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Preliminary Formaldehyde Testing Results
for the
Residential Standards Demonstration Program

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I. EXECUTIVE SUMMARY

Measurements are reported of winter formaldehyde concentration in indoor air for 530 homes in the Pacific Northwest. The homes are part of the BPA Residential Standards Demonstration Program, and include 182 dwellings constructed to the Model Conservation Standards proposed by the Northwest Power Planning Council (MCS homes), and 348 control dwellings build over the last several years to current building code (control homes).

For the entire sample of homes, the median formaldehyde level was 0.092 ppm. The median level in the MCS dwellings was 11 percent higher on average than that in the control dwellings, and this difference was found to be statistically significant ($P<0.1$). Every MCS home was equipped with an air-to-air heat exchanger in order to provide the same fresh air infiltration level as the control homes. The higher levels in the MCS homes was likely due principally to their younger age as compared to the control homes; one half year as compared to three years at time of the test. Small statistically valid variations were also observed between climate zones and between states, with the colder zones and states generally having the higher formaldehyde levels. These variations between MCS and control homes are not considered significant.

Formaldehyde is a common industrial chemical used in glues and plastic foam products. In homes, it is derived ~~from~~ principally from building materials which use urea formaldehyde glues, such as particle board, and from furniture built with such materials or containing plastic foam. Some plastic foam insulation also releases formaldehyde. Formaldehyde levels in indoor air will be greatest when the home is new and has been shown to decrease over time as the gas is released from materials. Different studies indicate that half the formaldehyde may be released in as little as 2 to 5 or as much as 10 to 15 years. Mobile homes tend to have higher levels of formaldehyde, although low formaldehyde containing products are becoming more available and are now more widely used in both mobile and conventional homes.

No standards have been set for formaldehyde levels in homes. The gas is irritating to most adult at levels in excess of about 0.25 ppm (parts per million) and a few people are sensitive at levels much lower than this. Indoor standards have been proposed at levels from 0.1 to 0.5 ppm.

II. INTRODUCTION

This report summarizes formaldehyde concentrations in indoor air observed for 530 occupied residential dwellings in the Pacific Northwest during the 1985 heating season. The measurements are average values for one week, and were made using passive detectors supplied by Air Quality Research, Inc. of Berkeley California. The dwellings are part of the Bonneville Power Administration's (BPA) Residential Standards Demonstration Program (RSDP) (1), and represent approximately half the total measurements which will be made and reported under the program. Both single and multi-family non-manufactured dwellings are included. Measurements for all homes will be completed during 1986 and will be reported in a final report, which will also include more analysis, discussion, and interpretation.

The RSDP is a field demonstration project of the Model Conservation Standards (MCS) proposed by the Northwest Power Planning Council (2). Under the RSDP, 500 all electric dwellings were constructed in compliance with the MCS (MCS dwellings), including both single and multi-family dwellings. These were matched on an aggregate basis to 500 control dwellings build over the last several years in compliance with current local building codes (control dwellings). A subset of the MCS dwellings (matched pair dwellings) were paired directly with control dwellings constructed concurrently with the MCS dwellings, and identical except for changes required by the new building code. The number of matched pair dwellings is currently insufficient for analysis. The dwellings in which the initial formaldehyde measurements were made are summarized in Table I.

Construction cost, thermal performance, and indoor air quality effects of the MCS are being studied under the RSDP, principally through aggregate comparison of these parameters between the MCS and control dwellings. Construction cost is being studied using detailed cost accounting obtained from the builder of the MCS dwelling and a hypothetical equivalent dwelling build to current practice. Thermal performance is being assessed using weekly summaries of submetered space and water heating energy, and concurrent actual heating degree days. This information is recorded by occupants. Indoor air quality is being studied using a fan pressurization infiltration test, three-month and one-year passive radon tests, a one week passive formaldehyde test, and a one-time measurement of air-to-air heat exchanger (AAHX) flow. The formaldehyde results are reported here, and the other results are in reports similar to this one.

In compliance with agency environmental policy, all MCS dwellings in the RSDP were equipped with an AAHX. These were designed and controlled to result in an overall infiltration rate (natural plus forced) of 0.6 air changes per hour (ach), the presumed rate for current practice dwellings. The control dwellings did not have an AAHX.

III. BACKGROUND

Formaldehyde is a colorless, water soluble gas with a pungent odor that is noticeable to most people at concentrations in excess of 0.1 parts per million (ppm). Formaldehyde in residences is most often derived from two compounds: urea-formaldehyde and phenol-formaldehyde. The urea compound releases free formaldehyde more readily than the phenol compound, and is therefore typically of more concern as a potential indoor pollutant source. It is a low cost chemical with excellent bonding characteristics often used as glue in building materials and products such as plywood, particleboard, laminates, furniture, cabinets, and carpeting. In homes, the predominant source is press-wood construction materials and furniture which use urea-formaldehyde resins. Exterior grade board products use phenol-formaldehyde bases glues and are therefore of lower source strength. Cigarette smoke also contains trace amounts of formaldehyde (3).

As formaldehyde containing products age, they gradually release formaldehyde gas. The amount of gas given off is greater when products are new and decreases over time. Higher temperature and humidity will increase the rate of release. Although this rate is neither uniform nor well-defined, decay half lives of two to five years (4), and ten to fifteen years (5) have been observed. It has also been observed that an increase in air exchange rate results in a less than proportionate decrease in formaldehyde concentration, due to compensating increases in source strength (6).

The passive samplers utilize an absorption medium isolated by a diffusion barrier. Trapped formaldehyde is analysed spectrophotometrically. The samplers have a working range of 0.018 ppm to somewhat over 1.0 ppm (weekly average formaldehyde concentration), and are restricted to use in indoor environments where average relative humidity is 60 percent or less. Measurement precision has been determined in field tests to be approximately ± 7 percent. Acrolein, the only compound considered to be a significant potential interference, has been shown to have negligible effect on the measurements even when in a 10:1 excess over formaldehyde. Post-exposure stability is two weeks minimum. Sampler specifications are summarized in Table 3 and in reference 9.

Passive samples were prepared by Air Quality Research as described in reference 8 except that the sodium bisulfite impregnated filters were dried under vacuum for approximately 3 hours, instead of under a constant stream of dry nitrogen. Sampling efficiency, as determined by sampling rate, is not affected by this change in procedure.

Passive samplers were deployed in the field by homeowners. Arrangements were made regarding sampler location by a trained technician on a previous site visit, and the samplers were then mailed to the occupants one week later. Samplers were mounted in conditioned space in a major common area on the first floor (living room, family room, or dining room) at a level out of reach of children and pets. Care was taken so that the samplers were not near windows, doors, or heating or heat exchanger vents.

Two detectors were used in every case for redundancy. They were spaced approximately 2 cm apart. The date and time of sampling were recorded by the homeowner, and at the end of the one week sampling period, the samplers were capped and returned for analysis in mailers provided by BPA. Weekly average concentrations were computed based upon the deployment times reported by the occupants. If only one vial was received, or if a vial was received broken or uncapped, only the one good vail was used. When no stop time was provided, the concentrations were rejected.

Because new homes contain younger formaldehyde-containing materials and possibly higher humidity (due to drying out of building components and lower air infiltration rates), they will generally have higher formaldehyde source strengths (outgassing rates) and hence higher levels of formaldehyde in indoor air. Mobile homes will also usually have higher levels than conventional homes because of the larger amount of plywood and particleboard used in their production in relation to the volume of living space.

For conventional homes older than a few years, formaldehyde pollution is generally not a concern, both because formaldehyde-containing materials have outgassed, and because air exchange rates are generally high enough to dilute pollutant sources with outside air and reduce concentrations to acceptable levels. As a house is made more airtight (as under the MCS) concentrations of formaldehyde will tend to increase, and it was for this reason that AAHX's were required in the RSDP. Source strengths, however, are still the primary determinant of indoor formaldehyde concentrations.

Specific standards for most indoor air pollutants have not yet been established. Existing guidelines are summarized in reference 7. Figure 1 relates formaldehyde concentrations in ppm to the ASHRAE recommended level for indoor air exposure.

IV: MONITORING METHODOLOGY

Formaldehyde levels in indoor air were measured using passive samplers developed by Lawrence Berkeley Laboratory (8) and are now available from:

Air Quality Research Inc.
901 Grayson St.
Berkeley, CA
(415) 644-2097

They were specifically designed for determining weekly average formaldehyde concentrations in residential indoor air. A one week sampling interval was chosen to average concentration variations which occur in response to environmental factors, such as temperature and humidity, and to natural and forced ventilation.

Several factors could contribute to the 11 percent increase in formaldehyde concentration in MCS dwellings with respect to control dwellings. These factors include differences between the MCS and control dwellings in infiltration rate, use of formaldehyde containing materials, indoor humidity, indoor temperature, and dwelling age.

The seasonal average infiltration rate for the MCS homes is estimated to be 0.6 ach (0.1 ach or 0.4 ach natural, depending on infiltration reduction package used (2), and 0.5 ach or 0.2 ach forced, respectively), and 0.6 ach for the control homes as well. More accurate estimates of infiltration will be made when results of a fan pressurization test and a AAHX delivered flow test are analysed). Actual forced infiltration rates for the MCS homes are likely lower than expected, based upon preliminary measurements of delivered AAHX flow, and actual natural infiltration rates for the control dwellings are likely also lower than expected, based upon recent national data (10). Thus, although it is possible that the MCS and control dwelling infiltration rates are different enough to account for the observed differences in formaldehyde level, data is not yet available for actual estimation of this effect. Perhaps a 20 percent difference in infiltration rate would be required to account for all the difference, due to the source strength effects mentioned above.

Different use of formaldehyde containing materials between the MCS and control dwellings could also effect formaldehyde concentration in indoor air, but the difference would appear to be opposite to that observed. MCS dwellings probably contain somewhat <u>less</u> formaldehyde releasing materials, both because this was emphasized to the builders during the extensive MCS training workshops, and because of the increasing availability of low formaldehyde building products, in particular particle board.

The indoor humidity in MCS dwellings may have been somewhat higher than that in control dwellings (although no measurements were made) due to drying out of building components (especially masonry), some recycling of moisture by AAHX's, and a lower overall infiltration rate. Indoor temperatures may have been different as well, owing to the relatively higher efficiency and lower air infiltration of the MCS dwellings. Some estimates of the temperature effect will be possible when the MCS and control dwelling temperature measurements are avaiible.

V. MONITORING RESULTS

The results of the formaldehyde measurements are summarized in Table IV and Figure 2 for the sample as a whole and for a number of subsamples by state and climate zones (as defined for the MCS (2)). In all cases, mean, standard deviations, maximum, and minimum were computed. Medians were also computed as a measure of central tendency.

MCS and control dwellings were compared for the various samples to determine the effects of the MCS on indoor air quality. Differences in mean formaldehyde concentrations were assessed for statistical significance using Z scores. The results of these comparisons are summarized in Table V. Differences in means were considered to be statistically significant for $Z > 2.58$ ($P < 0.01$) and not statistically significant for $Z > 1.96$ ($P < 0.05$), where:

$$Z = (X_1 - X_2)/(\sigma_1^2/N_1 + \sigma_2^2/N_2)^{0.5}$$

and:

X_i = mean for sample i
σ_i = standard deviation for mean of sample i
N_i = number of observations in sample i.

Frequency distribution of the formaldehyde concentrations for the various samples are given in Figures 3 through 13. These were computed for 0.025 ppm bins from 0 ppm to 0.4 ppm, and included all observations.

V1. DISCUSSION

It can be seen from Tables IV and V and Figures 3-12 that the median formaldehyde concentration for all dwellings monitored was 0.092 ppm, or slightly lower that the ASHRAE proposed standard of 0.1 ppm. Furthermore, the median concentration for the MCS dwellings was slightly higher (11 percent) than that for the control dwellings, and the difference in means was statistically significant. This was true for the entire sample of MCS dwellings, and for several subsamples.

Using the 5.5 year time constant model and median ages of one and three years for MCS and control dwellings respectively, one would expect the that the formaldehyde levels in MCS dwellings would be 30% higher than in control dwellings, all other things being equal. This is higher than the observed difference in median concentrations (ie, MCS 11% higher). Possible reasons for the discrepancy include the relatively crude dwellings age determination, and differences in the other source parameters discussed above, especially use of formaldehyde containing products. It is clear, however, that the observed greater formaldehyde levels in MCS dwellings could easily be due to differences in dwelling age.

In comparing formaldehyde concentration between MCS and control dwellings by climate zone and by state, for all cases except the state of Oregon, the MCS dwellings had a higher median level than the control dwellings. Differences by climate zone ranged from 4 percent to 24 percent, but were statistically significant only for zones 1 and 3. Differences by state ranged from 2 percent to 41 percent, but were statistically significant only for Washington. Dwelling age is again likely the largest contributing factor.

In comparing formaldehyde concentration between climate zones, there appears to be a statistically valid difference in means of 20% between climate zone 3 and the other two zones. In comparing between states, there appears to be a statistically valid difference between all states except Montana and Oregon. The differences ranged from 10 to 51 percent, with the colder state generally having higher levels. These differences could be due to reduced ventilation during the test (February) due to colder temperatures.

Assuming approximately equal infiltration rates and source strengths, the dependance in dwelling age is most likely to be the principle cause of the higher formaldehyde levels in MCS dwellings. Dwelling ages are summarized in Table VI, and age distributions shown in Figures 13 and 14. The ages are self-reported from an extensive survey given to each homeowner, and are calculated as the difference between 1985 and the reported year built. To the nearest year, then, the median age of MCS dwellings was one year, and of control dwellings was three years.

Median formaldehyde concentration for the entire sample by age is summarized in Table VII and in Figure 15. It can be seen that the median concentration decays steadily with age for the first three years and then seems to remain relatively constant. This could represent a superposition of several exponential decays of different time constants associated with different sources (ie, subflooring, carpeting, furniture, etc.).

