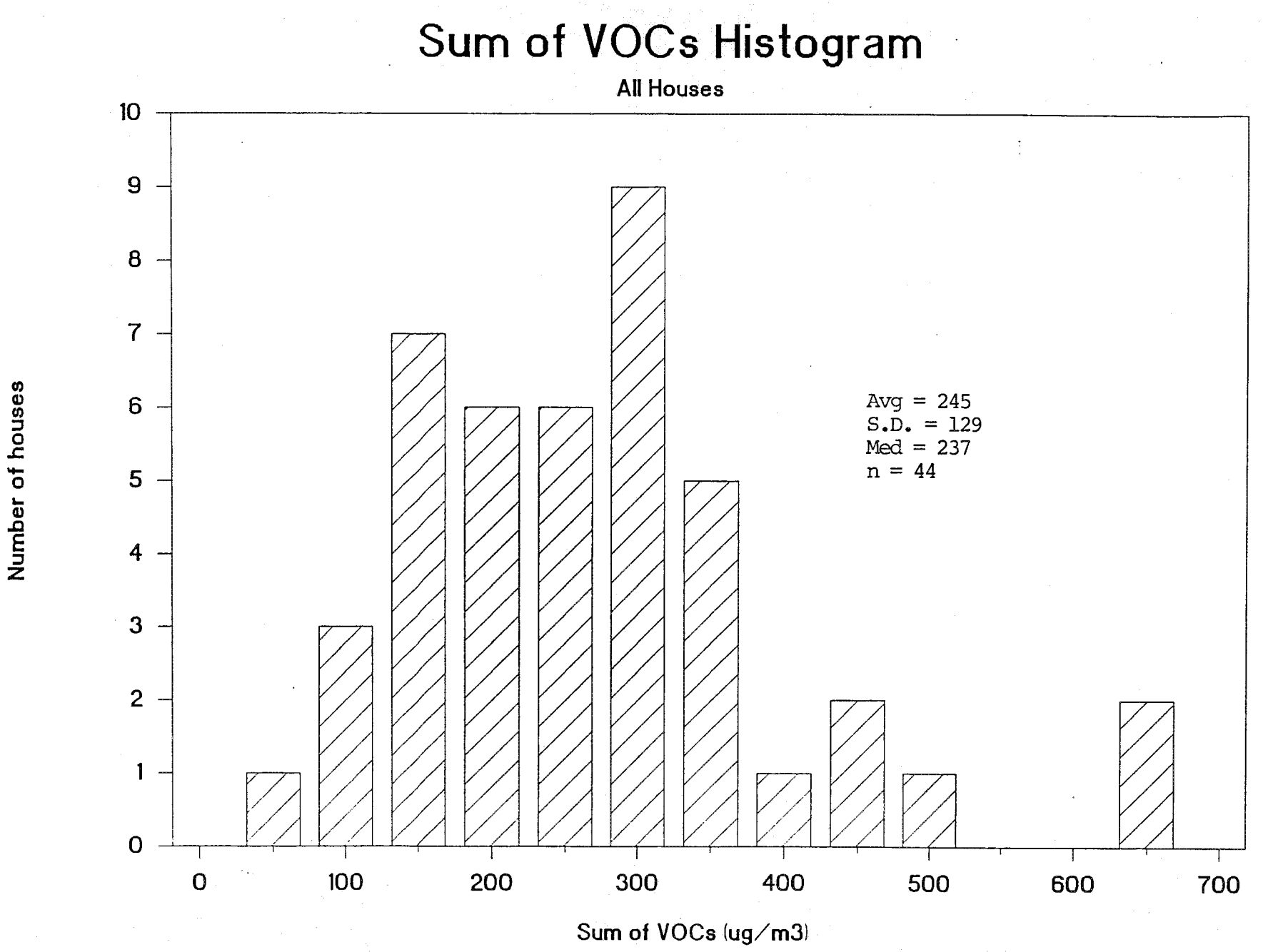

Figure 13. Histogram of the Sum of 26 VOCs

