SB

214

#2

STATE OF CALIFORNIA
George Deukmejian, Govenor

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
DIVISION OF CODES AND STANDARDS - ADMINISTRATIVE OFFICE
Mailing Address: P. O. Box 1407, Sacramento, CA 95807
6007 Folsom Blvd., Suite A, Sacramento, CA 95819
(916) 445-9471

July 18, 1983

Mr. Rocky P. Weller
Committee on Labor & Commerce
Alaska State Senate
Juneau, AK 99811

Dear Mr. Weller:

The State of California is currently engaged in a three phase evaluation of plastic and metal residential plumbing systems. These phases are:

1. Preparation of an environmental review document to summarize existing information,

2. Additional water quality and worker health laboratory studies, and

3. Preparation of an environmental impact report (EIR).

Phase 1 was completed in March 1983. Copies of the report are available for $62.33. I am enclosing one copy of the 588-page report. Please send payment to the above address.

Preparation for phase 2 are now being made. We expect the results in about five months.

A draft EIR should be available in June, 1984.

If you would like further information, please contact me.

Sincerely,

Michael C. McMillan
EIR Coordinator

MM/nm

Enclosure: 1 copy ERD

HEALTH HAZARDS

ASSOCIATED WITH

PLASTIC PIPE

A STATUS REPORT

SEPTEMBER 1981

LEONARDINI & FATHY
ATTORNEYS AT LAW
A PROFESSIONAL CORPORATION
400 CAPITOL MALL, SUITE 221
SACRAMENTO, CALIFORNIA 95814
(916) 441-4405

RAYMOND J. LEONARDINI
RICHARD G. FATHY
ALFONSO M. CEDILLO

HEALTH HAZARDS ASSOCIATED WITH PLASTIC PIPE

A STATUS REPORT

OF

THE CALIFORNIA PIPE TRADES COUNCIL

OF

THE UNITED ASSOCIATION OF JOURNEYMEN AND APPRENTICES OF THE PLUMBING AND PIPE FITTING INDUSTRY OF THE UNITED STATES AND CANADA

PREPARED BY:

LEONARDINI AND FATHY, ATTORNEYS AT LAW
GENERAL COUNSEL
CALIFORNIA PIPE TRADES COUNCIL
SACRAMENTO, CALIFORNIA

INTRODUCTION

Thousands of pages have been written on the advantages and disadvantages associated with plastic pipe. The debate normally concerns its effectiveness and usefulness as a new product. Most recently, issues have focused on human health hazards and potential long-range environmental dangers. With this type of dispute the problems surrounding plastic pipe involve a staggering level of scientific abstraction. Public officials and policy makers (usually not scientists by training) oftentimes are faced with a morass of scientific jargon, chemical formulae and mathematical probabilities. Such scientific disputes, if taken out of context, can be an obstacle to the appropriate protection of the health and safety of the general public.

The following paper is a short summary of the main health and environmental issues in the plastic pipe dispute. It includes documents of policy makers, environmental scientists and health officials that comment upon the proper health and safety approach to the issue, all of which documents are part of the Public Record of the California Housing Commission. These documents illustrate that scientific assertions of the petrochemical industry, when analyzed by independent testing agencies, do not overcome the threat of severe safety risks, health risks and environmental contamination that may arise from the use of plastic pipe.

Lastly, this paper documents the extreme peril of relying upon media presentations and press packages of the Plastic Pipe and Fitting Association (PPFA).

The reader should carefully note the serious need for policy decisions with regard to plastic pipe that reflect truly unbiased research and independent analysis.

I

FIRE SAFETY

In early 1980, the California State Fire Marshal, at the specific request of the California Legislature, (ACR 98), analyzed and evaluated every major scientific document on "the potential flammability of plastic pipe and the fire hazards associated with its use." It concluded:

> "In multi- (3 or more) story fire-rated construction, additional in-depth fire testing is necessary to (a) ensure that plastic pipe will not contribute to unusual fire spread; (b) that the toxicity generated by the combustion of plastic pipe will not extend beyond the area of initial exposure in quantities sufficient to prove hazardous." ("Fire Hazards of Plastic Pipe" State Fire Marshal. May 1980.)

The State Fire Marshal was particularly concerned at the time with "through-penetrations" of fire-rated walls by a combustible material and by the loading of plastic pipe, i.e., "stacking", in high-rise construction.

His concern proved to be prophetic after the tragic fire at the MGM Las Vegas in November 1980. News accounts and independent investigations on the Nevada fire led the State Fire Marshal to conclude: "... plastic pipe may have played a contributing role in...(the) tragic fire...in Las Vegas, and many news accounts describe the precise problems I alluded to in my reports to the (State Housing) Commission." (See Exhibit 1.) The Fire Marshal went on to "strongly recommend" specific research and standards evaluation prior to any approval of plastic pipe for high-rise construction.

II

HEALTH HAZARDS FOR WORKERS

In May 1980, the California Department of Health Services did the first compilation of medical literature and research data on the potential hazards to workers when exposed to the wide variety of toxic chemicals found in plastic pipe and glues. As with the State Fire Marshal, the Health Department's effort was the first major push by an independent governmental agency to fully evaluate heretofore disparate and complex chemical data. Their conclusions (see Exhibit 2) are wide-sweeping and "suggest the possibility of serious and previously unrecognized health effects among workers who install plastic pipe....Consequently, it is not clear that such pipe can be used safely under present conditions."

Unfortunately, but not unexpectedly, the petrochemical industry deliberately misrepresented the major findings of the Health Department, specifically Cal/OSHA. The Plastic Pipe and Fitting Association (PPFA) went to such an extreme in twisting and contorting the facts on plastic pipe that on March 5, 1981, the Deputy Chief for Health of the California State Occupational Safety and Health Administration wrote to the California Housing Commission to correct the false information. "...The PPFA has inappropriately extracted parts of our overall study, developed misleading statements and made these available to the press." (Exhibit 3.) Dr. Wade continued, "...we carefully identified what is known of the real and potential toxicity of these materials as well as the areas where we have inadequate information." He re-emphasized the importance for "all interested parties" to look at the evidence collected 'in total" as presented in the May 1980 report.

The California Health Department in November 1980, publicly testified on the relevance of its May 1980 "Interim Report":

> "We think further study is urgently needed about the possibility that some events in and around the construction of pipes, particularly, and the pipes that we have been studying may be associated with increases of cancer in workers, particularly lymphomas.... We also have a long list of adverse effects." (Reporter's Transcript, Commission on Housing and Community Development Hearing, November 24, 1980, p. 70.)

The health survey of plumbers in California reported, among other things, 54 lymphomas out of approximately 10,000 respondents. This staggeringly high rate of lymphoma drew the specific attention of the USC Medical School where the country's foremost research in lymphoma is being conducted.

In late 1980, Alexandra Levine, M.D., after an analysis of the biological slides and medical records of the first five cases submitted to the medical school, commented: "It is noteworthy to me that all five of these patients with documented diagnosis of lymphoma have had quite extensive exposure to plastic materials which were used during the course of their work." (Exhibit 4.)

In sum, the medical research conducted by the California Health Department, the Occupational Safety and Health Administration, USC Medical School and others, clearly documents the potential for serious, long-range health problems from worker exposure to plastic pipe and its glues.

III

ENVIRONMENTAL CONTAMINATION

Perhaps the most frightening aspect of the multi-faceted issues with plastic pipe concerns general environmental contamination. The toxic chemicals in plastic pipe and its cement solvents appear to be capable of leaching into the environment and thereby causing unalterable damage to our plants, our aquatic life, and our food chain.

For example, a study done by the California Analytical Laboratories and reviewed by the State Department of Health Services, documents the previously unknown presence of "impurities" in plastic pipe. The impurities include known carcinogens such as chloroform, benzene, DEHP, acrylonitrile, and styrene, as well as other toxic chemicals on the EPA list of priority pollutants. (Exhibit 5.) This poses not simply a human health risk to workers who install plastic pipe, but as discussed in more detail below, to consumers who drink water from plastic pipe. Furthermore, it points to a definite risk to the environment generally from the waste discharge of water flowing through plastic pipes. The subject chemicals will add to the existing load of pollutants known to have serious environmental effects because they display all of the characteristics of such chemicals: they can be accumulated in living organisms and food chains, and may be widely dispersed in the environment.

Policy makers may find it helpful to reflect on the numerous requests from public interest groups -- consumer groups, environmental coalitions, womens groups, public interest lawyers -- who have called for comprehensive analysis and evaluation of these potential long-range contamination factors before plastic pipe use is allowed to expand. (Exhibit 6.)

IV

PLASTIC PIPE FOR POTABLE WATER

(Poly Vinyl Chloride [PVC]
and Chlorinated Poly Vinyl Chloride [CPVC])

In the course of its exhaustive research of the scientific literature on plastic pipe, the California Department of Health Services found a previously unheralded article indicating that plastic pipe leaches its solvents into the drinking water. To confirm the potentially incalculable health consequences of this article, the Department of Health Services commissioned the Montgomery Testing Laboratory to conduct the first government sanctioned study to measure the amount of solvents that leached into drinking water from plastic pipe.

The landmark Montgomery test is highly controversial because it simply provides raw test data. Moreover, because the simulated pipe configuration test incorporated an arguably improperly designed pipe "fitting density," experts in the State Department of Health Services estimate the possibility of a 50 percent sampling error. That is, the results of the Montgomery tests may be <u>under</u>stated by as much as 50 percent ("Final Report on Potential Health Hazards Associated with the Use of Plastic Pipe in Potable Water System," Department of Health Services, p. 16).

Yet, even with a conservative evaluation of the data, alarming interpretations result. The Department of Health Services stated in their final report:

"With the possible exception of the leaching of the phthalates (DEHP), the principal public health finding of this study is the possibility of excessive amounts of solvents and carbon tetrachloride, chloroform and tetrachlorethene accumulating during the stagnant period between initial installation of plastic pipe and occupation of the dwelling." (Exhibit 7.)

The other conclusions in the final report of the Department of Health Services are tremendously complex and must be viewed in their proper context. For example, extensive "flushing" of the system "may" decrease the risk of abuse from the solvents leaching into the water. However, some of the so-called "volatile organic" chemicals in plastic pipe itself "can accumulate in chlorinated water" notwithstanding the flushing requirement. (See Exhibit 7, p. 35.) One of these chemicals (carbon tetrachloride) was present in the water at 10 times the EPA action level. Other equally dangerous chemicals (chloroform, tetrachloroethylene, DEHP) found at equally high and dramatic levels may not be reduced by flushing. For example, the Department stated:

"Because the possibility exists that some of these elements (carbon tetrachloride, chloroform, and tetrachloroethylene, DEHP) may be coming from the pipes themselves, particularly plasticizers, there is every possibility that they could build up on a longer interim after the initial flushing." (Reporter's Transcript, Commission on Housing and Community Development Public Hearing, November 24, 1980, p. 76.)

So damaging were the findings of the Montgomery tests and the Department of Health Services' evaluation, that the Plastic Pipe and Fitting Association (PPFA) proceeded to initiate a nationwide media strategy to "explain" the results.

In a January 19, 1981, letter from the National Association of Plumbing, Heating, Cooling Contractors (PHCC) to Dr. Marc Lappe', California Department of Health Services, the PHCC Technical Director complained to the California Health Department as to the reliability of the PPFA's explanation that the Health-commissioned tests showed plastic pipe and its glues were safe. The Contractors had received a number of inquiries from their members concerning the trustworthiness of the Plastic Pipe and Fitting Association's news accounts. The Technical Director of the Contractors requested back-up support information from the Plastic Pipe and Fitting Association. The information provided by the plastic pipe industry apparently was so poorly drafted, with unsigned reports, and missing data, that the Contractors decided to request review from the California Department of Health Services. In asking for Health Department reviews, the Contractors commented: "It is interesting to note how your report is reworded (by PPFA) or interpreted to mean something rather different from what was generated by your organization."

The California Health Department response (Exhibit 8) to the Contractors' request was directly to the point. According to Health, the Plastic Pipe Association's reports were "flawed," "incomplete" and "do not reflect accurately our own interpretation of the findings." The California Health Department reached "totally different conclusions regarding potential risks than did this (unidentified industry group of toxicologists) review committee." The PPFA press release was "factually in error and seriously misleading regarding our findings."