In an effort to model the observed variation in formaldehyde concentration, a single exponential of the form;

$$c(t) = c_o e^{-t/T}$$

where:

c = formaldehyde concentration at age t (ppm)
c_o = formaldehyde concentration at age 0 (ppm)
T = decay constant (years)
t = dwelling age (years)

was fit to the data. The fit was poor both when all years were considered, and when just years four to ten were considered separatively ($R^2 = 0.54$ and 0.14, respectively). The fit was much closer ($R^2 = 0.99$) when the first three years were considered separately, yielding a time constant of 5.5 years. (See Figure 16). The first three years could represent decay of a strong, short-time constant source (such as cabinets and furniture) as observed in other studies (4), and the later years the decay of other slower sources (such as subflooring).

VIII: FURTHER ANALYSIS

Further analysis of this data could be done on the following topics:

1. Differences in use of formaldehyde containing materials in MCS and control homes, including furniture and carpeting.

2. Effectiveness of AAHX in removing formaldehyde, particularly the heat wheel type AAHX's.

3. Survey of indoor air quality complaints and problems, as reported by occupants.

VII: SUMMARY CONCLUSIONS

1. The median formaldehyde concentration observed for all dwellings was 0.092 ppm, or sightly lower than the ASHRAE standard of 0.1 ppm.

2. The median formaldehyde concentration observed for MCS dwellings was 11 percent higher than that observed for control dwellings, and the difference was statistically valid ($P < 0.01$). Valid differences were also observed for the state of Washington (MCS 41 percent higher), and climate zones 1 and 3 (MCS 20 percent higher).

3. Statistically significant differences were observed between climate zone 3 and zones 1 and 2 (zone 3 20 percent higher). Differences were also observed between all states except Montana and Oregon (colder generally higher), with a range of 10 to 51 percent.

4. The higher level of formaldehyde observed in MCS dwellings as compared to control dwellings is most likely due to their approximately two year shorter age as compared to the control dwellings. Data from all dwellings for the first three years is consistent with a single source of 5.5 year time constant. Data for later years is not as regular. Different infiltration rates, use of formaldehyde containing materials, and indoor humidity and temperature may also be contributing factors.

5. More formaldehyde measurements and data on infiltration rate and AAHX delivered flow rate will be reported and discussed in future reports.

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Control	State Total
166	236
61	107
39	68
83	119
349	530

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10. 1985 ASHRAE Fundamentals Handbook, pg. 22.8.

TABLE II: Recommendations Guidelines, and Standards for Exposure to Formaldehyde (7)

AIR TYPE/ Organization	Concentration (ppm)	Status
RESIDENTIAL INDOOR AIR		
ASHRAE	0.1 ppm	
HUD	0.2 ppm plywood** 0.3 ppm particle board**	
California	0.05 ppm	Proposed
Minnesota	0.5 ppm	
Wisconsin	0.4 ppm	
Denmark	0.12 ppm max	Recommended
Netherlands	0.1 ppm max	Recommended by Ministers of Housing and Health
Sweden	0.1 ppm max, new buildings 0.4-0.7 max. old buildings*	Proposed by the National Board of Health and Welfare
Federal Republic of Germany	0.1 ppm max	Recommended by the Ministry of Health
OCCUPATIONAL AIR		
United States	3 ppm, 8-h time-weighted ave.	Promulgated by OSHA
	5 ppm, ceiling	Promulgated by OSHA
	2 ppm, threshold limit value	Recommended by ACGIH
	1 ppm. 30-min max	Recommended by NIOSH

* 0.4 to 0.7 ppm is a border area. Levels higher than 0.7 ppm do not meet the standard. Levels lower than 0.4 ppm meet the standard. Levels within the border area do not meet the standard if the dwellers complain. In recently built houses, 0.7 ppm should be acceptable during the first 6 months.

** When used in manufactured housing, plywood and particle board are not to exceed these levels. The Standards are targeted to provide an ambient level of 0.4 ppm or less in manufactured housing.

TABLE III: Description and Specifications of the LBL Passive Sampler (9)

CONTAMINANT:	Formaldehyde (HCHO)
SAMPLER:	Passive diffusion sampler; area, 3.98 cm^2; path length, 9.4 cm; collection medium, $NaHSO_3$ impregnated glass fiber filter
ANALYSIS:	Chromotropic acid spectrophotometric analysis, NIOSH P&CAM No. 125
SAMPLING RATE:	4.02 cm^3/min (0.296 µg/ppm-hr) at 1 atm and 20 °C
SAMPLING PERIOD:	1 week (168 hr)
SAMPLING RANGE:	.018 ppm to more than 1 ppm for 168 hr
ENVIRONMENTAL EFFECTS:	Independent of pressure, only slightly dependent on temperature Accuracy reduced when average relative humidity exceeds 60% at 25 °C
INTERFERENCES:	No identified significant interferences in residential environments
SHELF LIFE:	2 weeks minimum
SAMPLE STABILITY:	2 weeks minimum
OVERALL PRECISION:	Mean coefficient of variation = 6.7%
BIAS:	+15% based on field comparisons with reference method; true concentration = 0.87 x passive sampler concentration
OVERALL ACCURACY:	True concentration ± 95% confidence interval of 14%

TABLE IV: Summary of Formaldehyde Measurements

Case	Number of Observations	Formaldehyde Concentration in ppm Median	Mean+Std Dev	Max	Min
All	530	.092	.099±.048	.376	.021
All MCS	182	.102	.113±.054	.376	.028
All control	348	.085	.093±.043	.245	.021
Matched Pr MCS	15	.112	.138±.072	.280	.047
Matched Pr Cont.	11	.124	.128±.051	.204	.061
Zone 1	325	.087	.097±.049	.376	.021
Zone 2	83	.088	.093±.043	.300	.028
Zone 3	122	.108	.110±.047	.252	.027
Zone 1 MCS	90	.100	.114±.058	.376	.033
Zone 1 Cont.	235	.086	.091±.043	.245	.021
Zone 2 MCS	40	.099	.100±.051	.282	.028
Zone 2 Cont.	43	.080	.086±.033	.204	.030
Zone 3 MCS	52	.117	.120±.047	.252	.041
Zone 3 Cont.	70	.113	.103±.045	.199	.027
Idaho	68	.087	.099±.052	.280	.027
ID MCS	29	.099	.109±.060	.280	.028
ID Cont.	39	.078	.093±.045	.244	.027
Montana	106	.115	.115±.046	.252	.032
MT MCS	46	.120	.123±.047	.252	.041
MT Cont.	60	.105	.112±.048	.199	.032
Oregon	119	.105	.116±.051	.376	.030
OR MCS	37	.103	.128±.067	.376	.030
OR Cont.	82	.105	.112±.041	.245	.038
Washington	237	.076	.084±.041	.282	.021
WA MCS	72	.096	.102±.044	.282	.033
WA Cont.	165	.068	.077±.036	.225	.021

TABLE V: Statistical Significance (P 0.05) of Differences in Means of Formaldehyde Concentrations for Various Samples*

Comparison Samples		Z	Statistical
Higher Median	Lower Median	Score	Significance
MCS	Control	4.33	Yes
Matched Pr Cont	Matched Pr MCS	0.41	No
Zone 2	Zone 1	0.73	No
Zone 3	Zone 1	2.57	Yes
Zone 3	Zone 2	2.68	Yes
Zone 1 MCS	Zone 1 Cont.	3.42	Yes
Zone 2 MCS	Zone 2 Cont.	1.47	No
Zone 3 MCS	Zone 3 Cont.	2.01	Yes
ID MCS	ID Cont.	1.21	No
MT MCS	MT Cont.	1.18	No
OR Cont.	OR MCS	1.34	No
WA MCS	WA Cont.	4.24	No
Montana	Oregon	0.15	No
Montana	Idaho	2.07	Yes
Montana	Washington	5.96	Yes
Oregon	Idaho	2.17	Yes
Oregon	Washington	5.95	Yes
Idaho	Washington	2.19	Yes

* Statistical significance (P 0.05) for Z 1.98.

TABLE V1: Summary of Dwelling Ages

Case	Number of Observations	Year Built Mean	Year Built Std. Dev.	Median Age (years)
All	502	1981.9	4.9	1983
MCS	172	1983.8	1.6	1984
All control	330	1980.7	5.1	1982
Control, zone 1	289	1980.9	5.3	1982
Control, zone 2	61	1980.3	3.9	1980
Control, zone 3	83	1980.2	4.9	1981
Control, Idaho	50	1979.3	6.9	1981
Control, Montana	69	1981.0	2.5	1981
Control, Oregon	96	1981.0	5.2	1982
Control, Wash.	128	1980.8	5.0	1980

TABLE VII: Median Formaldehyde Concentration by Dwelling Age

Dwelling Age	Number of Observations	Median Formaldehyde Concentration (ppm)
0	26	0.128
1	213	0.102
2	68	0.086
3	34	0.074
4	31	0.082
5	29	0.073
6	22	0.080
7	22	0.076
8	8	0.080
9	4	0.064
10	3	0.078
10+	14	0.066

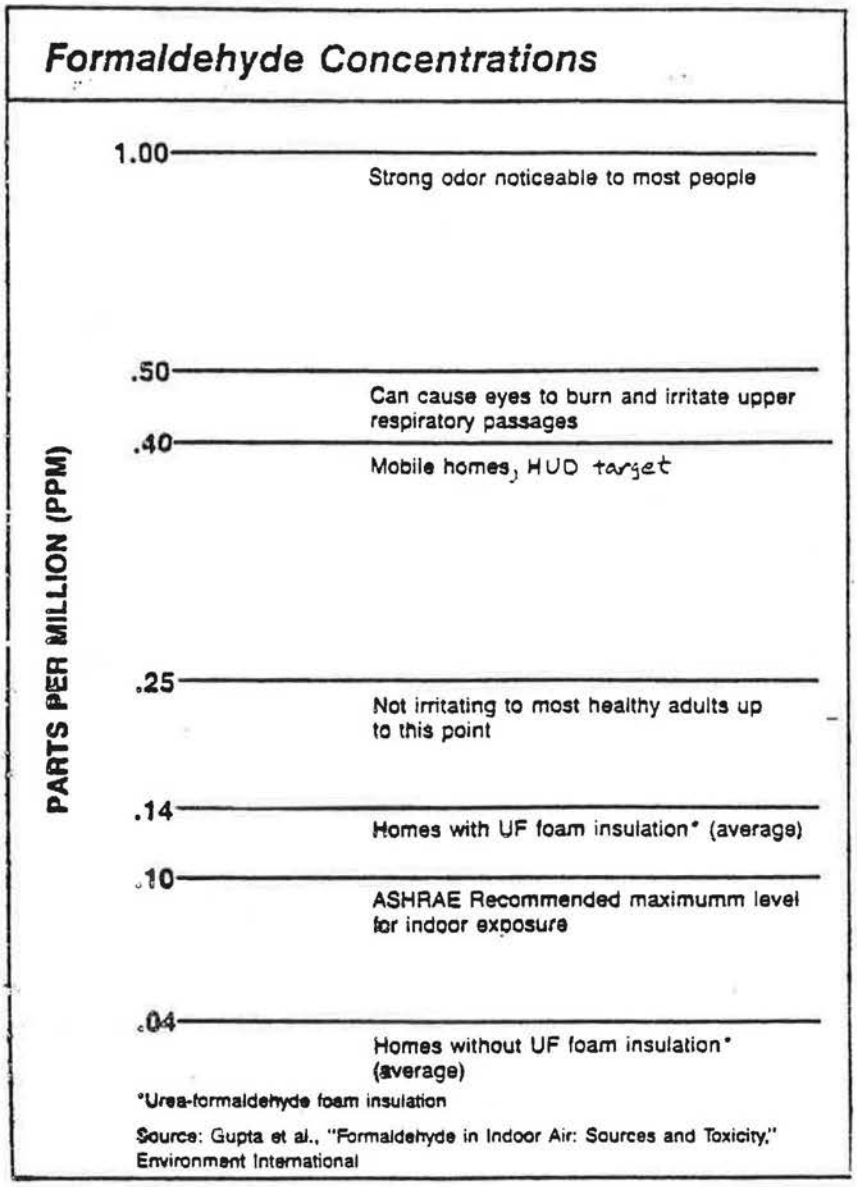

Figure 1: Illustration of formaldehyde concentrations.

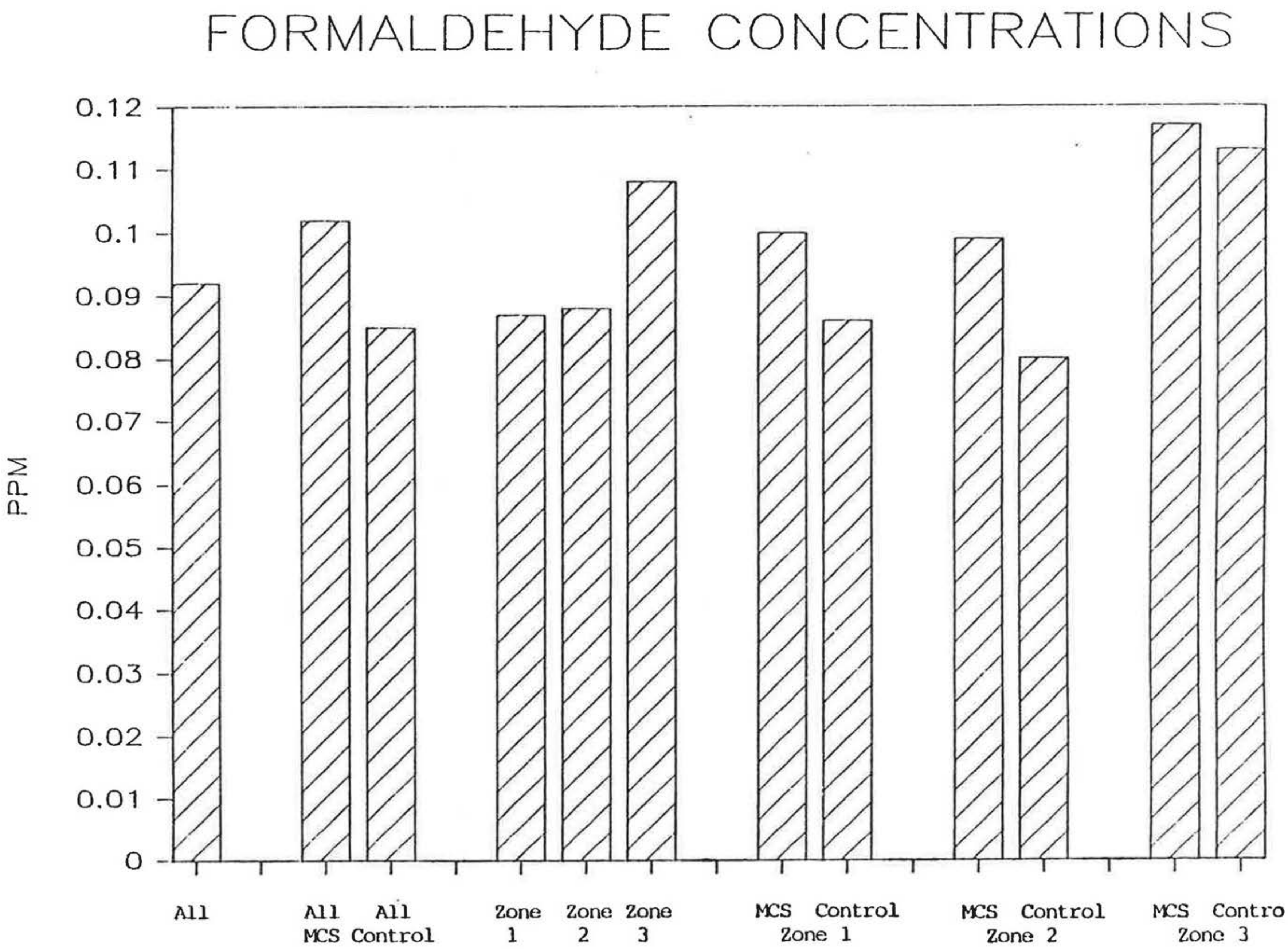

Figure 2: Summary of formaldehyde concentrations.