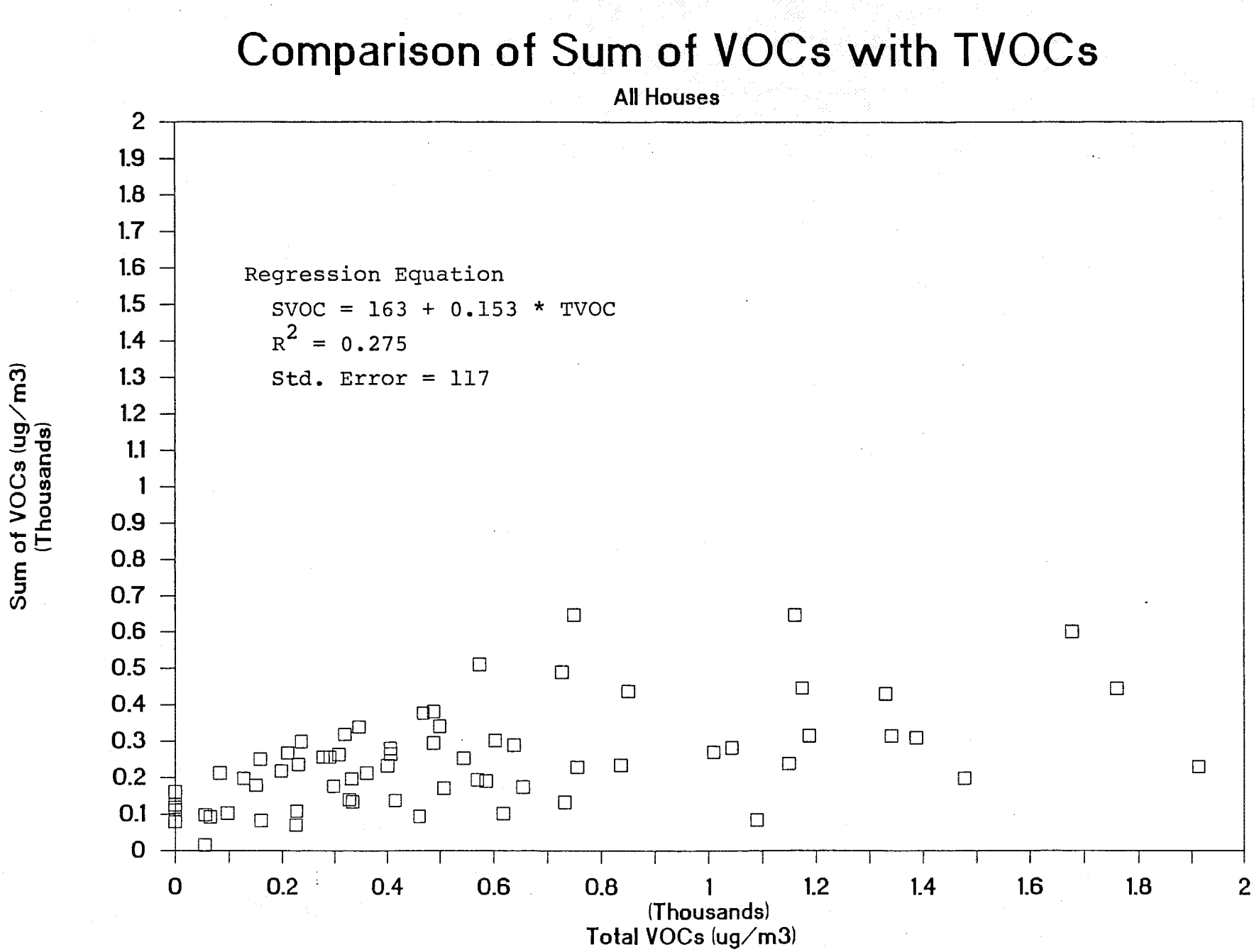

Figure 14. Comparison of Sum of 26 VOCs with TVOCs