In particular,

1. "PPFA did <u>not</u> submit Table 19 of the Montgomery Study to PHCC which "contained the highest readings on chemicals of concern to us, and substantially changed our analysis of the final results. (Table 19 attached for comparison.)"
2. PPFA's characterization that "solvent levels did not exceed safety values "severely distort(s)

the actual findings of the (Montgomery) Report." Specifically, the Health Department found that "solvent levels did exceed recommended (safety) values..."

3. Contrary to PPFA assertions that some chemicals found in the Montgomery tests were not found in the pipe but were induced from sloppy laboratory procedures, the Health Department stated "we resolved (that) issue...by repeat testing and concluded that the evidence pointed to the pipes or a combination of pipes and solvents as the source of DEHP and not laboratory artifact."

In a nutshell, the California Health Department found that the Plastic Pipe and Fitting Association had seriously misrepresented the real health and safety dangers with drinking water coming from plastic pipe.

As with the worker safety question, the plastic pipe industry again distorted, misrepresented, and inaccurately quoted California governmental reports on health and safety to the extent that each of these governmental agencies had to specifically correct the record. It is no wonder that the Director of the California Department of Consumer Affairs recommended:

> "It would be unwise to decide now to expose Californians in their homes to what may be an extremely serious health hazard." (Exhibit 9.)

V

POLYBUTYLENE PIPE FOR POTABLE WATER

Since the Montgomery test for plastic pipe drinking water safety was based on the hypothesis that solvents used to cement these plastic pipes leached toxic chemicals into the drinking water, the Department of Health Services did not request a study of polybutylene (PB) as this pipe does not require solvents for installation.

Yet because polybutylene is part of the generic plastic pipe grouping, it may have many of the same additives, stabilizers and plasticizers as PVC, CPVC and ABS.

In early 1981, the California Department of Consumer Affairs petitioned the State Housing Commission requesting the same stringent testing for PB as the Commission mandated for CPVC and PVC. In this context, the California Health Services Department analyzed the first research conducted on PB pipe itself. The results were alarming. (See Exhibit 10.)

In particular, the tests conducted by the California Analytical Laboratories found 50-500 ppm (parts per million) of DEHP (a known animal carcinogen) in the pipe itself. The United States Environmental Protection Agency (EPA), in a document published at the end of 1980 entitled "Priority Review Level 1 - Di-(2-ethylhexyl) Phthalate (DEHP)," recommends "appropriate action(s) under the Toxic Substance

Control Act, section 6 to prevent or reduce the carcinogenic risks from exposures to DEHP." (page 129).* Subsequent tests on other polybutylene pipe used for flexible connections to plumbing fixtures also found DEHP. (Exhibit 12.)

The results were all the more disturbing because the representative of Shell Chemical Company had testified on the public record that polybutylene pipe did not contain DEHP. The combination of Shell's apparent discrepancy in testimony and the data developed by California Analytical Laboratories finding DEHP, led the Department of Health Services to state:

> "It is disturbing that the (State Housing) Commission was given such apparently misleading testimony (by Shell), since the potential leaching of this compound (DEHP) if present in the type of polybutylene used for potable water poses a potential health hazard to consumers." (Exhibit 13.)

The Department of Health Services went on to conclude that "obviously this situation deserves immediate at-

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* The same EPA document reviewed the DEHP data from the Montgomery Tests on PVC and CPVC. (The test on PB had not been completed.) This document commented: "these data represent the most reliable data on levels or potential levels in drinking water from DEHP containing plastic pipe." (Exhibit 11.)

tention because of the health risks at stake."

To counter this substantive finding, Shell Chemical Company commissioned a first test to be conducted by Radian Labs of Austin, Texas. (Exhibit 14.) While purporting to show the absence of DEHP or any other toxic chemicals, the company's first test was so flawed as to be of little value. (Exhibit 15.)

At the April 20, 1981 public hearing before the California Housing Commission, the representative from the State Department of Health Services stated unequivocably that the chemical found by the California Analytical Labs was "without question" DEHP. Furthermore, the Health Department spokesperson specifically identified a three-member panel within the Health Department which had reviewed the California Analytical Laboratories Test. This impartial panel found the test to comply with strict EPA testing protocols and to be scientifically valid. The Health Department went on to assert that DEHP was also found, in smaller amounts, in Shell's own tests of the PB pipe conducted by Radian Labs.

Presumably embarrassed by the results of its first test, Shell Chemical Company conducted a second test on its product through the Radian Lab. Unfortunately for the industry, the second test revealed "unknown" chemicals that "have to be evaluated," according to the April 20, 1981 testimony of the Department of Health Services.

In a June 15, 1981 letter, the Department of Health Services expressed "cause for concern" to Shell with the chemicals BHT and alkylbenzene sulphonate, both of which were found in the Radian Lab tests.

> "Recent studies have shown that chronic, relatively low level ingestion of BHT can lead to reduced weight gain, increased liver size and raised serum cholesterol in a number of separate animal tests. Other studies have shown reduced litter size following exposure during embryonic development." (Exhibit 16.)

As of this writing, no additional information has been supplied on these chemicals for the Housing Commission's public record.

In conclusion, the Housing Commission agreed with the Department of Health Services, their own Director of the State Department of Housing and Community Development (Exhibit 17), and the Director of the State Department of Consumer Affairs (Exhibit 18) that polybutylene should not be authorized for use until the plastic pipe is thoroughly and impartially studied. (Exhibit 19.)

VI

CONCLUSION

It is now clear that every major California state governmental agency that has an interest in construction, including the State Department of Consumer Affairs, the State Department of Health Services, the State Department of Housing, the State Occupational Safety and Health Administration and the State Commission on Housing and Community Development, all advocate comprehensive analysis and evaluation of plastic pipe through the rigorously scientific and public procedures of the California Environmental Quality Act (CEQA) before any expansion of use is permitted. To do otherwise violates California law:

> "An adopting agency cannot avoid compliance with CEQA by adopting a 'model' code by reference where the code contains material that was previously found to be subject to CEQA. To do otherwise would violate both the State Building Standards Law and the California Environmental Quality Act." (Exhibit 20.)

Furthermore, major health, consumer and environmental interest groups, specifically the Sierra Club, the

Consumer Advisory Council, Women For, the Center for Law in the Public Interest, have unanimously called for plastic pipe to be scrutinized for long-range health and environmental contamination before plastic pipe is permitted for widespread use.

PAUL A. TAYLOR, PhD
PRESIDENT

CHARLES J. SODERQUIST, PhD
VICE PRESIDENT

[illegible]
VICE PRESIDENT

RUBY A. [illegible]
SECRETARY/TREASURER

California Analytical Laboratories, Inc.

401 NORTH 16th STREET
SACRAMENTO, CALIFORNIA 95814
(916) 444-9603

December 31, 1980
Lab No. 12343
Received: 11/17/80

Mr. Raymond Leonardini
Attorney at Law
717 "K" St., Suite 510
Sacramento, CA 95814

Dear Mr. Leonardini:

Attached are the results of our GC/MS analysis of two polybutylene pipe samples received at CAL from a representative of the City of Sacramento Public Works Department and logged under CAL I.D. 12343.

The method of sample preparation and the GC/MS techniques were essentially the same as those employed for the previous analyses of PVC, ABS and CPVC pipe (refer to CAL report of 12 November, 1980, CAL I.D. 12295 and 12298).

Over fifteen components were identified and their levels in the pipe samples estimated. It must be emphasized that the levels are rough estimates only.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Charles J. Soderquist, PhD
Vice President
Agricultural and Environmental Chemist

CJS/slh

TABLE I

Sample	Compound	GC/MS reference scan no. [a]	Estimated level, ppm (mg/kg)
12343-1	butene	V72	0.1-1.0
	acetone	V92	0.5-5.0
	diethyl ether	V160	0.01-0.1
	methyl cyclopentane	V226	0.1-1.0
	methyl cyclohexane	V324	1-10
	3-methyl hexane	V373	1-10
	3-ethyl-3-methyl pentane	V386	1-10
	heptane	V437	1-10
	5 alkanes ($>C_{16}$)	B407, B421, B479 B496, B647	100-1000 total
	butylated hydroxy toluene (BHT)	B533	50-500
	bis (2-ethylhexyl)phathalate (BEHP)	B633	50-500
	a C_{18}-C_{19} alkene	B681	5000-50,000
12343-2	acetone	V93	0.5-5.0
	diethyl ether	V161	0.05-0.5
	methyl cyclohexane	V325	0.5-5.0
	2,3,3-trimethyl hexane	V388	0.5-5.0
	10 alkanes ($>C_{16}$)	B388, B407, B420, B478, B488, B507, B540, B549, B596, B646	100-1,000 total

NOTES: a V = Volatile Organic fraction, B = Base/Neutral (hexane-extracted) fraction.

OFFICE OF PESTICIDES AND TOXIC SUBSTANCES, U.S. ENVIRONMENTAL PROTECTION AGENCY
(November 28, 1980)

Addendum

Priority Review Level 1 - Di-(2-ethylhexyl) Phthalate DEHP

After this assessment was completed, Assessment Division received information from the California Department of Health Services, and from representatives of the Plumbers Union concerning actual and projected levels of DEHP in drinking water resulting from the migration of DEHP from plastic water pipe.

Water pipe made from polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) and plasticized with DEHP is in common usage and is rapidly replacing copper pipe in new home construction. While the California studies were primarily concerned with solvents used to join the pipe together, data were developed from conditions simulating use situations that indicated that DEHP may be present at up to 246 ppb in drinking water. Limited evaluations of measured levels in drinking water supplies of new homes were up to 110 ppb. These levels are considerably higher than previously recorded for drinking water and represent a risk of 9.4×10^{-5} and 2.9×10^{-5} respectively.

The DEHP levels reported in these studies varied considerably. Factors such as the physical and chemical properties of the water, dwell time, and analytical methodology frequently lead to discrepencies in reported levels for DEHP. However, these data represent the most reliable data on levels or potentials levels in drinking water from DEHP containing plastic pipe.

PAUL A. TAYLOR, Ph.D.
PRESIDENT

CHARLES J. SODERQUIST, Ph.D.
VICE PRESIDENT

ANTHONY S. WONG, Ph.D.
VICE PRESIDENT

RUBY A. ULRICH
SECRETARY/TREASURER

California Analytical Laboratories, Inc.

401 NORTH 16th STREET
SACRAMENTO, CALIFORNIA 95814
(916) 444-9602

March 18, 1981
Lab Nos. 12752/12754
Received: 3/3/81

Ray Leonardini
717 "K" St., Suite 510
Sacramento, CA 95814

Four pipe and fixture connector samples were received from Mr. John Gorman to be analyzed for organic constituents.

CAL I.D.	Sample Description
12752-1	gray fixture connector, PB2110--QEST-H-PB2100-NSF-PW FDR 11-180°F 100 psi ASTM-D-3309 CAS CERT- (unreadable)-B137.80 1/4 CTS-062 080279
12752-2	gray fixture connector, PB2110-IAPMO UPC PB2110-SDR11-1 BSF-pw 1/4 X 3/8-180°-100 psi-D3309-CSA-CERT
12754-1	gray pipe, PB2110--QEST-H-IAPMO-UOC-PB2110-SDR11-NSF-pw 3/8 X 1/2 180°-100 psi-D-3309-CSA-CERT-B137.8 1/23/77
12754-2	black pipe, PB2110--NSF pw ASTM-D3309 100 psi-(unreadable)-180°F-122 1106C-(unreadable)-1/2" CTS SDR-11 P

Sample Preparation: Samples 12752 and 2-foot lengths of samples 12754 were cleaned with detergent, rinsed with copious amounts of water and air dried. Representative subsamples were obtained by filing with a coarse rasp. Each subsample was rinsed with hexane and portions then placed in clean sample tubes with 5 mL of hexane (-a series) and with benzene)-b series). Identical tubes were filled with the same solvents (both were Nanograde quality) to serve as controls. The samples were held under ambient conditions for five days (for GC/MS) and for an additional five days until selective detector GC analysis was made.

Analysis I--GC/MS. Just prior to analysis by gas-chromatography mass-spectrometry (GC/MS), a 1.0 mL aliquot of the extract was removed and spiked with D-10 anthracene as an internal standard. A 5 µL portion was then injected and processed per the EPA Priority Pollutant (B/N fraction) protocol. Compounds were identified by computer searches of an EPA library, and quantities were estimated by comparison to the known amount of D-10 anthracene added.