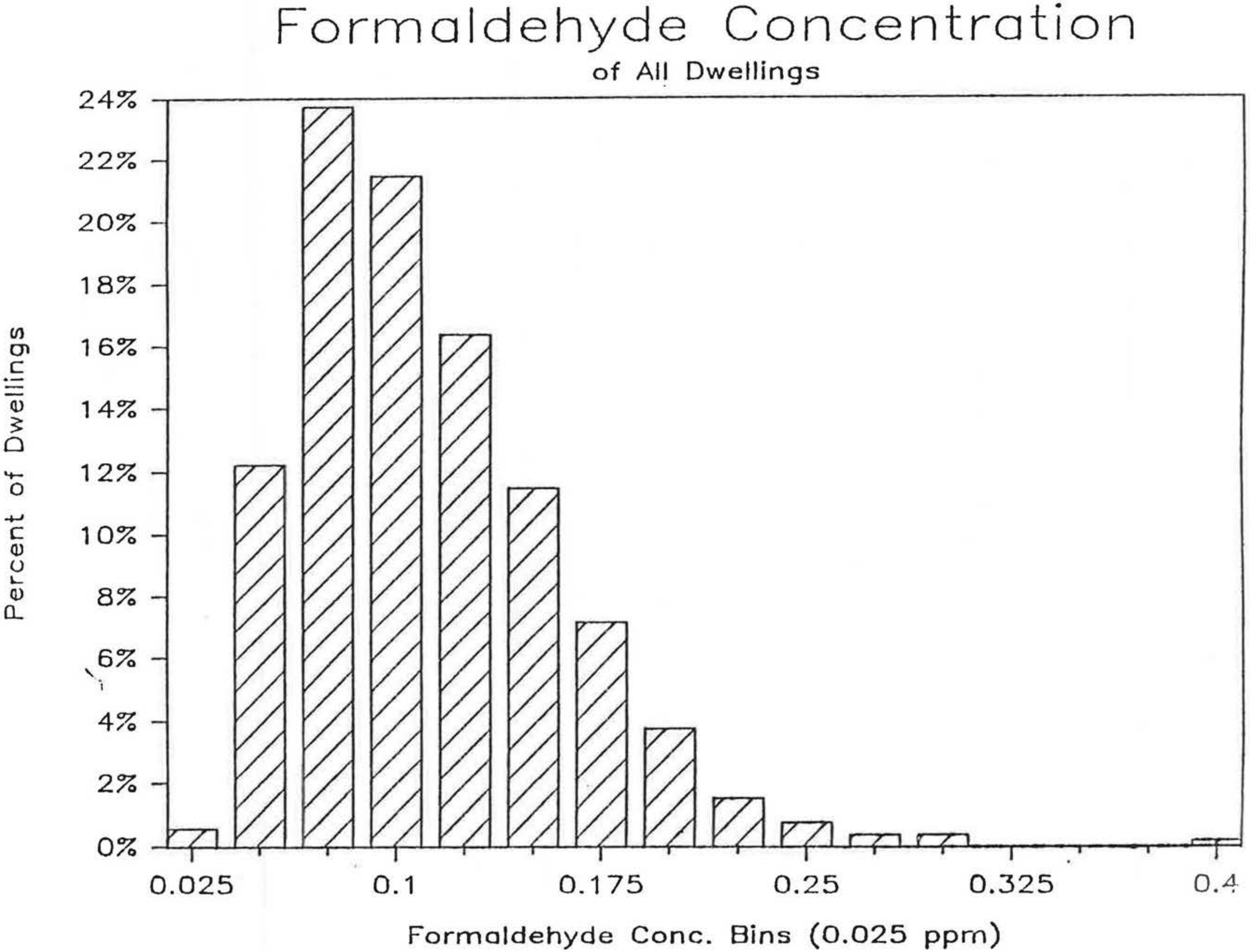

Figure 3: Distribution of formaldehyde concentrations, all Dwellings.

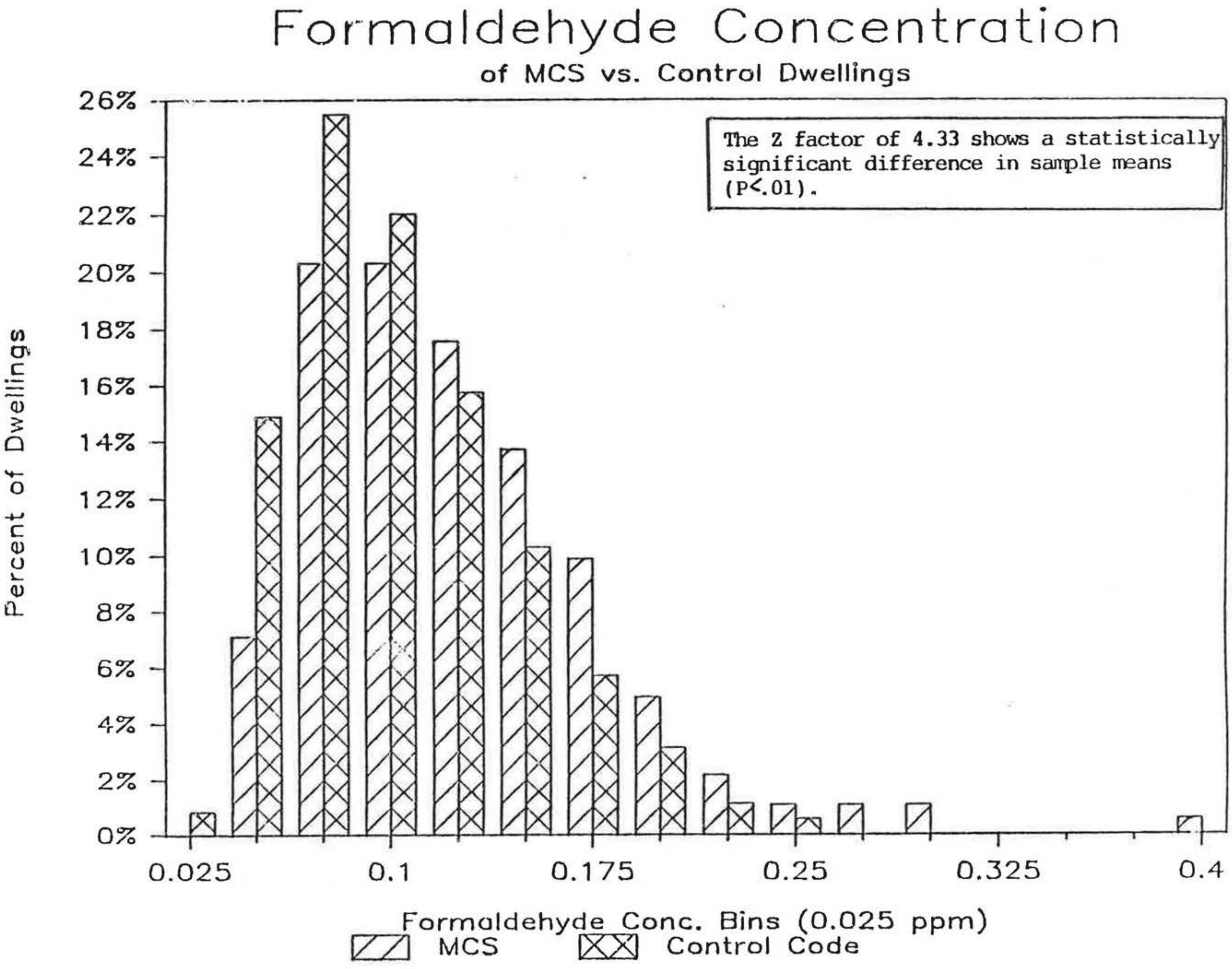

Figure 4: Distribution of Formaldehyde concentrations, MCS and Control Dwellings.

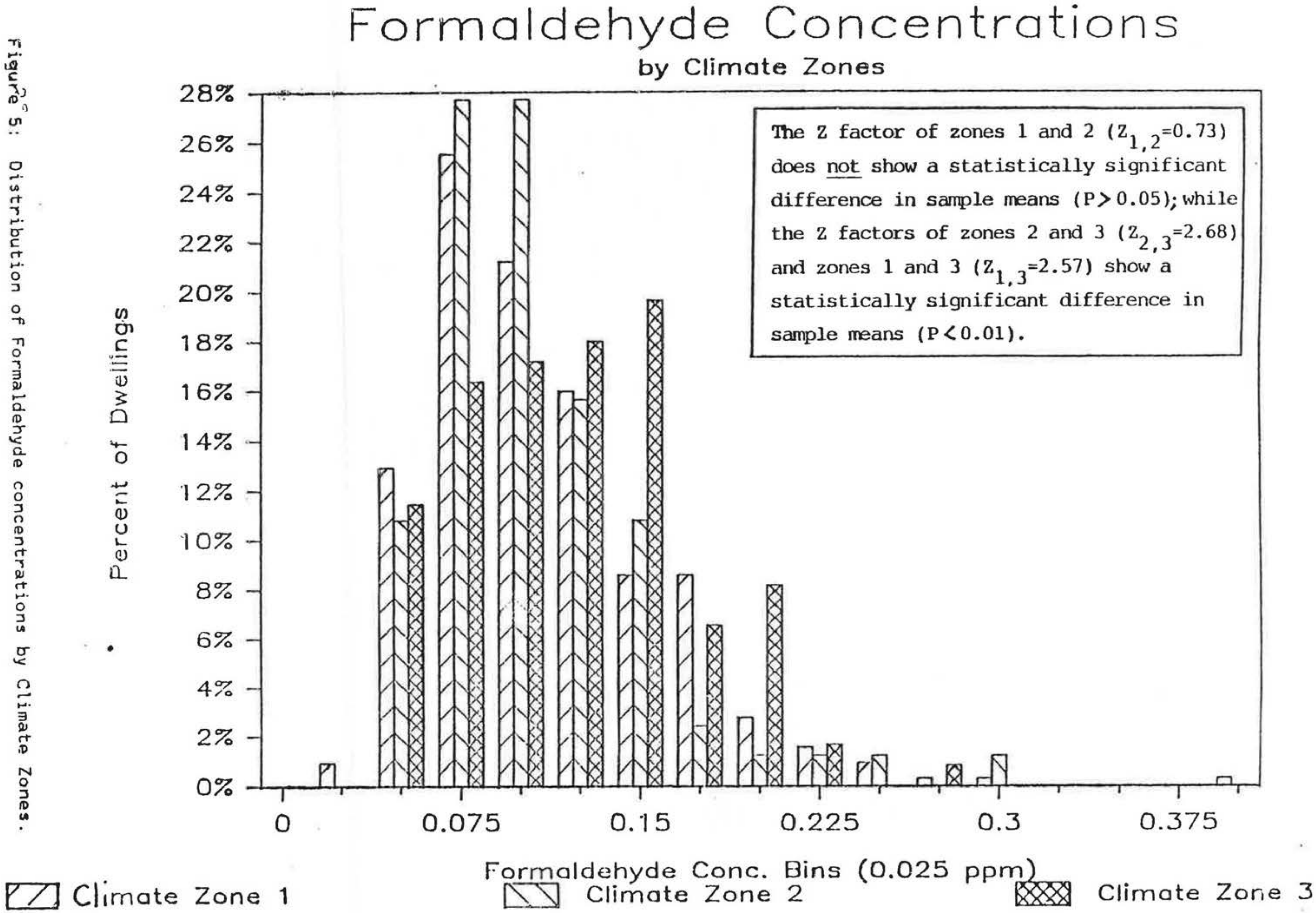

Figure 5: Distribution of Formaldehyde concentrations by Climate Zones.