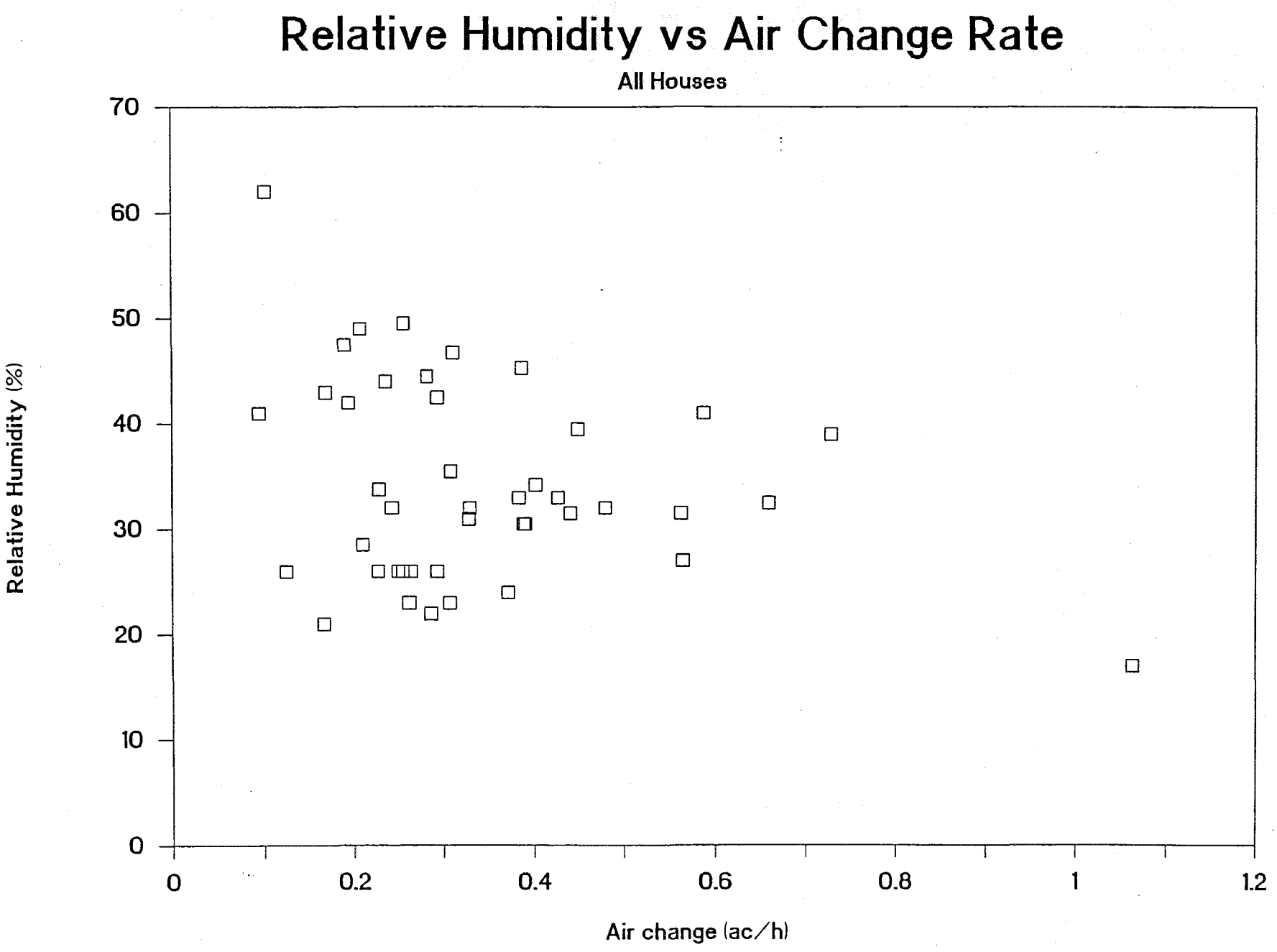

Figure 15. Relative humidity vs air change rate