Only the hexane extracts (-a series) were analyzed by GC/MS. The hexane blank was clean.

II. Specific-detector GC. Sample extracts were examined by electron-capture gas chromatography (ECD-GC) and thermionic-specific gas chromatography (TSD-GC); these detectors are generally selective for halogenated and nitrogen and/or phosphorus organics, respectively, although ECD-GC is suitable for the determination of phthalate ester plasticizers.

Results: The GC/MS analyses indicated that all four samples were qualitatively similar in that a series of C_{21}-C_{31} hydrocarbons was present in each; their total concentation was estimated to be in the 500-2,500 ppm (mg/Kg) range. Butylated hydroxytoluene (BHT) was present in each sample at the 10-50 ppm level. Bis (ethylhexyl) phthalate (DEHP) was also found at varying levels in each sample as indicated in Table I.

The TSD-GC analyses indicated that no nitrogen or phosphorus containing organic compounds, which were amenable to GC analysis, were present above 10 ppm.

The ECD-GC analyses indicated that DEHP was present in all samples. Identification and quantitation was based on co-chromatography with an authentic DEHP reference standard. Results are summarized in Table I.

Results of Table I should be considered as minimum values since the efficiency of extraction with either solvent is not known and is probably less than 100%.

Charles J. Soderquist, PhD
Vice President
Agricultural and Environmental Chemistry

Michael J. Miille, PhD
Director of GC/MS Services

CJS/slh

TABLE I

Sample	Extractant	ppm DEHP found (mg/Kg) by ECD-GC	ppm DEHP found (mg/Kg) by GC/MS
12752-1a	Hexane	4.0	4.5
-1b	Benzene	5.0	n.m.
-2a	Hexane	0.8	0.6
-2b	Benzene	0.7	n.m.
12754-1a	Hexane	≥20	32
-1b	Benzene	≥20	n.m.
-2a	Hexane	1.8	2.1
-2b	Benzene	1.4	n.m.

n.m. = not measured

V CEQA SUMMARY

This chapter covers various information not presented earlier but required by the California Environmental Quality Act (CEQA) for Environmental Impact Reports. As this document is a preliminary environmental review, this section has not been fully developed. When the draft and final versions of the EIR are proposed, it is likely to expand and some of the findings will undoubtedly change or at least be stated more confidently.

A. Significant Unavoidable Environmental Impacts

For this preliminary environmental review of a very subtle and complex proposal, SRI chose to describe our current overall conclusions about the proposed plumbing code changes and our reasons for them, without making definitive findings of significance except where they were clearcut.

First, we discovered nothing to suggest that the issues discussed earlier as the prime ones are insignificant or that other issues are dominant. The only new issue of potential significance that surfaced was the permeation of buried plastic pipe by contaminants in soil and the resulting possible public health impacts. Although the possibility that such effects could occur from permeation of water supply lines from the meter to the house is plausible, any potential problem would also occur--probably in much greater proportion--from the public water distribution system. This problem should be re-examined when better understood and if found significant should influence state policies with respect to plastic use in both public and residential systems. With adequate education of building inspectors on the permeation issue, improper installation of plastic water service in contaminated soils should be rare.

As to public health impacts from chemicals leaching from water pipe into potable water, we find that significant impacts are possible but unproven, both for plastic pipes--especially the chlorinated varieties--and for metal ones, specifically copper systems. If the upper ranges of possible concentrations of leachates are regularly reached, the cumulative risks to public health may be high enough to be of concern by typical standards of acceptable risk, for example, a lifetime cancer risk of one in a million. The chemicals of concern are lead from the solder in copper pipes, possibly leading to neurologic disorders, and carbon tetrachloride, perchloroethylene, and trichloroethylene from plastic (especially PVC and CPVC) pipes, possibly resulting in cancer.

Two major considerations limit the significance of the findings. First, the status of information about long-term levels of leachates is exceedingly flimsy. Reasonable further testing could resolve at least part of the uncertainty (see Section VI). Second, the risk assessment procedure is moderately conservative. If risks still appear to be of concern after concentrations are better known, more attention would need to be devoted to assuring that the assessment procedure took into account detailed properties of the chemical. Finally, thorough initial flushing would effectively mitigate the effects of the rapidly leaching materials, especially the solvents used with plastic pipe. Overall, current information does not establish an environmental preference between copper and plastic pipe, with neither clearly likely to cause a great number of deaths or serious illnesses.

For worker safety and health, a similar situation exists. Both lead from solder fumes in installing copper pipe and solvents from installing ABS, PVC, and CPVC pipe could be hazardous if plumbers have high exposures by inhalation; dermal absorption could also be significant in the case of solvents. The diseases of concern for solder fumes are related to the lead exposure and are neurologic. The solvents may also cause nerve damage, and they may be involved in liver damage or reproductive problems as well. However, they are not implicated in cancer unless benzene is more common than thought. Unless the NIOSH report about to be released resolves the range of exposures satisfactorily, further testing would be useful before completing the EIR. Safety issues generally favor plastic over metal, which appears to lead to more burns (hot solder and especially flux) and strains and contusions (from heavier metal pipes). PB (like PE, although its uses are not proposed for change) poses little if any worker safety and health concern. Use of gloves, other protective equipment, ventilation, and simple care will significantly reduce any potential hazards from either plastic or metal pipe, but these practices have not achieved widespread acceptance among plumbers.

Fire safety is a very real concern with plastic DWV pipe; ABS is combustible, and PVC and CPVC will at least soften and slump in lines. If these plastics are installed as direct substitutes for metal, as they already are in non-fire-rated residences, they will degrade the fire resistance of structures. The gaskets in no-hub cast iron will also fail in fires and cause the pipe to fall, leaving fire passages. But the proposed code changes apply to fire-rated, fire-resistive construction that could retain its fire rating if appropriate installation procedures are developed and enforced. In such conditions, no degradation of fire resistance would occur. This issue thus turns on enforcement, not science. The potable water pipes, kept cooler by the water inside and of much lower mass, are not a significant fire safety issue.

As with fire safety, smoke toxicity is an issue in which plastic can only be less environmentally acceptable than metal. However, whether the difference is significant is less certain. Both ABS, which seems likely to contribute the majority of pipe mass in California, and the polyolefins PB and PE produce combustion products that are not highly toxic; few if any additional fatalities or serious injuries would be likely from their combustion. PVC and CPVC both produce significant quantities of hydrogen chloride vapor in fire environments, and this corrosive material could, under certain circumstances, make a difference in the probability of human survival in lines. The frequency of such occurrences is clouded by lack of a generally accepted test for smoke toxicity. This problem is currently being addressed both by the State of California Department of Industrial Relations and by the State of New York. We believe DHCD should pay close attention to results from those studies, but does not need to delay a decision solely on those grounds.

No other significant adverse impacts are likely to result from the expanded use of plastic plumbing pipe if relatively simple mitigation measures are taken. Plastic drain pipes may be slightly noisier than cast iron pipe. See the following section (V-B) for further elaboration.

Overall, the SRI study team sees little evidence that expanded use of plastic plumbing pipe would cause significantly greater environmental problems than the materials it would replace. Unfortunately, lack of evidence is not the same as lack of hazard. We believe it is especially important to gather more information on leaching of chemicals from both plastic and metal pipe systems into potable water and on the exposures of plumbers to material from plastic (ABS, PVC, CPVC) and metal (copper) plumbing systems.

Table V-1 summarizes our present assessment of our relative environmental concern about pipe systems. There we show our relative degrees of concern for different materials for each of the major areas of impacts. A high rating does not necessarily mean an impact that is significant in the sense of CEQA, but does mean that the material rated seems to us more likely to be environmentally harmful then other materials on that dimension. For example, the chlorinated plastics clearly are of highest concern for smoke toxicity, but may not pose any significantly higher impacts in the proposed new DWV uses (fire-resistive construction).

Table V-1

RELATIVE DEGREE OF CONCERN REGARDING
POTENTIAL ENVIRONMENTAL IMPACTS*

Impact Area	Potable Water: Plastic		Potable Water: Metal		Drain, Waste, and Vent: Plastic		Drain, Waste, and Vent: Metal	
	PB/PE	PVC/CPVC	Copper	Galv. Steel	ABS	PVC/CPVC	Copper/ Gal.Steel	Ca Ir
Public Health	3	4	3	3	0	0	0	[illegible]
Worker Safety	1	2	4	2	2	2	3+	[illegible]
Worker Health	0	3	4	2	4	4	3+	[illegible]
Fire Safety	3	2	0	0	5	4	0	[illegible]
Smoke Toxicity	1	3	0	0	3	5	0	[illegible]
Other Impacts	0	0	0	0	1	1	0	[illegible]

*Key: 0 - No concern
1 - Considerably less concern than average
2 - Less concern than average
3 - About average concern
4 - More concern than average
5 - Considerably more concern than average

Note: High relative concern does not necessarily imply high absolute concern; significance of ratings depends on mitigation measures taken.

+More for copper, less for galvanized.

B. Insignificant Effects

The following environmental effects of expanded uses for plastic plumbing pipe may occur but are probably insignificant by any reasonable interpretation of CEQA:

. Plastic pipe systems may fail slightly more frequently than metal systems until a body of experience with installation errors has accumulated.

. Plastic pipe will consume slightly more petroleum than metal pipe, but slightly less energy overall.

. Plastic pipe will contribute a slightly different load of pollutants to public waste water treatment systems, but the direction of impact, let alone its magnitude, is uncertain.

. Plastic DWV pipe will be slightly noisier than metal systems if installed so as to contact wall surfaces; this may be more significant than otherwise in the multifamily, fire-rated construction that is affected in the DWV code changes.

. Plastic DWV pipe could be damaged by pipe cleaning equipment, but because of its resistance to corrosion, the frequency of such cleaning should be low.

. Plastic pipe will slightly decrease the life-cycle cost of plumbing and therefore of housing, but not enough to change demand patterns or growth.

. Small shifts in employment from metal pipe manufacturing to plastic pipe manufacturing will occur.

. A small reduction in the work of plumbers will occur, mostly as a result of repair and renovation work by do-it-yourselfers.

C. Effects of Alternative Actions

In addition to the proposed project, e.g., the proposed change to the 1982 Uniform Plumbing Code (UPC) allowing certain new uses of plastic plumbing pipe as described in the Project Description, this environmental review has examined the potential effects of alternatives to the proposed project on the quality of the natural and human environment The eventual EIR will consider alternatives as well as the project itself to provide a baseline for evaluating the significance of the impacts and to provide possible alternative courses of action should the proposed project create significant adverse impacts that cannot be successfully mitigated. With this goal in mind, the alternatives we have selected for analysis are no changes to the state code, partial approval of plastic pipe use, and complete rejection of all plastic pipe (that is, reversal of earlier provisions allowing certain uses of plastic pipe).

Under the no-action alternative, there would be no changes in the state code regarding the use of plastic plumbing pipe. All currently approved uses for plastic pipe would continue to be permitted and no new uses of plastic pipe would be allowed. None of the impacts attributable to the use of plastic pipe in expanded applications would be observed; any public health and worker safety and health effects of currently allowed plastic and metal piping systems would persist.

The partial approval alternative would amend the state code to permit certain new uses of plastic pipe, but not all of the new uses proposed under the project. Counting cold and hot water supply in a given application as one new use, the proposed project would change the code to permit 11 new uses of plastic pipe (i.e., 1 new use for ABS pipe, 3 for PB pipe, 1 for PVC pipe, and 6 for CPVC pipe). Considering all the possible combinations of these uses, over 2,000 partial approval alternatives are possible.

Our analyses of the environmental consequences of the proposed project have guided our selection of the subset of the partial approval alternatives to be considered in the EIR. That is, we define the partial approval alternative(s) to permit those new uses of plastic plumbing pipe that are least likely to have significant adverse effects on the quality of the natural and human environment. At present, the only partial alternative that seems reasonably certain to meet this requirement is to allow PB for hot and cold water supply both outside buildings and inside buildings that are not fire-rated or within the fire-resistive construction of fire-rated buildings. No other new uses of plastic pipe would be allowed. Parenthetically, there seems little reason to prohibit PB in exposed locations of fire-rated buildings so long as the penetrations of fire-resistant construction are designed to maintain the rating of that construction. The state of information on the impacts of this alternative is generally the same as on those of the metal water pipe currently allowed for these two uses. Although PB will certainly burn and metal will not, the additional risk of fire spread appears minimal, as does that of smoke toxicity. Leachates from PB have not been shown to be risk-free, but neither have those from copper or galvanized steel. Of the two plastic alternatives, PB is somewhat less likely to be a public health hazard than CPVC, although the relative ratings of PB, CPVC, copper, and galvanized steel will not be clear without further testing (see Section VI). PB is clearly a preferred material, from the worker safety and health viewpoint, compared both with metal systems and with plastics that require cementing.