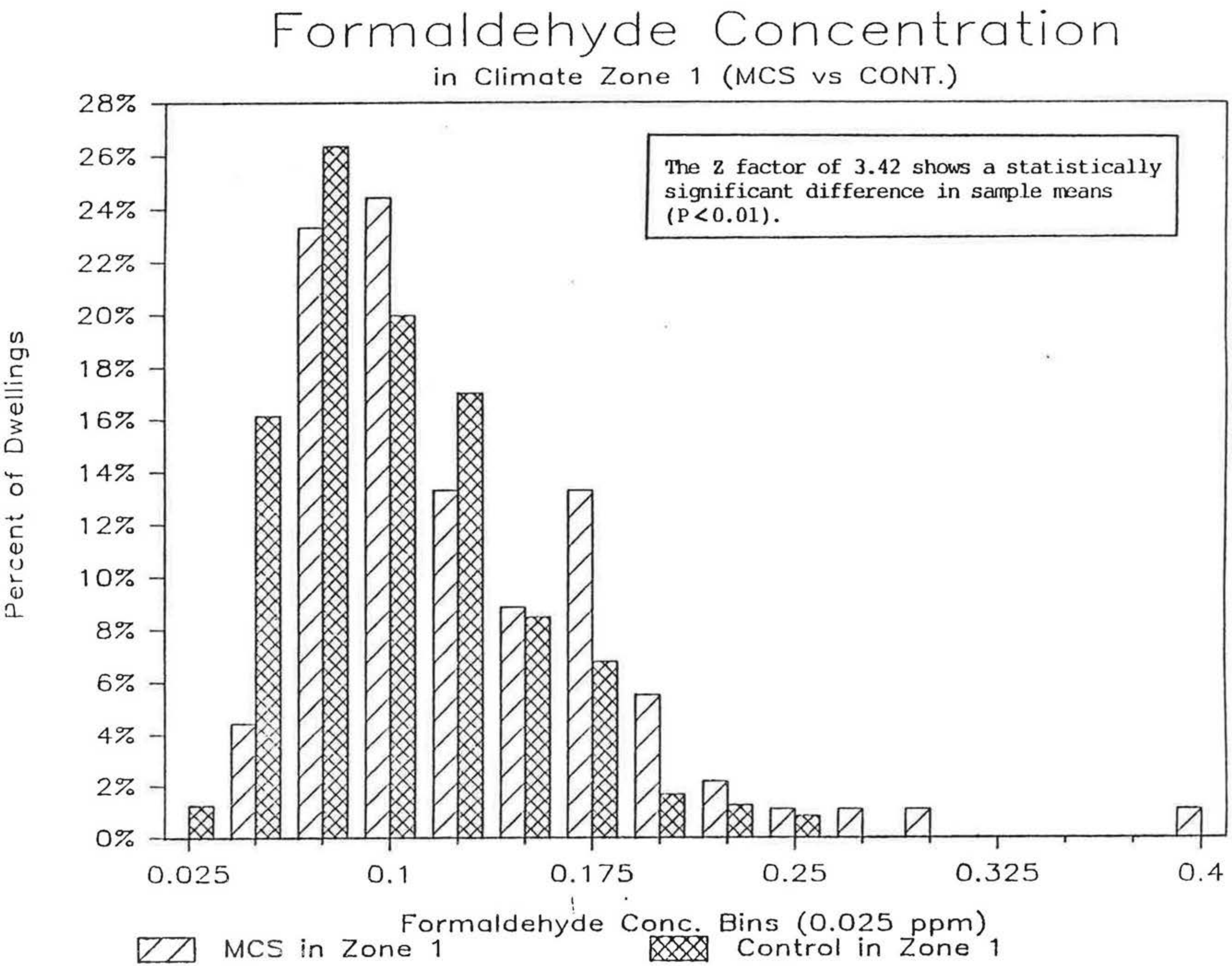

Figure 6: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Climate Zone 1.

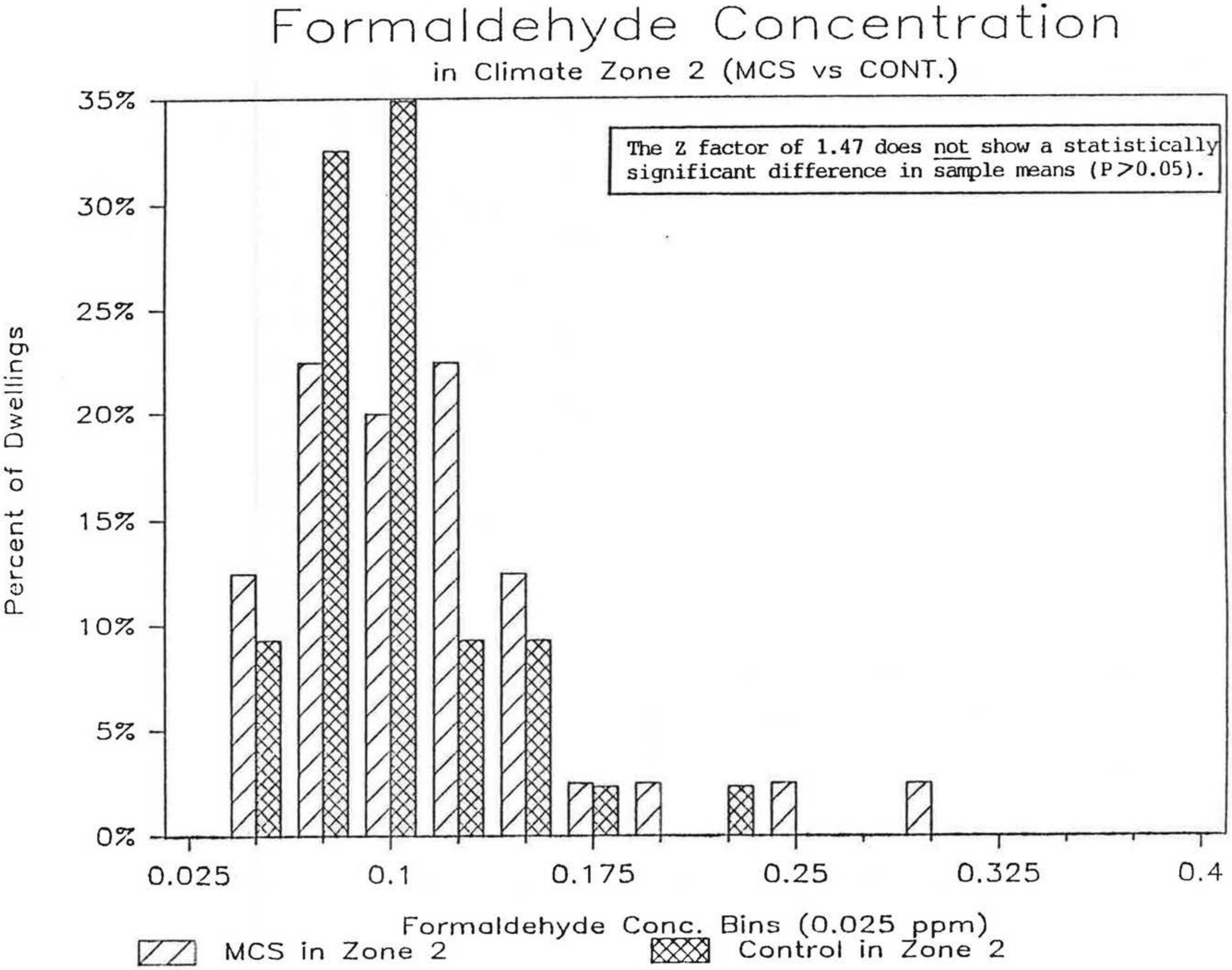

Figure 7: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Climate Zone 2.

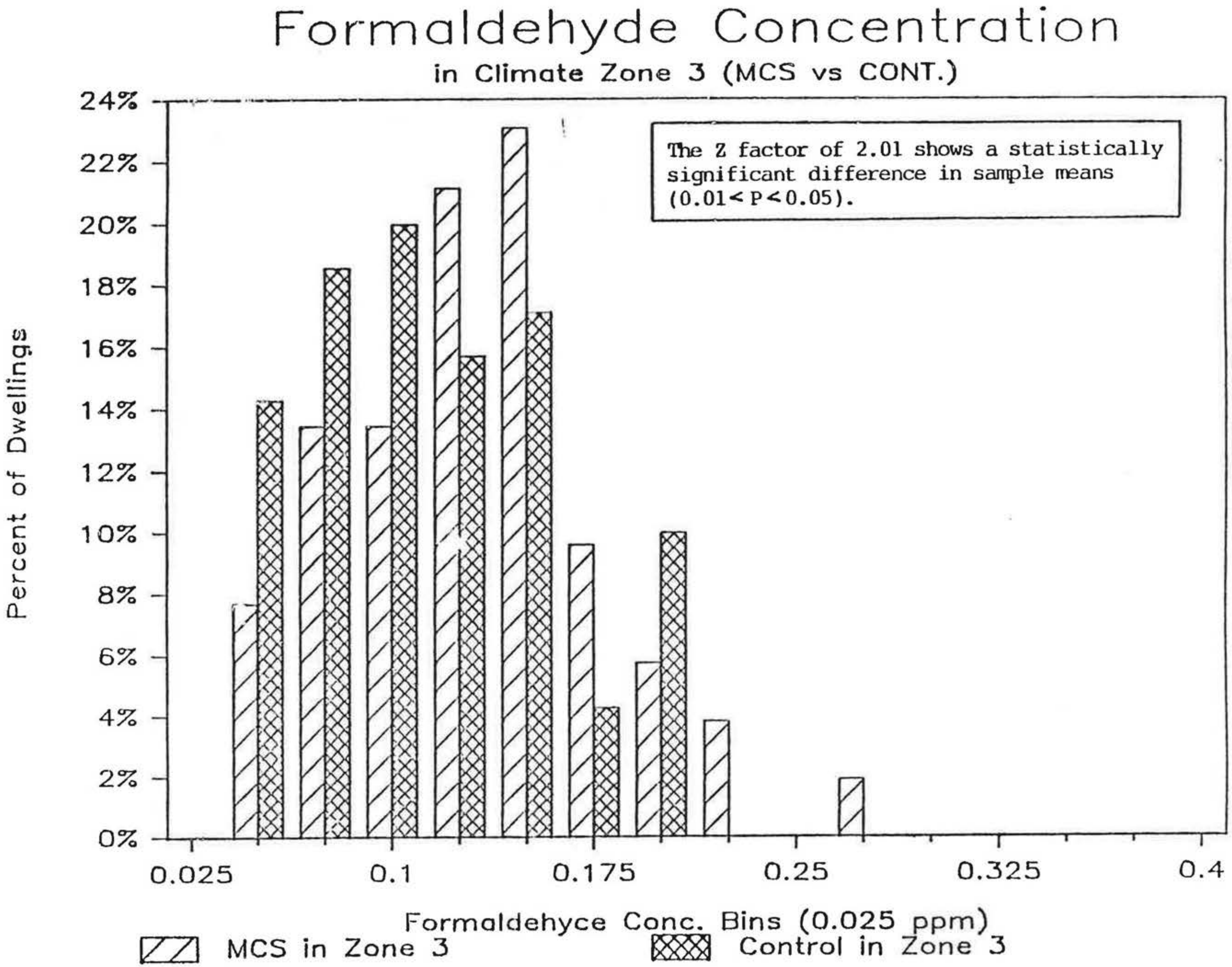

Figure 8: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Climate Zone 3.

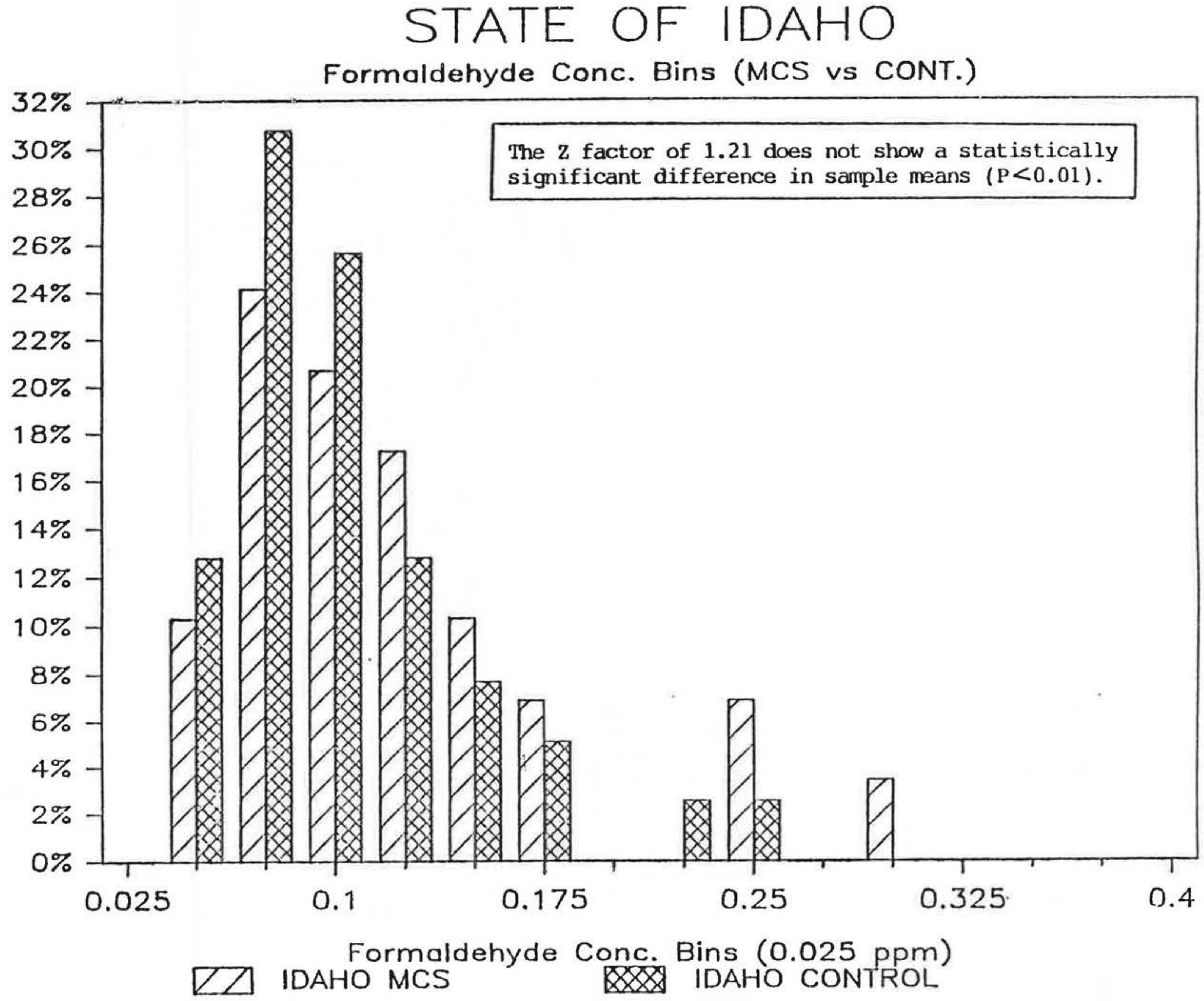

Figure 9: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Idaho.