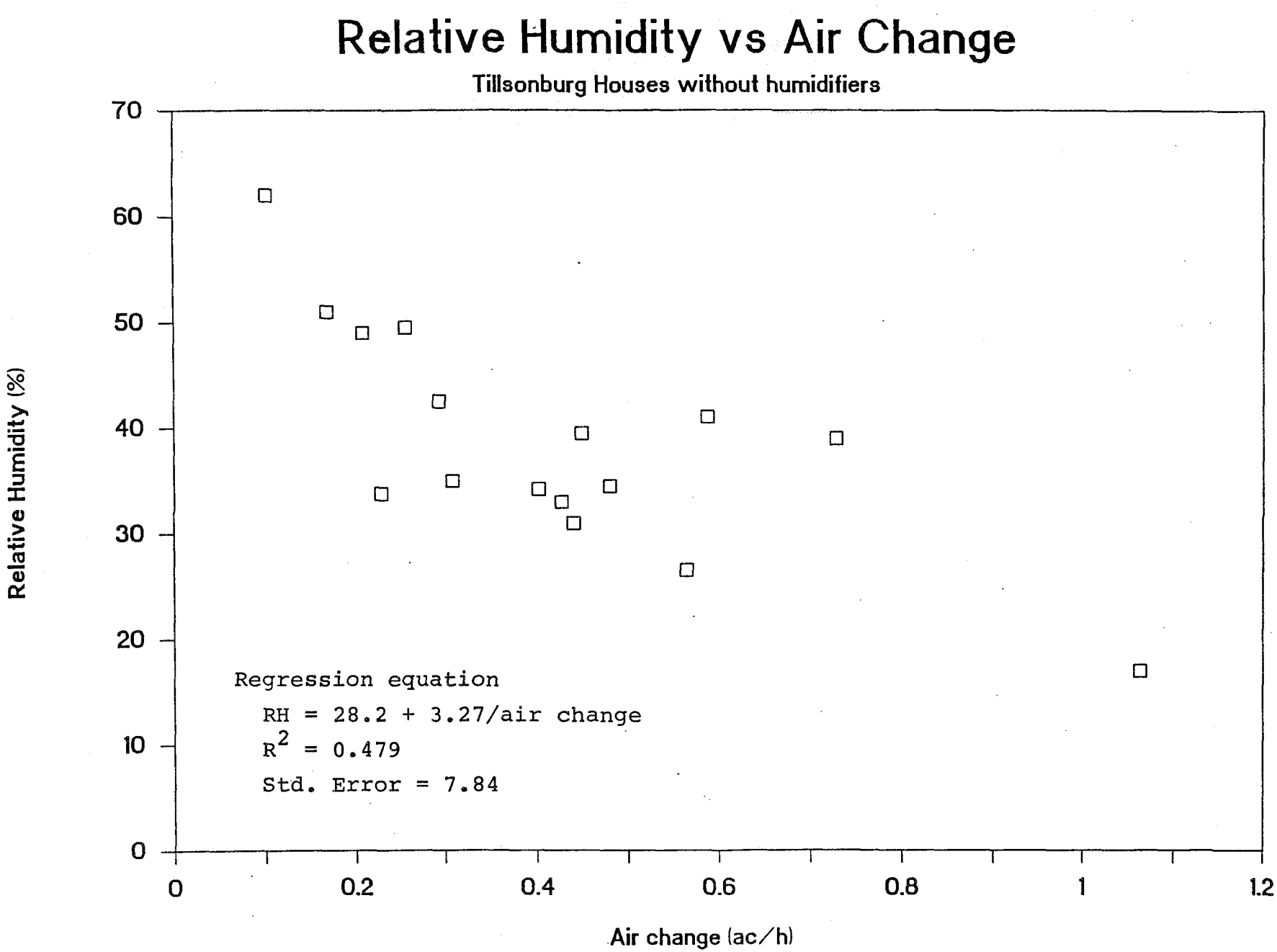

Figure 16. Relative humidity vs air change