Under the option of disallowing currently allowed uses of plastic pipe, any impacts of these materials would disappear and those of metal systems reappear. The possibility of permeation of water supply piping by organic contaminants would decrease to the extent that PVC and PE supply lines would be replaced by metal with impermeable joints (but even metal pipe joints can be permeable). Leachates from PVC and PB would be replaced by those from copper, with no clear impact, positive or negative, on public health. The metal pipes would be somewhat more likely to corrode in soil than plastic (galvanized steel is not recommended for buried supply lines). Only small changes in worker safety and health would result from the changes in water supply piping.

Any major impacts of disallowing current uses of plastic pipe would be associated with the widespread use of ABS (and less widespread use of PVC) in DWV applications. Fire load and fire spread would be reduced in nonfire-rated construction. It is probable that few fatalities or little property damage would be avoided by this action, but both are possible benefits. Smoke toxins would also decrease somewhat, especially if PVC were replaced. The decrease in plumbers' exposures to solvent cements would be offset by increased work-related injuries from working with cast iron and, to some extent, with soldered joints in copper DWV. Whether the net effect on worker safety and health would be positive or negative is difficult to predict, given the current lack of information on plumbers' exposures.

Finally, the alternative that would disallow current uses of plastic would transfer some profits and jobs from the plastics to the metal pipe industries. Since large quantities of DWV are involved, these impacts would probably be greater than those for the prime project alternative of allowing expanded uses of plastic pipe. Houses could become more expensive, depending on the prices of cast iron and copper, but probably not enough to significantly affect the demand for housing.

In summary, the alternative of approving only the expanded uses of PB appears to pose fewer environmental risks than does the full proposed project given the state of current information. Because metal systems also pose some unique risks and may be comparable to plastic systems in other risk areas, we are not prepared to say that the no-project alternative or the alternative that would disallow current uses of plastic are environmentally preferable to the partial approval alternative, or even to the full proposed project.

D. Cumulative and Long-Term Implications

Increased use of plastic plumbing pipe can contribute to cumulative environmental impacts in two ways.

First, the sum of the environmental impacts of plastic pipe could be significant even when no one individual impact is deemed significant. In the case of plastic pipe, the most plausible example is for the various leachates that could each contribute to public health impacts. For example, no one leachate might reach the level of 10^{-6} lifetime risk for cancer, but the cumulative risk of all leachates acting together might exceed that level. Given the current uncertainties about the public health impacts, especially those concerning the long-term levels of leachates in drinking water, we are unable to determine whether the cumulative impact is significant. A similar situation is found with worker health impacts, where the risk of one solvent might be insignificant, but that of two or more could be significant. For fire safety, the cumulative impact of all the proposed new uses for plastic pipe are likely to be dominated by the new DWV uses; the contribution of PW pipe is likely to be negligible. The same is true of smoke toxicity, except that the combined affect of HCl, CO, and other toxicants could be significant even when the effects of any one alone were not.

A second issue of cumulative impact is the question of whether the expanded use of plastic water pipe would add to the impacts of other similar actions and in total create a significant effect even though the use of plastic water pipe is not itself significant. We can consider two levels of cumulative impacts:

- Cumulative impact of expanded and existing use of plastic plumbing pipe.
- Contribution of plastic plumbing pipe to total use of plastic products.

As has been made clear earlier, the expanded uses of plastic pipe are in many ways rather small in comparison to existing approved use of plastic pipe. Most new California houses are already being plumbed with ABS DWV if they are not fire-rated; the addition of 10% (by weight) more plastic pipe as PB or (less likely) CPVC water pipe will be of little consequence for fire safety, especially as water piping is less sensitive. The increase for plastic pipe in fire-rated construction, of course, is total since no plastic is being used now; however, if ways of maintaining the rating are developed as required by code, little fire safety impact would be expected. Similarly, the cementing of plastic potable water pipe is probably much less of a problem for workers than the cementing of already approved ABS DWV. Thus, the greatest issue of cumulative impact involves public health impacts, in which plastic in residences can add to plastic in public utility distribution systems. We have no way of estimating the relative contribution of each to the total hazard, as the source of contaminants found in the water supply (control) during leaching tests is not known. We doubt that the combined effects of distribution and residential piping would be significant if neither one alone were, but we cannot rule out that possibility. Similarly, permeation of plastic distribution pipes by toxic substances is more likely than it is for residential piping systems, but the significance of either, in terms of an overall risk assessment, will not be clear for a long time.

With regard to plastics in total, the expanded uses of plastic pipe will be a relatively small contribution in most respects. Plastics are by now endemic in our society. Most of the contaminants of PVC and CPVC that could be public health hazards will be ingested in much greater quantities from other PVC products such as food containers or, in the case of some of the chlorinated methanes, simply from waste products reaching the raw water supply. Those from PB and PE are similar to those from PE food contact materials. If plasticizers do contaminate plastic pipe, they will still do so at much lower levels than they do in any number of plasticized products to which people are regularly exposed, such as flexible vinyl upholstery (where they would yield inhalation rather than ingestion exposures). But equally clearly, plastic pipe does contribute to the total load of plastic-related hazards in California--for example, to the total of all combustible plastics in residences. The hazards from the total use of plastics are undoubtedly appreciable, even though nearly impossible to estimate. Whether or not they are greater or less than the hazards of the materials they replace is perhaps even more difficult to state. About all that can be said is that plastic pipe is not an unusually prominent or special case among plastics in general.

CEQA also requires an assessment of whether long-term environmental costs will be incurred as a result of short-term economic or other benefits. Certainly, any public health impacts of plastic pipe that do occur will probably be delayed for decades, as will some of the worker health or smoke toxicity impacts. However, for the purpose of determining the environmental consequences of the expanded uses of plastic pipe, those should be counted as current impacts, and not discounted in comparison with current benefits. We believe that, when it is viewed from this perspective, this CEQA issue is irrelevant to the decision at hand.

E. Significant Irreversible Changes

CEQA also requires an assessment of environmental changes or consumption of resources that would be permanent and irreversible. For example, the mining of a mountain is an essentially irreversible impact, whereas most air pollutants and their impacts would disappear once the source of pollution is removed.

In the case of the expanded use of plastic plumbing pipe, there would be a small permanent commitment of petroleum resources (but not other energy sources) to the manufacture of the pipe constituents. Total energy resources would be conserved to a slight degree. If any deaths occurred as a result of diseases caused by leachates or occupational exposures, or from fire or smoke toxicity, they would also be irreversible. If plastic pipe were later disapproved, the occurrence of new fatalities would gradually disappear. Some of the leachates from plastic pipe are mutagens and some mutations can be heritable. Thus, it is possible that a heritable--and more likely than not adverse--mutation could persist in the population as a result of drinking from plastic water pipes. Neither the specifics of the leachates in water from plastic pipe nor the overall state of the art of genetic risk assessment allows an evaluation of this possibility at present. If the impacts of plastic pipe eventually were judged unacceptable, it is possible that the metal pipe industry would have declined by that time to the point at which it would prove difficult to revive, but that possibility is also extremely speculative. Overall, we believe that the reversibility of the impacts is not as important an issue to resolve as the magnitude and significance of current impacts.

F. Growth-Inducing Impacts

California's population is projected to increase from the 1980 total of 23.8 million people to 25.9 million by 1985 and to 27.9 million by 1990 (California Department of Finance, 1981). The proposed code change is not likely to significantly affect this forecast population growth for the following reasons. First, the reduction in the cost of housing construction that would result from use of the newly permitted plastics in place of currently approved plumbing materials is so small that it would have virtually no effect on the sales price or rent of dwelling units in the state. Therefore, there will be no change in the demand for housing and consequently no additional in-migration of residents who would be attracted by a drop in the price of housing. Second, the plumbing material substitutions that are likely to result from the proposed code change would not significantly affect employment opportunities in the state and so would not affect the in-migration and out-migration forecasts. Nor would either housing prices or employment opportunities significantly affect shifts in population from one part of California to another.

SACRAMENTO ADDRESS
STATE CAPITOL
SACRAMENTO 95814
(916) 445-8253

DISTRICT OFFICE
1064 STATE BUILDING
350 MCALLISTER
SAN FRANCISCO CA 94102
(415) 557-2253

Assembly
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PLASTIC PIPE AND PERMEATION; DOHS OVERSIGHT HEARING
OCTOBER 19, 1983

BACKGROUND PAPER FOR
ASSEMBLY WAYS AND MEANS SUBCOMMITTEE NO. 1
ON HEALTH AND WELFARE

Summary

This briefing document provides background information on the phenomena of plastic pipe permeation and discusses what the state has done to restrict the use of plastic pipe. The document is organized as follows:

I. Overview of the Issue

Permeation refers to the phenomenon by which chemical substances travel through the walls of plastic pipe from surrounding soils and contaminate fluids transported within the pipe. Permeation is of concern whenever drinking water is transported by plastic pipe through soils that are contaminated with hazardous substances. The evidence demonstrates that permeation does occur, although the data necessary to determine the extent and severity of the problem is not conclusive. Uncertainty rests both with the potential frequency of the problem and with the often unknown health effects resulting from chronic (long-term) exposure to low levels of toxic substances.

A. Types of Pipe:

There are three major types of plastic pipe commonly in use for water service. The types of pipe are refered to by their prime constituents: polybutylene (PB), polyethylene (PE) and polyvinylchloride (PVC). Pipe used for water mains is generally from two to twelve inches in diameter. Pipe used to service individual customers is two inches or less in diameter. Evidence indicates that the higher the density of the molecules of the plastics used in the pipe, the lower the permeability of the walls and the lower the rate of permeation.

B. Reports of Permeation:

Permeation has been reported in California and in the Netherlands and EPA data indicates that other states have also experienced permeation problems. Alleged incidents of permeation have been connected to contaminated soils in the vacinity of both the McColl and Stringfellow dumpsites. Permeation could also be a problem if plastic pipe is installed to carry drinking water near any of the hundreds of other identified California sites with known soil contamination.

The experience of one major California water utility demonstrates that the installation of plastic pipe in localized areas subject to soil contamination from the spillage of gasoline can lead to permeation. Other situations of concern include: a) cases in which pipe is installed in new housing developments located on old agricultural lands that have been sprayed with persistant pesticides; and b) application of common pesticides in a residential setting. In summary, the preconditions for permeation may be a common feature of residential and urban settings.

C. Related Public Health Issues:

Permeation is only one of several public health issues related to the use of plastic pipe. One major concern is the contamination of tap water from the leaching of plasticizing agents which are used in the manufacture of plastic pipe, and of solvents and glues used in connecting pieces of pipe. There are also concerns about toxic fumes that are generated during structural fires. Leaching and plastic fumes are major issues in an EIR being developed by SRI International for the State Department of Housing and Community Development (HCD). By contrast there is no scientific study of permeation being carried out in California.

D. Jurisdictional Issues:

Jurisdiction over the use of plastic pipe in California involves a split at the property line of the individual homeowner. The laying of water mains and the delivery of water up to, and away from the property line is regulated by the Sanitary Engineering Branch of the Department of Health Services (DOHS). The use of plastic pipe inside of the property line and within buildings is regulated by HCD. The failure to properly evaluate the threat of permeation in the five years that DOHS has known of the concern, and the failure to take appropriate preventive action, is partially due to this split in jurisdiction. In larger part, DOHS's failure on permeation is a function of:

- o very poor follow through once regulations are developed;
- o a tendency to downplay the potential severity of public health threats and;
- o understaffing.

E. Economic Interests:

The debate on permeation is often clouded by the large economic interests involved in the issue. Plumbers unions have generally been opposed to the use of plastic pipe on several grounds including:

- occupational health issues involved in using glues that contain synthetic organic compounds to join pieces of pipe and;

- public health issues of fire safety, leaching and permeation.