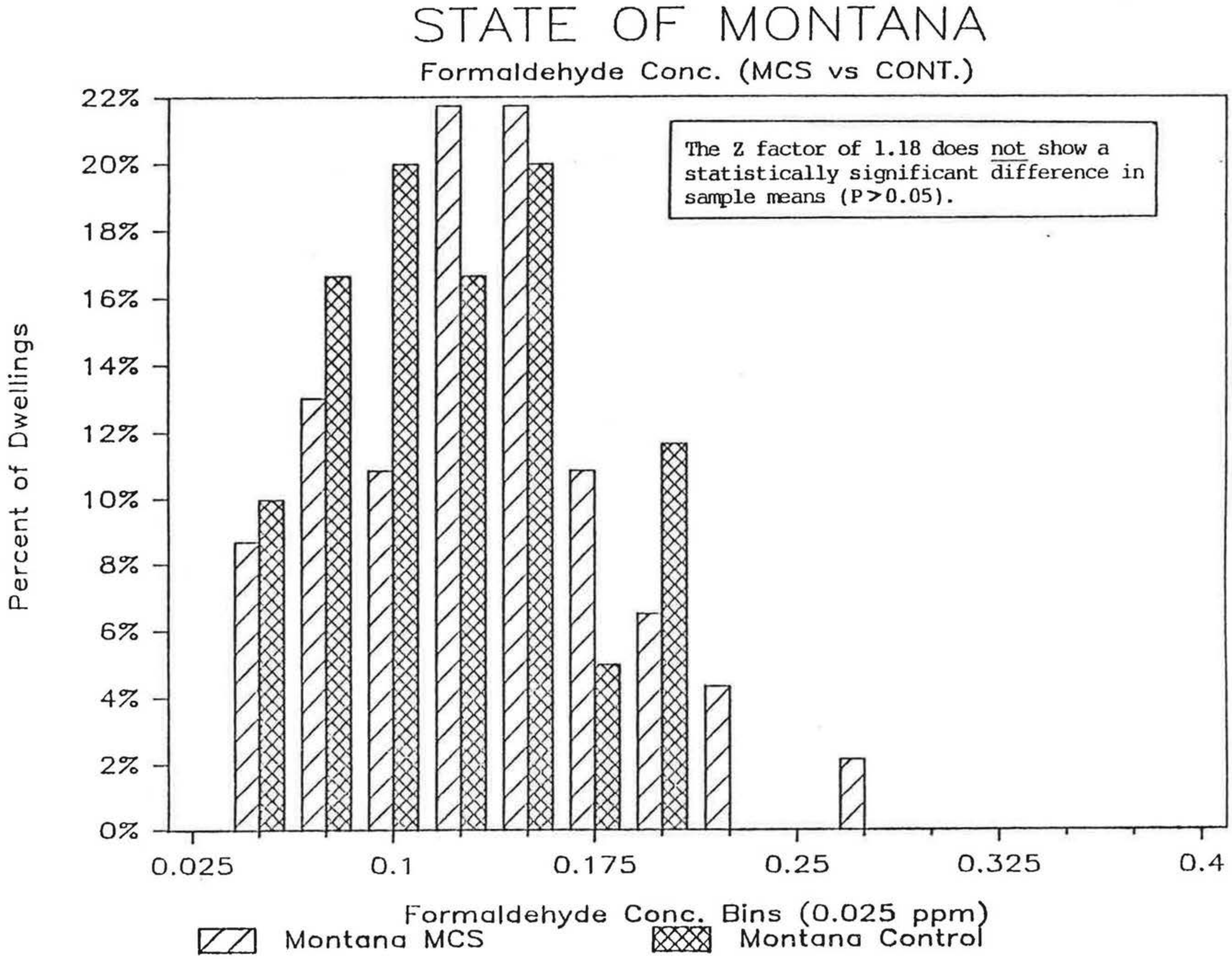

Figure 10: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Montana.

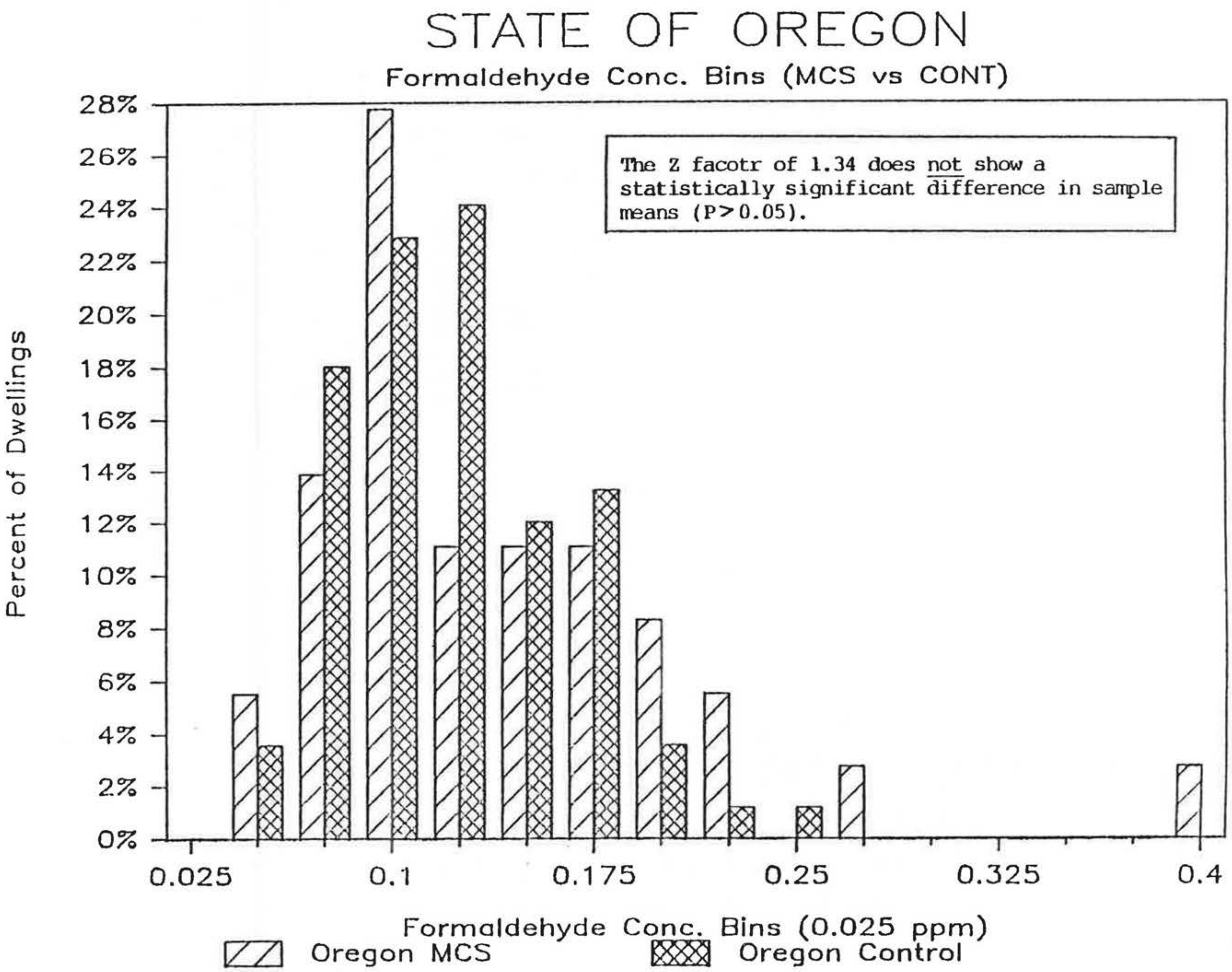

Figure 11: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Oregon.

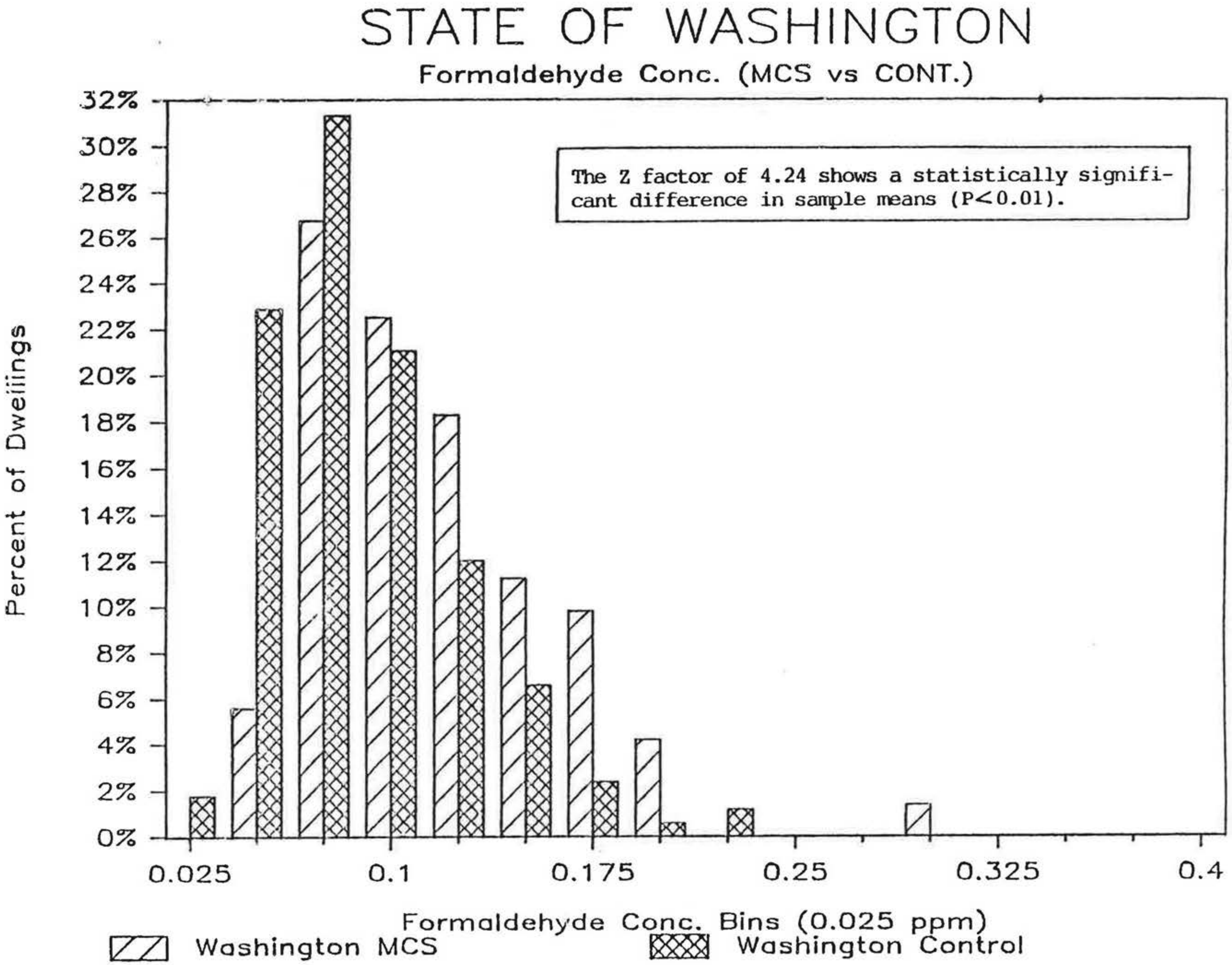

Figure 12: Distribution of Formaldehyde concentrations, MCS and Control Dwellings in Washington.

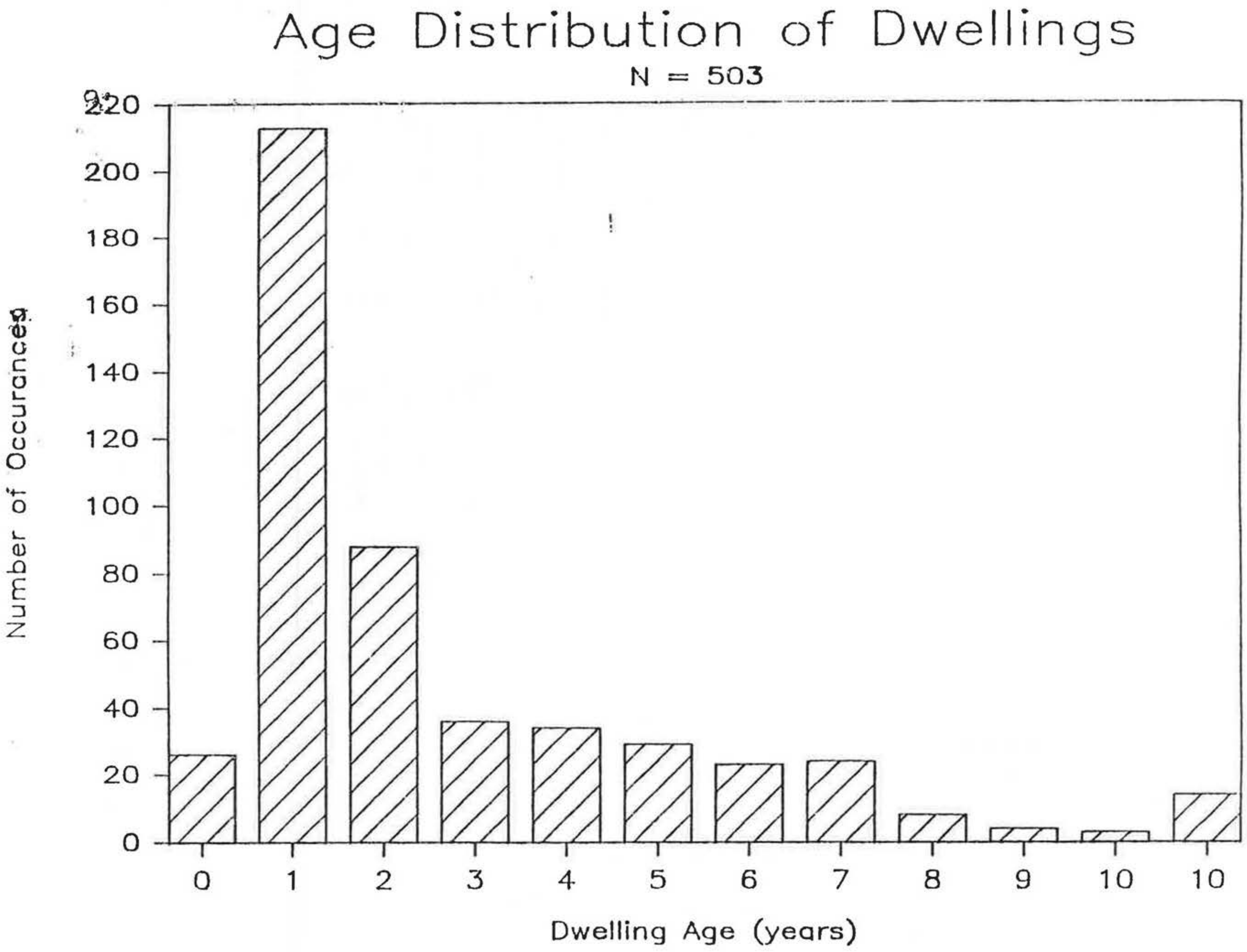

Figure 13: Distribution of Dwelling Age for the Entire Sample.