In addition, plastic pipe is generally less expensive than metal pipe and is more easily installed, particularly by homeowners and other nonprofessional plumbers that can use glue and avoid the soldering necessary with metal pipe. Plumbers have not been vocal in raising potential health concerns with nonplastic pipe. Yet there are also occupational and public health issues related to the use of asbestos in pipe, and the lead and cadmium used to solder metal pipe.

II. What is Known About Permeation?

The following is a summary of incidences of contamination and studies related to permeation. Events are presented chronologically where possible.

A. East Bay MUD:

In the late 1970's the East Bay Municipal Utility District (EBMUD) began to receive complaints about drinking water tasting and smelling of petroleum. After investigating several complaints EBMUD concluded that gasoline and other petroleum distillates must have been present in soils into which plastic water mains and service pipes were installed, and that these chemicals permeated through the walls of the pipe and into the tap water.

EBMUD conducted laboratory studies demonstrating that permeation occurs when PE and PB plastic pipe is allowed to soak in a solution of gasoline diluted with water. Results of an identical test of permeation through PVC pipe were negative. Several of the first incidents of petroleum distillate permeation were linked to: (1) the uncontrolled drainage of materials used to clean motorcycles and the corrosion of asphalt, and (2) the contamination of soil caused by the spillage of gasoline from the tanks of automobiles parked on a steep hill.

A third reported incident of permeation in the EBMUD service area involved the presence of butyl mercaptan in tap water. Mercaptans are added to natural gas to produce an odor for safety reasons. The mercaptans apparantly permeated from a natural gas service pipe made of PE and through a PB water pipe with which the gas pipe was in direct contact. EBMUD conducted a simple laboratory test of permeation using butyl mercaptan and PE pipe. Strong mercaptan odors were detected in several of the samples.

Several aspects of the EBMUD experience deserve note:

- o Although one of the reported cases of permeation occurred on the premises of an operating chemical manufacturing plant, EBMUD did no test for substances other than gasoline and butyl mercaptan.

- The EBMUD lab tests demonstrate that permeation occurs. There was no attempt, however, to quantitatively correlate concentrations of specific substances with the rate of permeation for each type of pipe.

- EBMUD conclusions that permeation is not a common phenomenon because of the relatively low number of reported cases may be erroneous. As the utility notes, permeation will not likely be reported unless the taste or odor of the tap water is adversely affected. Thus there may be unreported incidents of permeation that involve substances at concentrations too low to be detected by end users.

- A number of the EBMUD incidents involved contaminated soils on the property of the building involved. There is serious concern that the application of pesticides near a residence, particularly fumigation with lindane and chlordane for termite or ant control, may increase the likelihood of the permeation of service pipe running through soils within the property line. One consultant notes that it is common practice when fumigating for termites to deliberately spray both the soil and any pipes entering the house.

- The EBMUD permeation experiences resulted in the 1979 promulgation of DOHS regulations prohibiting the use of plastic pipe in soils contaminated with petroleum distillates.

B. Lekkerkerk:

Lekkerkerk is a town in the Netherlands that experienced what appears to be the most serious reported incident of permeation. PE pipe was installed in Lekkerkerk in soils that were heavily contaminated with a variety of substances including known carcinogens. Many of the buildings were located on top of an old chemical waste dump. Trichloroethylene (TCE), for instance, was found in concentrations of from 140 to 160 parts per million (ppm). In 1980, 800 inhabitants were evacuated from 270 houses which were then put up on piles while the contaminated soil, totalling 150,000 tons, could be removed.

Dutch scientists subsequently did several studies of permeation. One was a 1981 study of the permeation of gaseous methyl bromide through PE, PB and PVC pipe. An incident of suspected permeation involved this soil disinfectant which is commonly used in both the Netherlands and the U.S. PVC pipe was found to be the most resistant and of the three was the only one that did not permeate. These results are of concern in California because of the chemical similarity of methyl bromide to ethylene dibromide (EDB). Although EDB is now being banned for use by the EPA, the substance is very persistant and has been used for many years on California soils.

C. Housing and Community Development EIR:

The Department of Housing and Community Development is currently preparing an EIR on the impacts of expanding the legal uses for plastic pipe in residential buildings. Legal use is currently restricted to effluent and prohibits the use of plastic pipe to deliver potable water. Development of the EIR began in 1978 with the formation of a task force chaired by HCD and including representatives of DOHS, Consumer Affairs, Cal-OSHA, the Fire Marshall, the Pipe Trades Council (plumbers), the California Building Trades Council, a plumbers union and several manufacturers of plastic pipe. The study is being conducted by SRI International and funded by the Society of the Plastic Industry.

Although SRI identified permeation as an important public health concern, HCD does not want to include the issue in the EIR because:

- o the concern was brought up too late in the process;
- o too much basic scientific research is required before permeation can validly be evaluated in an EIR and;
- o the issue is outside of HCD's jurisdiction. Despite ongoing efforts of the Pipe Trades Council and a coalition of environmental and consumer organizations, it is not clear that the EIR is the proper forum for a study of permeation. The EIR focusses on the use of pipe in buildings and permeation occurs outside of residences.

D. McColl Dumpsite/Coyote Hills:

In 1981 residents of the Coyote Hills housing development near the McColl dumpsite began to complain of petroleum odors and tastes in their drinking water. Little was done at either the local or the state level to respond to these concerns. Two years later, during the summer of 1983, DOHS finally conducted water sampling and laboratory analyses of Coyote Hills tap water. Although DOHS concluded that permeation probably is not a problem in this Fullerton community, the report has been criticized by local residents and the Pipe Trades Council. Specific objections to the study include:

- o Water was only allowed to accumulate in the plastic service lines for two hours. Such a short period may not adequately reflect actual residential use, tending to understate any permeation.

- o No soil testing was done in the vacinity of the plastic pipe from which water entered the houses.

- o Instead of testing a random number of houses, essential for statistical validity, DOHS allegedly tested the first twelve houses they came across.

- o The Department never took the measurements of water flowrate necessary to assure that the sampled water came from the service pipe, where it was supposed to be static for two hours.

The Department found extremely low levels of one or more of three toxic organic compounds (toluene, styrene and tetrahydrofuran) in the water of three houses. The Department concluded that although he source of the substances is unknown, none of the stances is related to the oilfield wastes that contaminate the soils of the area, and that permeation is not demonstrated to be occuring. McColl residents will vociferously dispute the results of the DOHS study. The Department intends to do further water sampling at the Coyote Hills subdivision. The nature of this testing has not been announced.

E. Stringfellow Dumpsite:

Permeation has also become a concern at the Stringfellow dumpsite. In 1978 the regional water board released part of the liq contents of one of the Stringfellow ponds during a heavy rainstorm in order to avoid a breaching of the pond walls. The effluent ran down the canyon and across a portion of the playground at the Glen Avon school. Synthetic organic compounds have recently been found in water from the school drinking fountains. It is possible that some of the Stringfellow wastes may have percolated into the school's soils and permeated plastic water service pipe.

F. Department of Consumer Affairs:

The Department of Consumer Affairs has been involved in the issue of permeation in several different contexts:

- In mid-1982 Dr. Marc Lappe, a consultant for Consumer Affairs during the Brown Administration, learned of the Lekkerkerk inci and obtained a copy of the EBMUD studies that had been part of the hearing record fc. the DOHS regulations. Lappe designed a protocol, working with Consumer Affairs and funding from the state Building Trades Council, to duplicate the EBMUD tests on petroleum distillates and to test a broader range of organic compounds including solvents and pesticides. As with the EBMUD studies, the aim was to qualitatively rather than quantitatively, demonstrate the threat of permeation. The work was conducted by AnLab, a independent laboratory in Sacramento, and the results were relesed by Consumer Affairs in December 1982.

The results included:

- o In testing permeation of pipe with soil saturated by gasoline, AnLab found that benzene (a potent carcinogen) accumulated in pipe at levels of up to 100 ppm in one week. The federal regulatory action level for benzene in drinking water is approximately ten thousand times lower.

- o In testing a range of pesticides, AnLab obtained negative results for chlordane, but positive results for lindane. This result raises serious questions regarding common methods of ant and termite control that include spraying pesticides on water pipes.

- In the spring of 1983, Gus Koehler, then a research analyst with Consumer Affairs, learned of the experiences of McColl area residents. Koehler researched and wrote a paper entitled, "Plastic Water Pipe in Coyote Hills: A Case Study of Regulatory Failure", that became available in draft form in August 1983. The Koehler study is as an indictment of a state regulatory structure that is intended to protect the public health. The report demonstrates the ineffectiveness of the existing DOHS permeation regulations, due largely to lack of enforcement, and the finger pointing concerning the lack of soil testing prior to the installation of plastic pipe between the developer, the water agency and county health officials. Koehler has since been removed from his post at Consumer Affairs and shuffled to a desk with no phone in a different department.

G. Shell Study:

In July 1983 the Governor vetoed budget item 4260-001-014 which would have allocated $200,000 from DOHS' Hazardous Waste Control Account for an independent study of permeation. Department representatives testified in budget hearings that such a study would be useful.

DOHS is now working with Shell scientific staff at the firm's corporate headquaters in Houston to develop a protocol for a study to be both funded and conducted by Shell. Department spokepersons have indicated that Shell and DOHS are a long way from agreement about the initial protocol submitted by Shell. For example, Shell does not want to test soils contaminated above 1 part per million. In practice, soil is often contaminated at levels far in excess of this.

A number of questions are unanswered:

- o What was the impetus for the veto of the budgeted study and the Shell study? Did Shell offer to do the study or was the firm approached by the Administration?

- o How will the Shell study address the fundemental issue of permeation if it involves only one type of pipe, PB, of which Shell is the major manufacturer? Does the Department have any plans for more exhaustive study of permeation?

- To what degree will DOHS be able to exercise control over a study that is funded by Shell and is conducted in Texas? Will this study just be another example of suspect results from private testing by an affected industry?

The Shell study is already controversial. The Department contends that no actual work has been done by Shell and that only the protocol is now under discussion. The Pipe Trades Council asserts, however, that Shell has already conducted testing and is unhappy with the results. This controversy highlights the dangers of relying on a study such as Shell's as the basis for major public health decisions.

B. New Studies:

The results of several new studies are now becoming available including:

- Recent laboratory studies by a New Jersey utility, the American Water Works Company, strengthens the case on permeation. American Water Works conducted tests using substances present in low concentrations in the gaseous phase, rather than soil saturated with liquids. One major result is that PE, PB and PVC all were permeated by a gaseous solvent in periods ranging from one day to one week.

- AnLab, with funding from the Pipe Trades Council, has replicated its 1982 experiments using tighter controls to avoid any possible entry of substances through the joints between the pieces of pipe, rather than through the walls. The results, to be released at the hearing, include:

  - The degree and rate of permeation appears to be a function of identifiable chemical characteristics of a permeant. Constituents of gasoline, such as benzene, and chlorinated solvents permeate readily while pesticides permeate more slowly.

  - In order of the threat of permeation, PE pipe poses the greatest danger, PB pipe is of intermediate danger, and PVC appears to pose the least threat.

- California Analytical Labs, also under contract to the Pipe Trades Council, is conducting tests on a carbon water filter from one of the McColl area houses sampled by DOHS. The results, also to be released at the hearing, indicate the presence of over thirty organic chemicals, including a number of benzene-related molecules. Some of the chemicals are known or suspected carcinogens. A number of the chemicals are related to crude petroleum and could probably be linked to the McColl wastes.

I. Miscellaneous Notes:

Ray Leonardini's group, the Pipe Trades Council and a coalition of organizations including Friends of the Earth, Citizens for a Better Environment and the Consumer Federation of California, is suing the International Association of Plumbing and Mechanical Officials (IAPMO). IAPMO is developing rules governing the installation and use of plastic pipe. Although the rules do not have the weight of law, it is common for IAPMO rules to be incorporated into state building codes. The suit is now in the discovery phase and is expected to go to trial in Los Angeles in December.

IAPMO contends that sufficient data exists to certify plastic pipes as safe. The plaintiffs assert that there is insufficient data and that the development of the rules is premature.

III. Does California Need an Independent Study of Permeation? What are the Issues?

There are significant drawbacks to relying on an industry organization to both fund and conduct a study of permeation. The Shell study will examine only PB pipe, of which the company is the major manufacturer. In addition, representatives of DOHS indicate that Shell and the Department are far from agreement on the protocol initially submitted by the firm. The State has little if any leverage over research funded and conducted by a private firm. Is the public good served by a prolonged study that addresses only part of the issue? The results of the Shell study will be inconclusive for all parties except Shell.

IV. Are Existing Regulations Being Adequately Enforced? Are there Immediate Steps that Should be Taken to Restrict the Use of Plastic Pipe?

A. Existing Regulations:

In 1979 the Sanitary Engineering Branch promulgated two new regulations relating to the permeation of plastic pipe. These regulations were the direct result of studies by East Bay MUD, and were added to Title 22, Article 5, Water Mains and Appurtances.

- o Section 64624 (f) states that:

  "Plastic pipe shall not be used in areas subject to contamination by petroleum distillates."

- o Section 64630 (g) states that:

  "Installation of water mains near the following sources of potential contamination shall be subject to written approval by the Department on a case-by-case basis:

  (1) Storage ponds or land disposal sites for waste water or industrial process water containing toxic materials or pathogenic organisms.

  (2) Solid waste disposal sites.

  (3) Facilities such as storage tanks and pipelines where malfunction of the facility would subject the water in the main to toxic or pathogenic contamination."

B. The Need for Emergency Regulations:

The scope of existing regulations appears to be inadequate to protect public health from toxic contaminants. Existing regulations apply only to petroleum distillates and exclude many solvents, pesticides and other toxic substances that can permeate plastic pipe.

Section 64624 should be expanded beyond petroleum distillates to include all hazardous substances, including wastes. In addition the regulations could require:

- o certification that soil has been tested prior to installation of plastic pipe

- o that end users of water receive notice from the entity installing the pipe that plastic pipe has been used and that in the event of contamination of adjacent soils delivered water could become contaminated through permeation.

C. The Need for an Information Program:

The Department has no procedures to inform affected parties of the permeation regulations. A Department survey of water utilities found very poor knowledge of the regulations. It is unlikely that housing developers have any knowledge of the regulations. In the case of the alleged permeation in the vacinity of McColl, there were three forms of regulatory failure.

- o The contractor was unaware of Section 64624 which prohibits the use of plastic pipe in areas subject to soil contamination.

- o The water purveyor relied on the contactor to inform him of any soil contamination.

- o Despite the proximity of the McColl dumpsite the water purveyor did not request the Department's permission to install plastic pipe, in violation of Section 64630.

DOHS should develop procedures to:

- o Inform water utilities and contractors of their responsibilities under the permeation regulations.

- o Utilize data from a variety of sources within the Department, and from the regional water boards and the State Waste Management Board, to aid local governments in locating sites of known or potential contamination. This data base should include information on abandoned sites, underground storage facilities, solid and industrial waste disposal facilities and liquid waste surface impoundments.

PRESS INFORMATION

for

WAYS & MEANS SUBCOMMITTEE NUMBER 1
ART AGNOS, CHAIRPERSON

HEARING ON PLASTIC PIPE PERMEATION

1 p.m. Room 437

October 19, 1983

Presented by:

The Consumer Federation of California, Friends of the Earth, Citizens for a Better Environment, The Natural Resources Defense Council, and the California Pipe Trades Council

Coordinator:
Raymond J. Leonardini
(916) 444-0223

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6. Commonly asked questions on the permeation problem.

1

A STATEMENT OF CONCERN FOR A NEW PUBLIC HEALTH RISK POSED BY TOXIC SUBSTANCES THAT PENETRATE PLASTIC DRINKING WATER PIPES

Presented to

The Assembly Ways and Means Subcommittee Number 1
Art Agnos, Chairperson

by

The Consumer Federation of California, Friends of the Earth, Citizens for a Better Environment, The Natural Resources Defense Council, and the California Pipe Trades Council

October 19, 1983

We wish to alert the Committee to a new and previously underestimated source of environmental contamination. We are gravely concerned that California consumers may be unknowingly exposed to hazardous chemicals which may enter drinking water supplies from contaminated soils by migrating through the walls of permeable plastic water pipes.

The degree of our concern is heightened by two facts:

1) the increasing occurrences of soil contamination following accidental spills, leaks from underground storage tanks and, chemical migration from landfills [from the records of the Environmental Protection Agency we know of 58 episodes of major spills of gasoline or diesel oil in one month in California alone (January, 1983)]; and,

2) the increasing reliance of many municipalities on plastic pipes as the conduits for potable water.

In the past, such episodes of soil contamination had been thought to be rare and small in magnitude. From the EPA records we know that spills in the million-gallon range may occur monthly. In early May, 1983, the Regional Water Quality Control Board in Santa Clara reported a total of 57 major underground leaks from storage tanks containing industrial solvents and stripping solutions.

Municipalities either have been unaware of these problems or have underestimated its seriousness. San Francisco uses plastic piping in over 50 percent of its water service connections. The East Bay Municipal Utility District (EBMUD), in spite of having uncovered over a dozen such episodes since 1978, relies almost exclusively on polybutylene plastic pipe for its mains and recommends such use for service laterals.

Research done at the Anlab Laboratory in Sacramento under the supervision of Prof. Marc Lappe' of the UC Berkeley School of Public Health has shown that several major groups of hazardous chemicals can permeate different types of plastic pipe. Some of these pipes, such as polybutylene and polyethylene, are strikingly permeable to chlorinated solvents including some which are carcinogenic in animals.

At the Fairchild plant in San Jose, for instance, soils have been contaminated with chlorinated solvents like 1,1,1 trichloroethane and 1,1 dichloroethylene. Homes in the immediate vicinity of the plume of contamination are plumbed with subsoil polyethylene (PE) and polyvinychloride pipe (PVC). PE has proven to be extremely permeable to these solvents, PVC less so.

Homes sold throughout California are commonly sprayed with lindane, a carcinogenic and teratogenic pest control agent which the EPA has just recertified for use as a structural pest control agent. The labels on several such formulations carry the instruction to spray directly on exposed pipes. Anlab studies show that prolonged contact (1-7 weeks) between PVC pipe and a concentrated lindane solution results in substantial contamination of water inside the intact pipe with this highly persistant pesticide.

Although it contains less toxic ingredients than lindane, the chemical of greatest concern remains gasoline because of its ubiquitous presence in the environment. In spite of studies done in 1978-79 by EBMUD which showed that gasoline will readily penetrate PE and PB (polybutylene) pipe, the level of concern of health officials for this now commonly recognized permeation event remains inexplicably low. A survey of water utility districts in California performed in the summer of 1983 by the Sanitary Engineering Branch of the State Department of Health Services showed that 62 percent of the representatives of districts which regularly recommend the use of plastic pipe for water lines knew nothing about State regulations which proscribed their use in the presence of petroleum distillates.

In spite of their familiarity with permeation problems with plastic pipe, the Department of Health Services failed to specify permeability when asked to indicate what public health concerns were properly within the scope of an Environmental Impact Report on expanded use of plastic pipe being conducted by the Department of Housing and Community Development. This omission is all the more questionable in the face of the fact that Robert Stephens, then the Department's head of hazardous substances, had just returned from an oversight mission in Holland where he had observed the most serious environmental episode involving plastic pipe permeation then known (Lekkerkerk).

Perhaps of greater concern, is the fact that the attorney for the Society for Plastics, Inc., failed to divulge any data about plastic pipe permeation when asked to do so by the Department of Health Services in March of 1981 following the first public reports of the Lekkerkerk event. It is clear from material submitted for the public record that such industry data were available.

Part of the lack of the Department's concern may have stemmed from the mistaken belief that problems of the magnitude of the Lekkerkerk episode (often called Europe's Love Canal) could not happen in the United States. But we know now of several episodes reported to American water districts and the EPA which have involved potential human exposure to extremely hazardous substances such as benzene as the result of permeation of plastic pipe.

Another explanation for Department passivity is the belief that the taste or odor of the water will alert consumers to the existence of a problem. Published data on odor thresholds for the chemicals of concern for permeation establish that consumers cannot be expected to detect them before they are already above the level of health concern.

A case in point is benzene, a human leukemia-causing agent. Data from the Anlab studies showed that this constituent of gasoline will readily go through PB and PE pipe walls and reach extremely high concentrations (100 ppm) after just one week of exposure. This observation could have predicted a permeation contamination episode in Columbus, Ohio, where seven people were exposed to levels of benzene well above those considered the threshold for regulatory action. For benzene in particular, the odor detection threshold is known to be substantially above this threshold, set by the EPA at 0.66 parts per billion (ppb). At 100 parts per million, the levels found by the Anlab work--albeit with pure gasoline--are over 100,000 times the action level.

The lack of response on the part of the plastics industry to the Department's request for data on permeation (March, 1981) is even less understandable, since several industry studies on the resistance of various plastics to attack by chemicals, show that they have known about the vulnerability of various plastics since the early 1960's. That they permitted water pipes to be constructed of these same materials without public disclosure of this vulnerability to appropriate public agencies is cause for concern.

Because of the gravity of the potential health hazards posed by these and other carcinogenic chemicals, and the uncertainties surrounding where and when health-threatening episodes may occur throughout the state, we believe that the following moratoria requirements and authorizations should be adopted immediately:

1) A specific moratorium on use of underground plastic

pipes for carrying potable water in and around high-risk sites in the state. These sites, to be specified by the Department of Health Services, Department of Food and Agriculture, and CalTrans, would include, but not be limited to, areas of proximity to present and abandoned hazardous waste disposal sites; land in proximity to underground chemical storage tanks; agricultural land where residual contamination with pesticides or soil sterilants may occur; and, rights-of-way at high risk for accidents or spills that contaminate soils with potentially permeating chemicals.

2) A requirement that soils at all major construction sites and rights-of-way in which contractors intend to use plastic pipe be monitored prior to use to determine the presence of significant levels of permeating chemicals.

3) A directive to the Department of Health Services to rigorously enforce relevant statutes and regulations dealing with the siting of water mains and service laterals.

4) A notification requirement that householders whose service lines have been plumbed with plastic be warned of the health risks associated with permeation of toxic chemicals from contaminated soil.

5) A requirement that CalTrans and other emergency agencies notify local water utilities known to use plastic pipe of any spill or leakage of hazardous chemicals which can permeate plastic piping (A model notification request for PCB permeation of PB pipe was recently developed by the North Marin County Water District).

6) A requirement that the Department of Food and Agriculture monitor agricultural soils for residual contaminants which can permeate underground plastic irrigation pipes and thereby recontaminate crops or workers (examples include DBCP and dichloropropanes). And

7) An authorization for the Department of Health Services to modify its existing regulations proscribing the use of plastic pipe where petroleum distillates are present to encompass all classes of chemicals known

to permeate plastic pipe.

We believe that the health and welfare of California citizens will be substantially served by taking the steps outlined above to offset the real and potentially damaging health threat posed by the permeation of plastic water pipes by toxic organic chemicals.

INCIDENTS OF PERMEATION OF PLASTIC WATER SUPPLY LINES

SITE	NUMBER OF EPISODES
East Bay Municipal Utility Districts, Oakland, California: Reports of at least twelve specific incidents of potable water being contaminated by gasoline distillates via permeation of plastic pipe. Specific types of plastic pipes permeated are unknown at this time.	12
Marin Municipal Water District, Corte Madera, California: Episodes of gasoline permeation of PB pipe at two residences.	2
North Marin County Water District, Novato, California: Permeation of PB pipe by gasoline (accident near meter) at a residence.	1
State of Delaware: Department of Health and Social Services Division of Public Health reported an episode of permeation at a shopping center of PE pipe by Tetrachloroethylene (PCE).	1
Columbus, Ohio: Shopping center, 2492 Morse Road, Columbus, reports of permeation of PE by gasoline distillates. Adverse health effects reported.	2

2

INCIDENTS OF PERMEATION OF PLASTIC WATER SUPPLY LINES
(Continued)

SITE	NUMBER OF EPISODES
Chattanooga, Tennessee:	
Permeation of a residential plastic service line by gasoline.	1
Lekkerkerk, Nederlands:	
See attached description. 800 Inhabitants evacuated; 270 homes contaminated.	270

CONTACT:
Raymond Leonardini
(916) 444-0223

FOR IMMEDIATE RELEASE

October 19, 1983

(3)

A new danger associated with the use of plastic pipe was revealed today in Sacramento at an Assembly committee hearing. Laboratory tests have shown that lindane, a carcinogenic chemical commonly sprayed on or near pipes for the control of termites and other structural pests, will penetrate the walls of some plastic pipe and contaminate drinking water according to Dr. Marc Lappe of the U.C. Berkely School of Public Health.