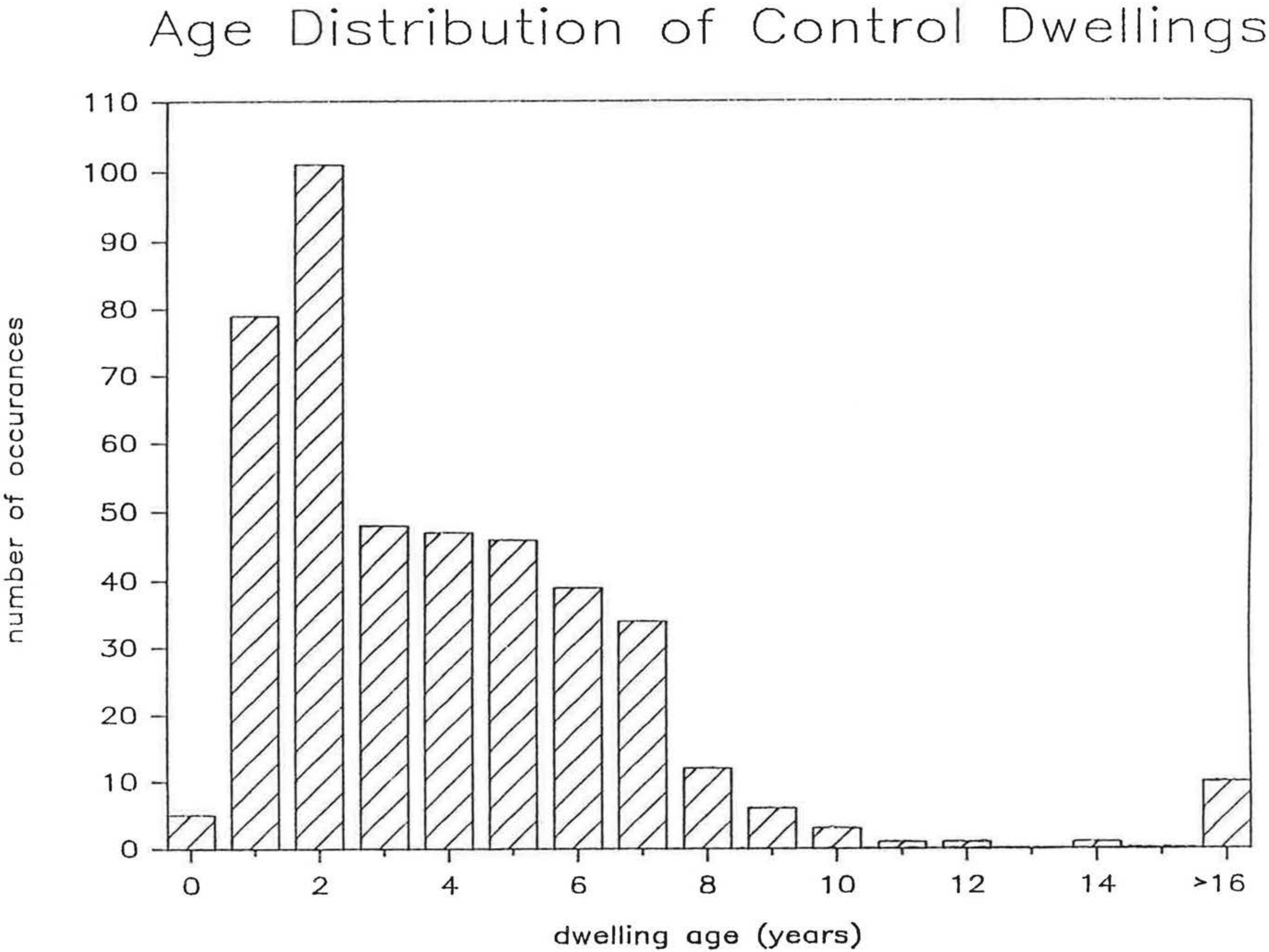

Figure 14: Distribution of Dwelling Age for the Control Dwellings.

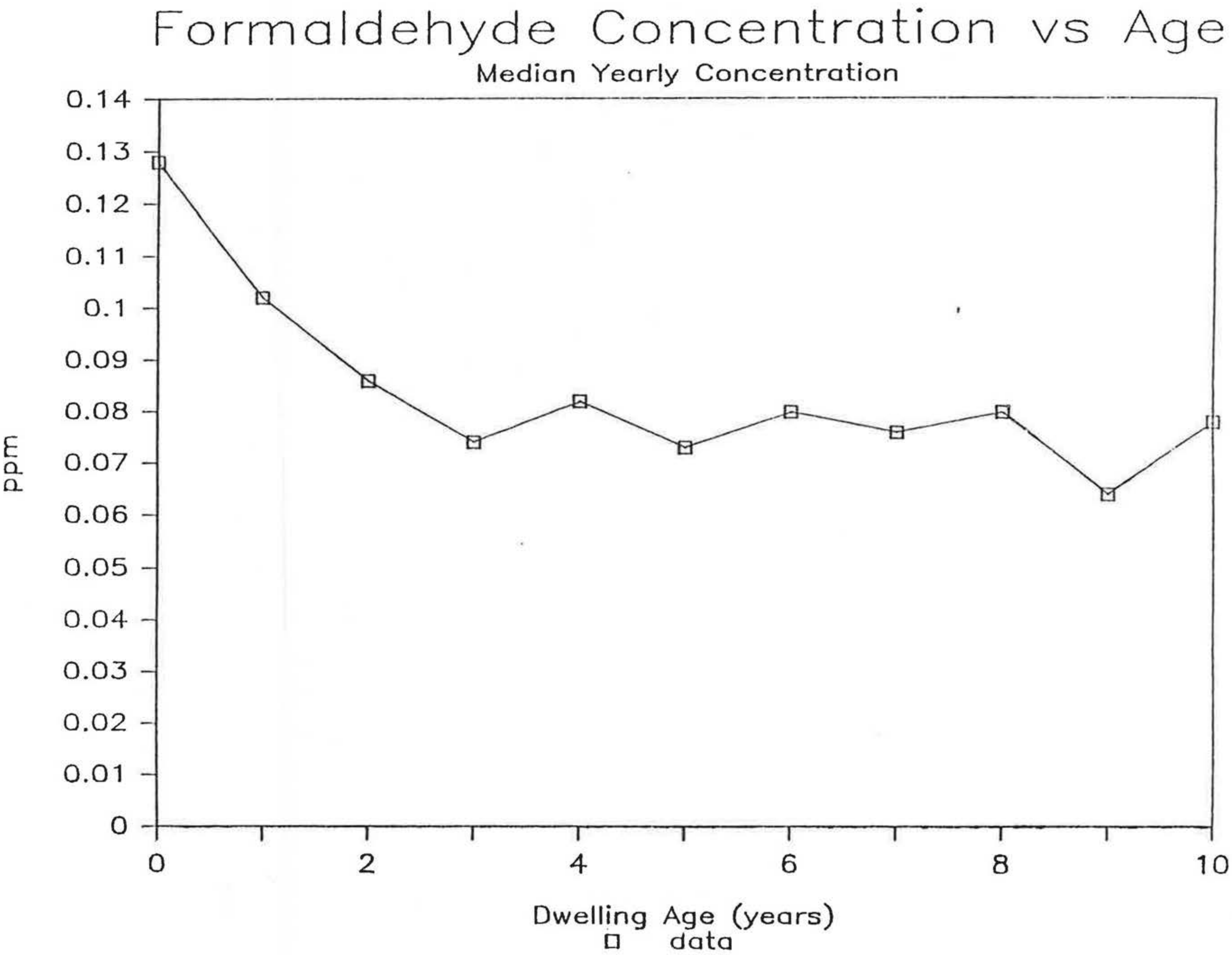

Figure 15: Median Formaldehyde Concentration vs Dwelling Age (all dwellings)

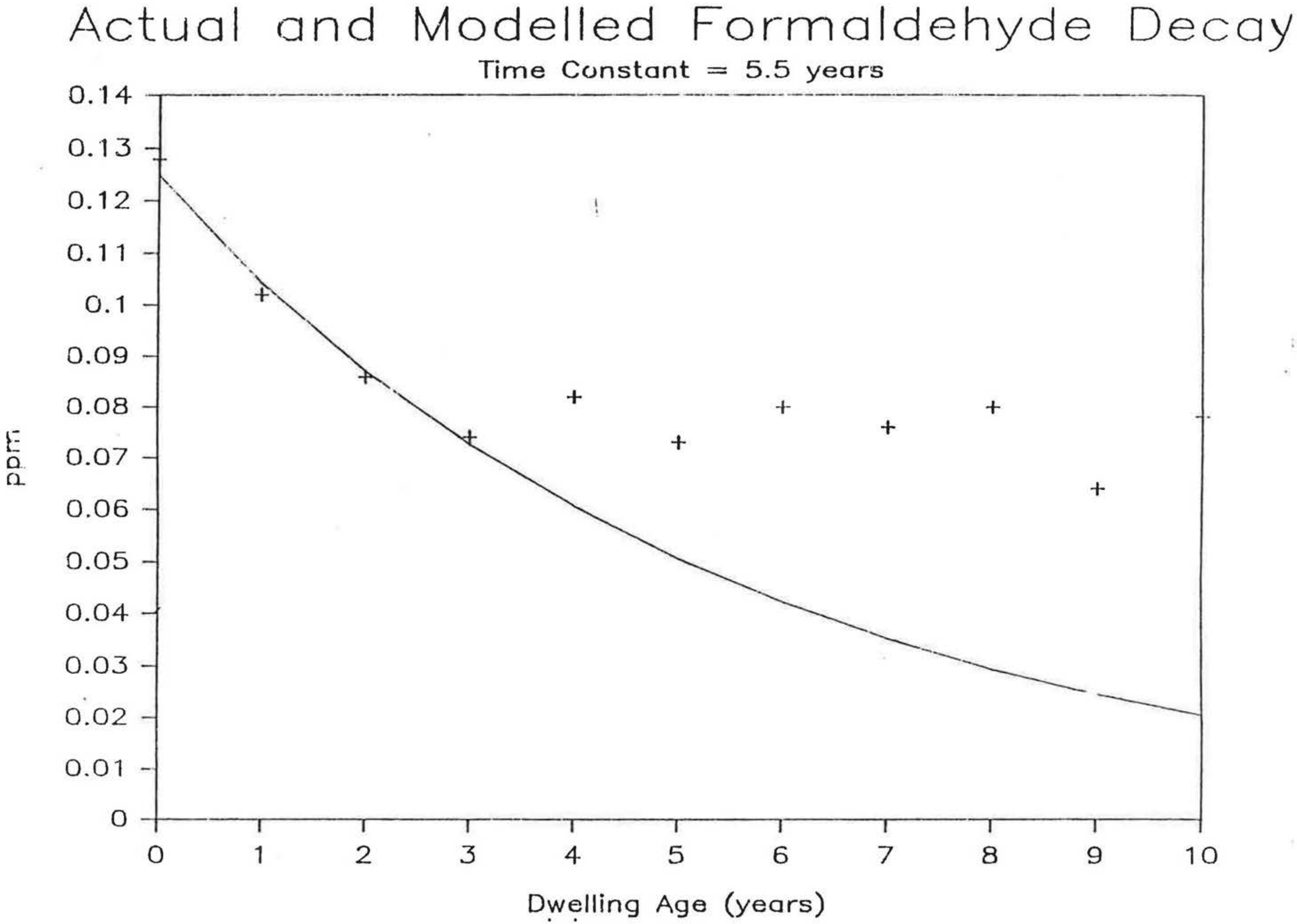

Figure 16: Modeled and Observed Median Formaldehyde Concentration vs Dwelling Age (all dwellings).