Testifying before an Assembly Ways & Means Subcommittee chaired by Assemblyman Art Agnos (D-San Francisco), Lappe urged the state to adopt an emergency regulation to prevent the application of lindane on or near plastic pipe.

Under California law, all structures must be treated for termites before sale or resale. The average home in California is resold every four years, according to Lappe, and lindane is the second most common chemical used for the required treatment. Lappe speculated that, by the year 1990, most Californians will have drunk water from lindane contaminated pipes.

Lappe warned the committee that "the state departments which are responsible for health and environmental protection need to conduct comprehensive examinations of plastic pipe permeation and do a better job of coordinating information amongst themselves." The testing for lindane permeation was recently completed under Lappe's supervision by an independent laboratory in Sacramento. Previous research had indicated that gasoline and other toxic chemicals commonly spilled, dumped, or sprayed in or on soil will permeate plastic pipe.

"Despite the reports of gasoline permeation episodes by three different California utility districts and independent confirmation of my findings by the American Water Works Service Co. in New Jersey, the state has attempted to ignore this serious health hazard," Lappe charged.

Agnos had called the hearing in response to an unreleased report by the Department of Consumer Affairs that the Department of Health Services and other agencies had failed to properly protect drinking water quality in a housing tract developed near the McColl hazardous waste site in Fullerton. The hearing also questioned the Governor's veto of a Budget Bill appropriation which would have commissioned a study of pipe permeation.

#####

LINDANE

Common Name: Lindane

Synonyms: Hexachlorocyclohexane; gamma benzene hexachloride; BHC

Uses: Fumigant in homes and gardens* (See attachments); control of body lice

*Approximately 29,000 pounds of Lindane were used for structural pest control in California in 1981.
Pesticide Use Report, Dept of Food and Agriculture, State of California, 1981.

Type of Chemical: Organochlorine (chlorinated hydrocarbon)

Chemical and Physical Properties: Colorless; persists in environmeant for approximately 10 years**

** An Assessment of the Health Risks of Seven Pesticides Used for Termite Control. Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences. National Academy Press, Washington, D.C. August, 1982.p.3.

LD_{50}: Acute oral: 88 mg/kg. in male rats*

*Thomson, W.T. Agricultural Chemicals, Thomson Publications, California. 1977.

Antidote: No antidote available

Acute Health Effects: As an organochlorine, lindane may disrupt the function of the nervous system, principally that of the brain. Acute symptoms may include headache, disorientation, apprehension, weakness, muscle twitching and convulsions. Chlorinated hydrocarbons are fat soluble and may be stored in human body fat.

Morgan, D.P., 1977. Recog. & Mgmt. of Pesticide Poisonings, U.S. EPA, Washington, D.C.

A 2-year-old boy developed aplastic anemia after playing with a dog treated with lindane solution for mange.

Vodopick, H. "Cherchez la Chienne: Erythropoietic Hypoplasia After Exposure to -Benzene Hexachloride." JAMA, 234(8), 850-851, 1975.

Lindane can be absorbed through the skin.

Chronic Health Effects: Lindane has been shown to cause cancer in rats and mice.

Reuber, M.D., 1979. "Carcinogenicity of Lindane." Environ. Res. 19(2): 460-481.
Reuber, M.D., 1979. "Carcinomas and Other Lesions of the Liver in Mice Ingesting Organochlorine Pesticides." Toxicol. Annu. 3:231-256.

Lindane has been found to be mutagenic in human cell cultures and plant root tips.

Vachkova-Petrova, R.(Inst. Hyg. & Occup. Dis., Med. Acad., Sofia, Bulgaria), 1978. Mutagenna aktivnost na pestitsidite. (Mutagenic activity of pesticides). Khig. Zdraveopaz. 21(5):496-605. (Bulgarian).
Kolmark, F.G. "The Induction of Cytogenetic Changes and Atypical Growth by Hexachlorocyclohexane." Science, 109, 467-468.

Long-term administration of lindane to rats resulted in decreased fertility and produced teratogenic, carcinogenic and central nervous system effect.

Petescu, S., V. Dobre, M. Leibovici, Z. Petroscu, S.A. Ghelberg, 1974. "The Effects of Long-Term Administration of Organochlorine Pesticides (Lindane, DDT) on the White Rat." Rev. Med. Chir. 78(4):831-842.

CAUTION

May be fatal if swallowed. Harmful if inhaled or absorbed through the skin or eyes. Do not swallow or inhale vapor or spray mist or allow contact with skin eyes or clothing.

Avoid contact with food or feeds.

If swallowed, induce vomiting by giving the victim 1 Tablespoon of table salt in a glass of water. If on skin, remove contaminated clothing and wash with soap and water; if in eyes, flush with running water. Call a physician in all cases of suspected poisoning. Do not use in dairy barns or milkhouses.

Do not use in edible products areas of food processing plants, restaurants or other areas where food is commercially prepared or processed. Do not use in serving areas while food is exposed.

This product is toxic to fish, birds, and other wildlife. Keep out of lakes, streams, or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

Apply this product only as specified on this label.

NOTICE — Recommendations for the use of this product are based upon information believed to be reliable in the time of printing. The storage and use of this product being beyond the control of Los Angeles Chemical Company, no guarantees expressed or implied are made as to the effects of such, or the results to be obtained. If not used in strict accordance with the recommendations and established safe and sound practice. The Buyer assumes all responsibility including any injuries and/or damages resulting from its misuse as such, or its combination with other products. No recommendations are made under abnormal storage or use conditions, or under conditions not reasonably foreseeable to the seller.

EPA REG. NO. 962-366 AA
EPA EST. NO. 962-CA-1

Lacco

HI-LIN

CONTAINS 1 LB. LINDANE PER GAL.

FOR SPOT APPLICATION ONLY

ACTIVE INGREDIENTS:	
Lindane (Gamma Isomer of Benzene Hexachloride)	12.9%
Xylene	78.4%
INERT INGREDIENTS	8.7%

CAUTION

KEEP OUT OF REACH OF CHILDREN

KEEP CONTAINER CLOSED. DO NOT LEAVE IN SUNSHINE

Do not reuse empty drum. Return to drum reconditioner or destroy by perforating or crushing and burying in a safe place away from water supplies.

WARNING — FLAMMABLE!

KEEP AWAY FROM HEAT OR OPEN FLAME

See other precautions on the back/side panel

LOT NUMBER

NET CONTENTS

1 GALLON

HTFB579 MANUFACTURED BY

LOS ANGELES CHEMICAL COMPANY

DIRECTIONS

LACCO HI-LIN is prepared for use against certain household and structural pests as listed below. Dosages are given in terms of fluid quarts of this product.

HOUSEHOLD: 1 quart in 25 gallons as a coarse, wet spray or with a paint brush as directed for the control of the following pests. Repeat as needed to maintain effective control. May cause staining in some cases.

ANTS: Apply to ant trails, door sills, window frames, openings around water pipes, heat ducts, electrical outlets, baseboards and other areas where ants may enter rooms.

ROACHES, WATERBUGS: Apply to infested cracks, hiding places and adjacent exposed surfaces where pests may crawl when not in hiding.

MOSQUITOES: Apply to doors, door sills, screens, window frames, and other areas where the pests frequently alight.

SILVERFISH: Apply to baseboards and areas behind shelving, bookcases and storage spaces.

FLEAS: Apply to infested areas around baseboards, windows and door frames, wall cracks, sleeping quarters of household pets and localized areas of floors and floor coverings; place fresh bedding in animal quarters after treatment and do not apply directly to pets.

DIRECTIONS (Continued)

FLIES: 1 quart in 8 gallons of water. Apply to doors, door sills, screens, window frames, and other areas where pests frequently alight.

STRUCTURAL: 1 quart in 25 gallons of water, pre-construction. Apply as a coarse, wet spray, or with a paint brush. Inspect treated areas annually for signs of infestation.

SUBTERRANEAN TERMITES: Slab construction, use a solution of 1 quart to 3½ gallons of water. For treatment before gravel or cinder fill has been added, apply 1 gallon of solution per [illegible] square feet of soil surface. Where fill has already been added, apply 1½ gallons per 10 square feet. Conventional construction, use a solution of 1 quart to 3½ gallons of water. Apply to trench 6 inches wide and up to 30 inches deep for buildings with deep foundations along both sides of exterior and interior foundations, around piers and under utility entrances; placing about 1/3 of the solution in the bottom of the trench with the remaining 2/3 mixed into the soil as the trench is backfilled. Use 2 gallons of solution per 5 linear feet for trenches not over 15 inches deep and 4 gallons per 5 linear feet for trenches exceeding 15 to 18 inches in depth. On voids of unit masonry walls, apply to 125 linear feet, from the surface of the soil to the footing.

CAUTION

Do not use in dairy barns or milk houses.
Keep container closed.
May be absorbed through skin.
Avoid inhalation and skin contact.
In case of contact, wash immediately with soap and water.
Avoid contamination of feed and foodstuffs.
Do not use on household pets or humans.
Harmful if swallowed.

DO NOT LEAVE IN SUNSHINE. DO NOT USE, POUR, SPILL OR STORE NEAR HEAT OR OPEN FLAME.
DESTROY OR RETURN THIS CONTAINER WHEN EMPTY.

Do not reuse empty drum. Return to drum reconditioner or destroy by perforating or crushing and burying in a safe place away from water supplies.

DIRECTIONS

LACCO LIN-O-FLY is prepared for use against certain household pests, listed below. Use as a spot treatment inside dwellings. Do not use as a general space spray or broadcast vapor. Use a coarse type spray.

ANTS: Spray around doorways, windows and cracks or openings of any kind in floor, walls or ceiling where ants might enter the room. Pay particular attention to space behind baseboards, under sinks, in cupboards and behind built-in drawers. Repeat as needed for complete control.

FLIES, MOSQUITOES: Spray to heavy dampness on and around doors, around windows, on screens and any surface on which flies or other insects congregate. Repeat often as necessary to maintain maximum killing value.

SPIDERS, CENTIPEDES: Spray infested baseboards, corners, behind pipes, storage or dark areas. Pay particular attention to basements or areas under houses, garages and storage sheds. Repeat often as needed to maintain killing efficiency of treatment.

EPA REG. NO. 962-375 AA
EPA EST. NO. 962-CA-1

LIN-O-FLY

KILLS FLIES WITH LINDANE

ACTIVE INGREDIENTS:	
Lindane (Gamma Isomer of Benzene Hexachloride)	.50%
✓Deodorized Kerosene	95.10%
✓Toluene	4.25%
INERT INGREDIENTS:	.15%

CAUTION!
KEEP OUT OF REACH OF CHILDREN
SEE CAUTION STATEMENT TO LEFT.

LOT NUMBER 3351 NET CONTENTS 1 GALLONS

MANUFACTURED BY

LOS ANGELES CHEMICAL COMPANY

DIRECTIONS (Con't.)

CRICKETS: Spray baseboards, floors of closets and storage places. Spray thoroughly around doorways and openings of any kind through which crickets might enter. Repeat each 2 to 4 weeks during heavy cricket infestations.

ROACHES, WATERBUGS: Spray around doors, windows, and into any cracks or spaces (such as around drain pipes) through which insects might enter. Pay particular attention to areas behind built-in drawers and cupboards. Repeat as needed to maintain control.

CARPET BEETLES: Spray infested areas of carpets and surrounding floor. Spray dark corners and into cracks where insects might hide. Repeat as needed.

CLOTHES MOTHS: Clothing, blankets and other woolens to be protected should be cleaned and thoroughly sprayed so as to dampen all surfaces. Pay particular attention to seams, cuffs and pockets. Dry thoroughly and place in good tight storage. Treated items should be dry cleaned before being used as clothing or bedding.

FLEAS: Spray infested areas carefully. Direct spray into cracks, crevices and other hiding places in out-houses, yards and kennels, so that all infested areas are dampened. Repeat at monthly intervals. Do not use in human habitations. Do not spray animals. Dry treated areas carefully before allowing pets to re-enter.

SILVERFISH: Spray baseboards, behind drawers or shelving, book cases and storage areas. Repeat as needed to maintain efficient control—usually about each 2 to 3 months.