APPENDIX

This appendix contains site-by-site primary data used in the analysis contained in this report. The following column abbreviations have been used:

ST:.......State: 1 = Idado
2 = Montana
3 = Oregon
4 = Washington

ZN:.......Climate zone

MP:.......Matching: 1 = matched pair
2 = unmatched

MCS:......Dwelling type: 1 = MCS dwelling
2 = Control dwelling

ppm 1:....Formaldehyde reading in ppm from sampler 1

ppm 2:....Formaldehyde reading in ppm from sampler 2

Ave ppm:..(ppm1 + ppm2)/2

ST	ZN	MF	MCS	S/M	ppm 1	ppm 2	Ave ppm
1	1	2	1	1	0.139	0.163	0.151
1	1	1	1	1	0.129	0.173	0.151
1	1	2	2	1	0.252	0.235	0.244
1	1	1	1	1	0.242	0.250	0.246
1	1	2	1	1	0.120	0.095	0.108
1	1	1	1	1	0.306	0.254	0.280
1	1	2	2	1	0.134	0.100	0.117
1	1	1	2	1	0.177	0.169	0.173
1	1	2	1	1	0.080	0.093	0.087
1	1	2	2	1	0.045	0.041	0.043
1	2	2	1	1	0.060	0.069	0.065
1	2	2	1	1	0.029	0.026	0.028
1	2	1	2	2	0.124	0.114	0.119
1	2	1	1	2	0.074	0.065	0.070
1	2	2	2	1	0.113	0.120	0.117
1	2	2	1	1	0.086	0.059	0.073
1	2	2	2	1	0.089	0.110	0.100
1	2	2	2	1	0.069	0.067	0.068
1	2	2	1	1	0.231	0.230	0.231
1	2	2	2	1	0.088	0.045	0.067
1	2	2	1	1	0.095	0.094	0.095
1	2	2	2	1	0.064	********	0.064
1	2	1	1	2	0.053	0.060	0.057
1	2	2	2	1	0.040	0.088	0.064
1	2	2	2	1	0.077	0.083	0.080
1	2	1	2	2	0.065	0.058	0.061
1	2	2	2	1	0.080	0.075	0.078
1	2	2	1	1	0.045	0.027	0.036
1	2	2	2	1	0.076	0.074	0.075
1	2	1	2	2	0.117	0.108	0.113
1	2	1	2	2	0.070	0.070	0.070
1	2	2	2	1	0.099	0.099	0.099
1	2	2	2	1	0.090	0.048	0.069
1	2	2	1	1	0.058	0.050	0.054
1	2	2	2	1	********	0.068	0.068
1	2	1	1	1	0.061	0.181	0.121
1	2	2	2	1	0.077	0.117	0.097
1	2	2	2	1	0.119	0.134	0.127
1	2	2	1	1	0.092	0.106	0.099
1	2	2	1	1	0.134	0.165	0.150
1	2	2	2	1	0.074	0.078	0.076
1	2	2	2	1	0.157	0.163	0.160
1	2	1	1	2	0.107	0.096	0.102
1	2	2	1	1	0.077	0.004	0.041
1	2	1	2	1	0.209	0.199	0.204
1	2	2	1	1	0.078	0.072	0.075
1	2	2	2	1	0.082	0.077	0.080
1	2	2	2	1	0.134	0.120	0.127
1	2	1	1	2	0.099	0.108	0.104
1	2	2	1	1	0.085	0.114	0.100
1	2	2	2	1	0.089	********	0.089
1	2	2	2	1	0.132	0.129	0.131
1	3	2	2	1	0.081	0.027	0.054
1	3	2	1	1	0.117	0.098	0.108
1	3	2	2	1	0.030	0.024	0.027
1	3	2	1	1	0.091	0.090	0.091

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
1	3	2	2	1	0.036	0.035	0.036
1	3	2	2	1	0.067	0.070	0.069
1	3	2	1	1	0.174	0.124	0.149
1	3	2	1	1	0.074	0.052	0.063
1	3	2	2	1	0.044	0.043	0.044
1	3	2	2	1	0.070	0.073	0.072
1	3	2	1	1	0.076	0.079	0.078
1	3	2	2	1	0.114	0.050	0.082
1	3	2	1	1	0.142	0.156	0.149
1	3	2	2	1	0.040	0.042	0.041
1	3	2	2	1	0.117	0.124	0.121
1	3	2	2	1	0.086	0.099	0.093
2	3	2	2	1	0.058	0.058	0.058
2	3	2	1	1	0.066	0.063	0.065
2	3	1	2	1	0.169	0.088	0.129
2	3	2	2	1	0.046	0.051	0.049
2	3	2	1	1	0.227	0.203	0.215
2	3	2	1	2	0.133	0.135	0.134
2	3	2	1	1	0.093	0.095	0.094
2	3	2	1	1	0.135	0.133	0.134
2	3	2	1	1	0.094	0.095	0.095
2	3	2	2	1	0.082	0.118	0.100
2	3	2	1	1	0.065	0.071	0.068
2	3	2	1	1	0.135	0.141	0.138
2	3	2	2	1	0.189	0.209	0.199
2	3	2	2	1	0.103	0.103	0.103
2	3	2	2	1	0.189	0.201	0.195
2	3	2	2	1	0.150	0.145	0.148
2	3	1	1	1	0.097	0.082	0.090
2	3	2	2	1	0.108	0.101	0.105
2	3	2	2	1	0.075	0.072	0.074
2	3	2	2	1	0.046	0.046	0.046
2	3	2	1	1	0.052	0.084	0.068
2	3	2	1	1	0.149	0.138	0.144
2	3	1	2	1	0.160	0.214	0.187
2	3	2	1	1	0.157	0.132	0.145
2	3	2	1	1	0.058	0.060	0.059
2	3	2	1	1	0.145	0.144	0.145
2	3	2	1	1	0.108	0.100	0.104
2	3	2	2	1	0.106	0.103	0.105
2	3	2	1	1	0.110	0.099	0.105
2	3	2	1	1	0.155	0.137	0.146
2	3	2	1	1	0.115	0.097	0.106
2	3	2	2	1	0.047	0.042	0.045
2	3	2	1	1	0.104	0.111	0.108
2	3	2	1	1	0.140	0.155	0.148
2	3	1	2	1	0.085	0.083	0.084
2	3	2	2	1	0.143	0.149	0.146
2	3	2	2	1	0.075	0.097	0.086
2	3	2	1	1	0.085	0.081	0.083
2	3	2	1	1	0.104	0.114	0.109
2	3	2	2	1	0.111	0.108	0.110
2	3	2	2	1	0.216	0.119	0.168
2	3	2	2	1	0.110	0.119	0.115
2	3	2	2	1	0.083	0.023	0.053
2	3	2	2	1	0.040	0.043	0.042

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
2	3	2	1	1	0.119	0.114	0.117
2	3	2	1	1	0.161	0.141	0.151
2	3	2	2	1	0.100	0.092	0.096
2	3	2	2	1	0.148	0.139	0.144
2	3	2	1	1	0.121	0.118	0.120
2	3	2	2	1	********	0.116	0.116
2	3	2	2	1	0.153	0.169	0.161
2	3	2	1	1	0.045	0.053	0.049
2	3	2	2	1	0.164	0.030	0.097
2	3	2	2	1	0.132	0.105	0.119
2	3	2	1	1	0.116	0.139	0.128
2	3	1	1	1	0.046	0.047	0.047
2	3	2	2	1	0.074	0.066	0.070
2	3	2	2	1	0.038	0.038	0.038
2	3	2	2	1	0.074	0.069	0.072
2	3	2	2	1	0.112	0.134	0.123
2	3	2	2	1	********	0.196	0.196
2	3	2	2	1	0.122	0.124	0.123
2	3	2	2	1	0.075	0.071	0.073
2	3	2	2	1	0.170	0.104	0.137
2	3	2	2	1	0.075	0.073	0.074
2	3	2	2	1	0.170	0.102	0.136
2	3	2	2	1	0.075	0.076	0.076
2	3	2	2	1	0.122	0.125	0.124
2	3	2	2	1	0.175	********	0.175
2	3	2	2	1	0.025	0.038	0.032
2	3	2	2	1	0.104	0.061	0.083
2	3	2	1	1	0.180	0.146	0.163
2	3	2	2	1	0.054	0.054	0.054
2	3	2	1	1	0.139	0.195	0.167
2	3	2	1	1	0.111	0.116	0.114
2	3	2	1	1	0.190	0.146	0.168
2	3	2	2	1	0.094	0.098	0.096
2	3	2	1	1	0.177	0.172	0.175
2	3	2	1	1	0.110	0.129	0.120
2	3	2	2	1	0.114	0.138	0.126
2	3	2	2	1	0.100	0.095	0.098
2	3	2	1	1	0.075	0.074	0.075
2	3	2	1	1	0.066	0.057	0.061
2	3	2	2	1	0.120	0.146	0.133
2	3	2	1	1	0.103	0.076	0.090
2	3	1	1	1	0.177	0.184	0.181
2	3	2	2	1	0.183	0.180	0.182
2	3	2	1	1	0.160	0.204	0.182
2	3	1	2	1	0.078	0.079	0.079
2	3	2	2	1	0.124	0.129	0.127
2	3	2	2	1	0.114	0.065	0.090
2	3	2	2	1	0.120	0.139	0.130
2	3	2	1	1	0.110	0.127	0.119
2	3	2	2	1	0.130	0.131	0.131
2	3	2	1	1	0.133	0.122	0.128
2	3	2	2	1	0.128	0.133	0.131
2	3	1	2	1	0.194	0.193	0.194
2	3	2	1	1	0.178	0.219	0.199
2	3	2	2	1	0.053	0.057	0.055
2	3	2	1	1	0.212	0.189	0.201

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
2	3	2	1	1	0.054	0.027	0.041
2	3	1	1	1	0.229	0.274	0.252
2	3	2	2	1	0.181	0.174	0.178
2	3	2	2	1	0.076	0.067	0.072
2	3	2	2	1	0.094	********	0.094
2	3	2	1	1	0.037	0.045	0.041
3	1	2	1	1	0.097	0.085	0.091
3	1	2	2	1	0.093	0.102	0.098
3	1	2	2	1	0.094	0.104	0.099
3	1	2	2	1	0.099	0.098	0.099
3	1	2	1	1	0.207	0.211	0.209
3	1	2	2	1	0.159	0.148	0.154
3	1	2	1	1	0.061	0.066	0.064
3	1	2	1	1	0.240	0.190	0.215
3	1	3	1	1	0.382	0.369	0.376
3	1	2	1	1	0.084	0.067	0.076
3	1	2	2	1	0.139	0.116	0.128
3	1	2	2	1	0.171	0.136	0.154
3	1	2	1	1	0.209	0.159	0.184
3	1	2	2	1	0.165	0.151	0.158
3	1	1	1	1	0.148	0.201	0.175
3	1	2	2	1	0.173	0.155	0.164
3	1	2	2	1	0.126	0.123	0.125
3	1	2	2	1	0.185	0.145	0.165
3	1	2	2	1	0.124	0.142	0.133
3	1	2	2	1	0.109	0.083	0.096
3	1	2	2	1	0.119	0.128	0.123
3	1	2	2	1	0.096	0.094	0.095
3	1	2	1	1	0.159	0.153	0.156
3	1	2	2	1	0.028	0.162	0.095
3	1	2	2	1	0.088	0.155	0.122
3	1	2	2	1	0.170	0.162	0.166
3	1	2	2	1	0.038	0.037	0.038
3	1	2	2	1	0.080	0.105	0.093
3	1	2	1	1	0.147	0.159	0.153
3	1	2	1	1	0.070	0.062	0.066
3	1	2	2	1	0.137	0.142	0.140
3	1	2	2	1	0.088	0.096	0.092
3	1	2	2	1	0.106	0.126	0.116
3	1	2	1	1	0.093	********	0.093
3	1	2	2	1	0.119	0.112	0.116
3	1	2	2	1	0.059	0.048	0.054
3	1	2	2	1	0.110	0.119	0.115
3	1	2	2	1	0.165	0.171	0.168
3	1	2	2	1	0.149	0.141	0.145
3	1	2	1	1	0.081	0.064	0.073
3	1	2	2	1	0.115	0.106	0.111
3	1	2	1	1	0.112	0.105	0.109
3	1	2	2	1	0.046	0.040	0.043
3	1	2	2	1	0.093	0.081	0.087
3	1	2	2	1	0.105	0.114	0.110
3	1	2	2	1	0.174	0.168	0.171
3	1	2	2	1	0.083	0.128	0.105
3	1	2	2	1	0.090	0.082	0.086
3	1	2	1	1	0.140	0.154	0.147
3	1	2	2	1	0.074	0.058	0.066

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
3	1	2	2	1	0.146	0.146	0.146
3	1	2	2	1	0.068	0.103	0.086
3	1	2	1	1	0.158	0.122	0.140
3	1	2	2	1	0.082	0.087	0.085
3	1	2	2	1	0.108	0.098	0.103
3	1	2	2	1	0.063	0.051	0.057
3	1	2	2	1	0.093	0.109	0.101
3	1	2	1	1	0.086	0.086	0.086
3	1	2	1	1	0.144	0.044	0.094
3	1	2	2	1	0.086	0.081	0.084
3	1	2	1	1	0.152	0.223	0.188
3	1	2	2	1	0.083	0.083	0.083
3	1	2	2	1	0.067	0.067	0.067
3	1	2	2	1	0.160	0.184	0.172
3	1	2	2	1	0.118	0.132	0.125
3	1	2	2	1	0.075	0.086	0.081
3	1	2	2	1	0.132	0.137	0.135
3	1	2	2	1	0.088	0.069	0.079
3	1	2	2	1	0.128	0.116	0.122
3	1	2	2	1	0.177	0.168	0.173
3	1	2	2	1	0.126	0.152	0.139
3	1	2	2	1	0.074	0.081	0.078
3	1	2	1	1	0.078	0.074	0.076
3	1	2	2	1	********	0.059	0.059
3	1	2	1	1	0.070	0.077	0.074
3	1	2	2	1	0.189	0.173	0.181
3	1	2	1	1	0.049	0.055	0.052
3	1	2	2	1	0.084	0.066	0.075
3	1	2	2	1	0.043	********	0.043
3	1	2	1	1	********	0.103	0.103
3	1	2	2	1	0.104	0.106	0.105
3	1	2	2	1	0.075	0.075	0.075
3	1	2	1	1	0.146	0.140	0.143
3	1	2	2	1	0.079	0.069	0.074
3	1	2	2	1	0.104	0.099	0.102
3	1	2	2	1	0.202	0.173	0.188
3	1	2	1	1	0.265	0.248	0.257
3	1	2	2	1	0.214	0.170	0.192
3	1	2	1	1	0.166	0.190	0.178
3	1	2	2	1	0.068	0.079	0.074
3	1	2	1	1	0.152	0.164	0.158
3	1	2	1	1	0.087	0.113	0.100
3	1	2	2	1	0.115	0.125	0.120
3	1	2	1	1	0.098	0.101	0.100
3	1	2	2	1	0.126	0.161	0.144
3	1	2	2	1	0.053	0.072	0.063
3	1	2	2	1	0.154	0.137	0.146
3	1	2	2	1	0.074	0.072	0.073
3	1	2	2	1	0.142	0.162	0.152
3	1	2	2	1	0.073	0.073	0.073
3	1	2	2	1	0.246	0.244	0.245
3	1	2	2	1	0.178	0.241	0.210
3	1	2	2	1	0.119	0.123	0.121
3	1	2	1	1	0.097	0.092	0.095
3	1	2	2	1	0.114	0.106	0.110
3	1	2	2	1	0.065	0.063	0.064

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
3	1	2	1	1	0.133	0.143	0.138
3	1	2	2	1	0.079	0.053	0.066
3	1	2	1	1	********	0.080	0.080
3	1	2	2	1	0.122	0.125	0.124
3	1	2	2	1	0.115	0.094	0.105
3	1	2	2	1	0.070	0.071	0.071
3	2	2	2	1	0.115	0.080	0.098
3	2	2	1	1	0.111	0.116	0.114
3	2	2	1	1	0.070	0.017	0.044
3	2	2	1	1	0.108	0.108	0.108
3	2	2	1	1	0.032	0.027	0.030
3	2	2	2	1	0.102	0.079	0.091
3	2	2	2	1	0.146	0.115	0.131
4	1	2	2	1	0.066	0.071	0.069
4	1	2	2	1	0.042	0.048	0.045
4	1	2	2	1	0.065	0.070	0.068
4	1	2	2	1	0.046	0.044	0.045
4	1	2	2	1	0.068	0.067	0.068
4	1	2	2	1	0.044	0.044	0.044
4	1	2	1	1	0.063	0.066	0.065
4	1	2	2	1	0.043	0.044	0.044
4	1	2	2	1	0.075	0.059	0.067
4	1	2	2	1	0.107	0.104	0.106
4	1	2	2	1	0.068	0.066	0.067
4	1	2	2	1	0.089	0.123	0.106
4	1	2	2	1	0.056	0.040	0.048
4	1	2	2	1	0.177	0.130	0.154
4	1	2	2	1	0.106	0.096	0.101
4	1	2	2	1	0.066	0.063	0.065
4	1	2	2	1	0.052	0.043	0.048
4	1	2	1	1	0.071	0.062	0.067
4	1	2	2	1	0.049	0.045	0.047
4	1	2	2	1	0.075	0.069	0.072
4	1	2	2	1	0.048	0.157	0.103
4	1	2	2	1	0.074	0.071	0.073
4	1	2	2	1	0.120	0.085	0.103
4	1	2	2	1	0.072	0.074	0.073
4	1	2	2	1	0.050	0.043	0.047
4	1	2	2	1	0.064	0.061	0.063
4	1	2	2	1	0.047	0.046	0.047
4	1	2	2	1	0.073	0.074	0.074
4	1	2	2	1	0.106	0.101	0.104
4	1	2	1	1	0.099	0.092	0.096
4	1	2	2	1	0.103	0.105	0.104
4	1	2	2	1	0.057	0.062	0.060
4	1	2	2	1	0.047	0.045	0.046
4	1	2	2	1	********	0.059	0.059
4	1	2	2	1	0.065	0.070	0.068
4	1	2	2	1	0.061	0.057	0.059
4	1	2	1	1	0.065	0.065	0.065
4	1	2	2	1	0.075	0.078	0.077
4	1	2	1	1	0.085	0.095	0.090
4	1	2	1	1	0.069	0.048	0.059
4	1	2	2	1	0.061	0.076	0.069
4	1	2	1	1	0.109	0.086	0.098
4	1	2	2	1	0.072	0.066	0.069

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
4	1	2	1	1	0.047	0.062	0.055
4	1	2	2	1	0.116	0.127	0.121
4	1	2	2	1	0.053	0.047	0.050
4	1	2	1	1	0.103	0.112	0.108
4	1	2	2	1	0.049	0.049	0.049
4	1	2	2	1	0.031	0.038	0.035
4	1	2	2	1	0.052	0.045	0.049
4	1	2	2	1	0.035	0.034	0.035
4	1	2	2	1	0.049	0.048	0.049
4	1	2	2	1	0.036	0.032	0.034
4	1	2	2	1	0.070	0.070	0.070
4	1	2	2	1	0.116	0.131	0.123
4	1	2	2	1	0.066	0.061	0.064
4	1	2	2	1	0.037	0.030	0.034
4	1	2	2	1	0.066	0.060	0.063
4	1	2	1	1	0.083	0.090	0.087
4	1	2	1	1	0.036	0.030	0.033
4	1	2	2	1	0.039	0.022	0.031
4	1	2	2	1	0.056	0.065	0.060
4	1	2	2	1	0.129	0.119	0.124
4	1	2	2	1	0.076	0.075	0.076
4	1	2	1	1	0.108	0.109	0.109
4	1	2	2	1	0.074	0.080	0.077
4	1	2	2	1	********	0.030	0.030
4	1	2	2	1	0.079	0.078	0.079
4	1	2	2	1	0.028	0.032	0.030
4	1	2	2	1	0.082	0.077	0.080
4	1	2	2	1	0.084	0.168	0.126
4	1	2	2	1	0.072	0.088	0.080
4	1	2	1	1	0.041	0.049	0.045
4	1	2	1	1	0.090	0.086	0.088
4	1	2	2	1	0.022	0.029	0.026
4	1	2	2	1	0.189	0.188	0.189
4	1	2	2	1	0.024	0.022	0.023
4	1	2	2	1	0.081	0.087	0.084
4	1	2	2	1	0.137	0.117	0.127
4	1	2	2	1	0.100	0.071	0.086
4	1	2	2	1	0.021	0.020	0.021
4	1	2	1	1	0.106	0.098	0.102
4	1	2	2	1	0.020	0.021	0.021
4	1	2	1	1	0.097	0.107	0.102
4	1	2	1	1	0.114	0.115	0.115
4	1	2	2	1	0.056	0.051	0.054
4	1	2	2	1	0.146	0.113	0.130
4	1	2	2	1	0.091	0.094	0.093
4	1	2	2	1	0.124	0.136	0.130
4	1	2	2	1	0.090	0.097	0.094
4	1	2	2	1	0.134	0.126	0.130
4	1	2	2	1	0.094	0.095	0.095
4	1	1	1	1	0.078	0.073	0.076
4	1	2	2	1	0.049	0.053	0.051
4	1	2	1	1	0.122	0.111	0.117
4	1	2	2	1	0.049	0.052	0.051
4	1	2	1	1	********	0.193	0.193
4	1	2	2	1	0.050	0.050	0.050
4	1	2	1	1	0.105	0.129	0.117

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
4	1	2	1	1	0.076	0.060	0.068
4	1	2	2	1	0.061	0.071	0.066
4	1	2	2	1	0.067	0.091	0.079
4	1	2	1	1	0.108	0.102	0.105
4	1	2	2	1	0.075	0.084	0.080
4	1	2	2	1	0.109	0.108	0.109
4	1	2	1	1	0.054	0.060	0.057
4	1	2	1	1	0.069	0.077	0.073
4	1	2	2	1	0.077	0.083	0.080
4	1	2	1	1	0.077	0.070	0.074
4	1	2	1	1	0.097	0.103	0.100
4	1	2	2	1	0.039	0.046	0.043
4	1	2	2	1	0.078	0.086	0.082
4	1	2	2	1	0.044	0.041	0.043
4	1	2	2	1	0.055	0.060	0.058
4	1	2	2	1	0.078	0.143	0.111
4	1	2	2	1	0.055	0.060	0.058
4	1	2	2	1	0.107	0.116	0.112
4	1	2	2	1	0.062	0.053	0.058
4	1	2	2	1	0.029	0.056	0.043
4	1	2	2	1	0.055	0.057	0.056
4	1	2	2	1	0.115	0.111	0.113
4	1	2	2	1	0.091	0.079	0.085
4	1	2	2	1	0.110	0.117	0.114
4	1	2	2	1	0.057	0.053	0.055
4	1	2	2	1	0.040	0.044	0.042
4	1	2	2	1	0.054	0.055	0.055
4	1	2	2	1	0.041	0.041	0.041
4	1	2	2	1	0.060	0.048	0.054
4	1	2	2	1	0.040	0.041	0.041
4	1	2	2	1	0.087	0.088	0.088
4	1	2	2	1	0.117	0.114	0.116
4	1	2	2	1	0.087	0.090	0.089
4	1	2	2	1	0.053	0.026	0.040
4	1	2	2	1	0.107	0.072	0.090
4	1	2	2	1	0.041	0.037	0.039
4	1	2	2	1	0.050	0.056	0.053
4	1	2	1	1	0.057	0.044	0.051
4	1	2	2	1	0.051	0.055	0.053
4	1	2	2	1	0.036	0.042	0.039
4	1	2	1	1	0.053	0.058	0.056
4	1	2	1	1	0.038	0.036	0.037
4	1	2	1	1	0.081	0.095	0.088
4	1	2	2	1	0.125	0.112	0.119
4	1	2	2	1	0.113	0.074	0.094
4	1	2	1	1	0.052	0.042	0.047
4	1	2	2	1	0.045	0.059	0.052
4	1	2	2	1	0.120	0.119	0.120
4	1	2	2	1	0.049	0.054	0.052
4	1	2	2	1	0.040	0.036	0.038
4	1	2	2	1	0.095	0.097	0.096
4	1	2	2	1	0.037	0.039	0.038
4	1	2	2	1	0.049	0.053	0.051
4	1	2	1	1	0.065	0.082	0.074
4	1	2	2	1	0.098	0.096	0.097
4	1	2	2	1	0.116	0.126	0.121

ST	ZN	MP	MCS	S/M	ppm 1	ppm 2	Ave ppm
4	1	2	1	1	0.051	0.056	0.054
4	1	2	2	1	0.122	0.139	0.131
4	1	2	2	1	0.234	0.216	0.225
4	1	2	1	1	0.191	0.167	0.179
4	1	2	2	1	0.062	0.063	0.063
4	1	2	1	1	0.157	0.167	0.162
4	1	2	2	1	0.060	0.058	0.059
4	1	2	2	1	0.145	0.123	0.134
4	1	2	2	1	0.069	0.048	0.059
4	1	2	2	1	0.115	0.153	0.134
4	1	2	1	1	0.055	0.060	0.058
4	1	2	1	1	0.158	0.164	0.161
4	1	2	2	1	0.063	0.052	0.058
4	1	2	1	1	0.161	********	0.161
4	1	2	2	1	0.081	0.089	0.085
4	1	2	1	1	0.157	0.160	0.159
4	1	2	2	1	0.097	0.077	0.087
4	1	2	2	1	0.134	0.143	0.139
4	1	2	2	1	0.125	0.056	0.091
4	1	2	2	1	0.150	0.127	0.139
4	1	2	2	1	0.088	0.100	0.094
4	1	2	2	1	0.174	0.152	0.163
4	1	2	2	1	0.038	0.063	0.051
4	1	2	1	1	0.144	0.160	0.152
4	1	2	2	1	0.108	0.088	0.098
4	1	2	1	1	0.177	0.125	0.151
4	1	2	2	1	0.158	0.277	0.218
4	1	2	1	1	0.079	0.089	0.084
4	1	2	1	1	0.093	0.098	0.096
4	1	2	1	1	0.072	0.090	0.081
4	1	2	2	1	0.061	0.054	0.058
4	1	2	1	1	0.121	0.124	0.123
4	1	2	2	1	0.082	0.090	0.086
4	1	2	2	1	0.146	0.145	0.146
4	1	2	2	1	0.047	0.058	0.053
4	1	2	1	1	0.144	0.152	0.148
4	1	2	2	1	0.093	0.101	0.097
4	1	2	1	1	0.146	0.144	0.145
4	1	2	2	1	0.068	0.057	0.063
4	1	2	1	1	0.144	0.136	0.140
4	1	2	2	1	0.084	0.083	0.084
4	1	2	2	1	0.140	0.161	0.151
4	1	2	2	1	0.042	0.060	0.051
4	1	2	2	1	0.144	0.159	0.152
4	1	2	2	1	0.059	0.057	0.058
4	1	2	1	1	0.055	0.052	0.054
4	1	2	1	1	0.056	0.056	0.056
4	1	2	1	1	0.129	0.150	0.140
4	2	2	2	1	0.071	0.062	0.067
4	2	2	1	1	0.096	0.112	0.104
4	2	2	2	1	0.103	0.084	0.094
4	2	2	1	1	0.122	0.132	0.127
4	2	2	2	1	0.084	0.091	0.088
4	2	2	1	1	0.086	0.078	0.082
4	2	2	2	1	0.052	0.057	0.055
4	2	2	1	1	0.164	0.146	0.155

ST	ZN	MF	MCS	S/M	ppm 1	ppm 2	Ave ppm
4	2	2	1	1	0.106	0.098	0.102
4	2	2	1	1	0.073	0.078	0.076
4	2	2	2	1	0.088	0.078	0.083
4	2	2	1	1	0.111	0.114	0.113
4	2	2	1	1	0.058	0.056	0.057
4	2	2	2	1	0.037	0.023	0.030
4	2	2	2	1	0.080	0.083	0.082
4	2	2	2	1	0.036	0.034	0.035
4	2	2	2	1	0.077	0.080	0.079
4	2	2	2	1	0.112	0.104	0.108
4	2	2	1	1	0.060	0.058	0.059
4	2	1	1	1	0.113	0.141	0.127
4	2	2	2	1	0.064	0.057	0.060
4	2	2	1	1	0.156	0.222	0.189
4	2	2	2	1	0.069	0.056	0.063
4	2	2	1	1	0.117	0.104	0.111
4	2	2	1	1	0.095	0.095	0.095
4	2	2	2	1	0.038	0.039	0.039
4	2	2	2	1	0.064	0.080	0.072
4	2	2	1	1	0.147	0.152	0.150
4	2	2	1	1	0.063	0.058	0.061
4	2	2	2	1	0.033	0.032	0.033
4	2	2	1	1	0.264	0.300	0.282
4	2	2	1	1	0.116	0.140	0.128
4	2	2	1	1	0.088	0.092	0.090
4	2	2	1	1	0.088	0.096	0.092