NOTICE: Recommendations for the use of this product are based upon information believed to be reliable at time of printing. The use of this product being beyond the control of LOS ANGELES CHEMICAL COMPANY, no guarantee, expressed or implied is made as to the effects of such or the results to be obtained if not used in accordance with directions or established safe and sound practice. The BUYER must assume all responsibility including injury and/or damage resulting from its misuse as such or in combination with other products.

Environment Di. :torate

ENV/WMP/80.Sem.15

To: [illegible]
Seminar on Hazardous Waste
"Problem" Sites

English only

(4)

EXPERT SEMINAR

ON HAZARDOUS WASTE 'PROBLEM' SITES

Case of Lekkerkerk

(Contribution by Mr. Strybis)

The attached paper is submitted for consideration at the expert seminar on hazardous waste "problem" sites, OECD, Paris, November 3-7, 1980.

It has been specially prepared by Mr. Stybis, Netherlands.

Lekkerkerk

One of the most serious cases of soil pollution in the Netherlands is the case of Lekkerkerk.

Lekkerkerk is a village north east of Rotterdam on the river Lek in a reclaimed coastal swamp area. Aroun 1970 for the expansion of this village the ditches in the expansion area west of the village were not filled up with crushed peat, straw and saw dust, as usually is done for building purp in marshy polders, but for financial reasons with the building and demolition wastes. Among these, chemical wastes and waste oil were dumped illegally, partly in drums (of which more than a thousand have been found until now) and probably partly unpacked. Soon after the houses on this "ground" were built and inhabited complaints arose about bad smells in the houses, while at a number of places gas and water tubes in the ground were so badly affected by polluted grondwater that they broke.

After the fainting of two workmen in a pit dug for inspection of gas pipes an investigation was started in 1978. From this resulted that soil and grou water in this new part of the village were badly polluted by aromatic hydrocarbons, mainly xylene, toluene and ethylbenzene (solvents widely usec in the paintindustry) that, as later appeared, floated as a film on a layer of oily waste material on the groundwater.

Because of the low permeability of the peat soil and because of the fact that Lekkerkerk lies in an area behind the dike of the river Lek where the groundwater wells up, the pollution had not spread laterally nor vertically to the subsoil. But when in april 1980 further investigations showed that not only the atmosphere inside the houses contained relatively high concentrations of aromatic hydrocarbons by evaporation from the soil, but that these polluting compounds also penetrated through the network of PVC and PCE tubes in the ground for the distribution of drinkin water as a result of which the quality of this water could not be guarante any longer, in the interest of public health it was decided that at the shortest possible ⌈ all pollutions should be removed. This cleaning operation is now in progress and reached the world press for because of th some 800 inhabitants had to be evacuated from their 270 homes for about six to nine months.

⌈ notice

The operation is complicated by the fact that for social and financial reasons the aim is to save the 270 houses that are built on piles, some of concrete, others of wood.

The following works have been carried out or are still to be carried out.

1. All pavements, trees and other vegetation, street lights, garages, tubes and cables in the ground have been removed and if polluted have been destroyed. Only the houses were left standing.

2. The canal around the concerning part of the village was dammed off from the surrounding surface waters to prevent possible spreading of pollutions during the operation. By steel barrages the subsoil of the quarter was divided into five compartments to reduce spreading of pollutions from uncleaned territory into cleaned territory and to reduce the quantities of groundwater that have to be pumped away during the operation.

3. The groundwater level in the compartments was lowered by pumping for the time of the operation to a level just under the pollutions so that work can be done under dry conditions, which makes grading and concentrating easier. Well from the river Lek is opposed by a number of deep well pumping stations.

4. All polluted materials deposited on the original surface and in the ditches are removed and transported to a combustion installation for domestic and chemical wastes at Rotterdam to be burned. All polluted water thas is pumped out of the compartments is led to a temporary purification installation on the spot, where it is purified and finally led through active carbon filters before it is drained into the river Lek. Saturated active carbon sludges and chemicals separated from the water are burnt at the combustion installation in Rotterdam.

5. Underneath the houses the removal of soil and polluting substances is done by special drilling and dragging machines that can work horizontally. To prevent leaning to one side of the houses work is done two opposite sides at the same time. Houses on wooden piles are kept up straight by temporary steel constructions for additional support while work underneath them is going on.

6. After removal of all wastes and polluted soil (estimated on 75.000 tons of which 2.000 drums) the depressions are filled with clean sand, for which was chosen "flugsand" to prevent differential setting of the ground afterwards. Flugsand is a light vulcanic sand from the Eifel area

in Germany, which has about the same volumeweight under water saturated conditions as peat. Next clean topsoil is brought up. After that the infrastructure of the quarter can be reestablished and the groundwater is raised to its original level again.

It is expected that the inhabitants can return to their homes on a new clean subsoil between november 1980 and february 1981. The costs of the whole operation are estimated to be more than 140 million guilders.

5

Anlab
ANALYTICAL LABORATORY
A DIVISION OF DEWANTE & STOWELL

1914 S STREET, SACRAMENTO, CALIFORNIA 95814 • 916-447-2946

PERMEATION OF ORGANIC COMPOUNDS IN PLASTIC PIPE

Anlab
ANALYTICAL LABORATORY
A DIVISION OF DEWANTE & STOWELL
1914 S STREET, SACRAMENTO, CALIFORNIA 95814 • 916 447-2946

September 15, 1983

Mr. Ray Leonardini
555 Capitol Mall, Suite 435
Sacramento, CA 95814

The results of the pipe study are in the report enclosed.

The findings indicate that certain organic chemicals can permeate through plastic pipe under the conditions of the study.

Sincerely,

Tom Ikesaki

Tom Ikesaki

TI:et
Encls.

ABSTRACT

Four potable water service pipes were tested for permeability to specific organic compounds. These organic compounds were used in concentrated form in these tests and may not be representative of normal applications. Three series of test designs were used. Successive tests were designed to reduce the possible effect of pipe joints to the inward migration of chemicals through the pipe material.

Three groups of chemicals were tested; chlorinated solvents, pesticides and gasoline in Polybutylene (PB), Polyethylene (PE), Polyvinylchloride (PVC) and Copper (CU) pipes.

Permeation by small molecular weight chlorinated solvents was pronounced for polyolefin pipes (PB & PE), less for PVC. Trace contamination of joined pipe systems (PVC and Copper) was also found. Controls with no joints in pipes showed that PVC but not Copper was permeable to specific molecular weight chemicals.

For systems showing permeation, the rank order of chemicals was related to molecular weight and polarity, with constituents of chlorinated solvents, gasoline (benzene and substituted benzenes) showing the greatest permeation effect in polyolefin and chlorinated pipes, respectively. The rank of pipes according to decreasing permeability is: Polyethylene, Polybutylene, Polyvinylchloride and Copper.

Results indicate the presence of organic chemicals from other sources such as pipe joining and sealing compounds, and a group of chemicals that appear to have been extracted as specific plastic pipes were permeated.

SOME FREQUENTLY ASKED QUESTIONS CONCERNING PIPE PERMEATION

ANSWERS PREPARED BY THE CALIFORNIA PIPE TRADES COUNCIL

Q. WHAT IS PIPE PERMEATION?

A. Pipe permeation is the phenomena whereby toxic substances seep through pipe material causing the contamination of the drinking water which is carried by those pipes. This occurs most commonly with pipe which is buried in soil.

Q. WHEN WAS PIPE PERMEATION FIRST DISCOVERED?

A. That is hard to answer. Pipe permeation was not widely reported until the Department of Consumer Affairs released test results in December, 1982, which showed that plastic pipe can be permeated by a number of carcinogens. The test was sponsored by the California Pipe Trades Council and was conducted by Anlab, an independent testing laboratory in Sacramento. The investigation leading to that test, however, revealed that the East Bay Municipal Utility District had recognized permeation as early as 1978 and had reported its findings to the Department of Health Services. Further, the president of the Society of the Plastics Industry (a major trade association of plastic resin and plastic product producers) stated, in response to DCA's permeation announcement, that the findings "are not new, since they have been identified long ago . . ."

Q. IS ONLY PLASTIC PIPE PERMEABLE?

A. As far as we know, the only testing for permeation has been conducted with plastic pipe and the only reported instances of pipe permeation have involved plastic pipe (although metal pipes have been used as test control, but were not permeated). We believe, however, that all pipe materials should be tested to make absolutely certain that public health is protected. The Budget Bill item (#4260-001-014) which would have appropriated funds for a permeation study called for the testing of all pipe materials. It was vetoed by the Governor.

Q. WHICH CHEMICALS CAN PERMEATE PLASTIC PIPE?

A. No one knows for sure how many different chemicals can permeate plastic pipe, nor under which conditions the permeation is most likely to occur. Among the toxics discovered to permeate, however, are some known carcinogens and some which are known to cause liver and kidney damage, mobility impairment, birth defects, lung congestion, nausea, and anemia. Until a comprehensive test is conducted, we simply won't know which chemicals permeate at hazardous levels. The Anlab test found the following will permeate:

1, 2 dichloropropane
1, 1, 1 trichloroethane
trichloroethylene
1, 1 dichloroethane
1, 1 dichloroethylene
Ethyloxirane
Benzene
Methylpyrole
Butane
Toluene
Xylenes
Trimethylbenzenes
Tetramethylbenzenes
Ethylbenzene
Chloroform
Lindane

(An attachment to this series of questions & answers, excerpted from "The Merck Index" shows some of the common uses of these toxic chemicals.)

Q. WHY DID THE GOVERNOR VETO THE PIPE PERMEATION STUDY?

A. In his veto message, the Governor stated, "I am eliminating the $200,000 legislative augmentation for the study of the permeation and infiltration of toxic chemicals into pipe and pipe water mains. I believe it is more appropriate for this study to be funded by the pipe industry."

Q. WHY SHOULDN'T THE INDUSTRY BE REQUIRED TO FUND THE STUDY?

A. We're talking about a potentially serious health hazard which could affect millions of Californians. It requires a thorough and objective examination. Just as statistics can be manipulated, so can test protocols and results. Although the plastics industry acknowledges that they have known of the permeation phenomena for some time, the industry has not been at the forefront of any effort to restrict the use of plastic pipe to safe applications. Further, the president of the Society of the Plastics Industry, while referring to the permeation tests financed by the California Pipe Trades Council, stated, "There should be serious questions about the validity of a report funded by a source opposed to the product it is testing." We concur that privately funded tests may have a credibility problem and we also assert the same logic used by the S.P.I. president should discourage reliance on tests funded by advocates of products. The potential health hazard related to permeation is simply too serious to have its examination and evaluation financed, designed, or conducted by any organization other than one that is thoroughly and unquestionably objective.

Q. WAS THE TEST FUNDED BY THE PLUMBERS UNIONS (CALIFORNIA PIPE TRADES COUNCIL) A RELIABLE TEST?

A. The objective of the test was to determine whether or not certain chemicals could permeate plastic pipe. The test did not replicate "real-life" circumstances. It used highly saturated sandy soil in a controlled environment in order to accelerate the results. The test did prove that, under those conditions, plastic pipe is permeable. We know that a much more expensive and sophisticated test, such as the one which the Governor vetoed, is necessary to accurately determine which chemicals will permeate and under which soil conditions the permeation will occur. The plumbers' test was not designed to be the "last word"; its purpose was to provide sufficient evidence of the problem in order to prompt responsible parties (such as the State) to conduct a comprehensive and objective test.

Q. WHO BESIDES THE PLUMBERS UNIONS HAVE HAD EXPERIENCE WITH PERMEATION TESTING?

A. Apparently the East Bay Municipal Utility District conducted some limited testing after their initial discovery of permeation. We have recently learned, also, that testing has been conducted by the American Water Works Service Co. in New Jersey and that the company's results have shown findings similar to our own. None of this testing, however, has been nearly as comprehensive as the one which would have been conducted pursuant to the Budget Bill provisions. Strangely, although the Department of Health Services has jurisdiction over the regulation of public drinking water distribution systems and although the department has been aware of the permeation phenomena at least since 1978, DHS has never shown any interest in permeation testing until now.

Q. HASN'T A PERMEATION TEST BEEN CONDUCTED BY THE CITIZENS FOR SAFE DRINKING WATER?

A. No. The Citizens for Safe Drinking Water did widely report its discovery of lead leaching in copper pipe. The test was conducted at a few locations in Sacramento. The City of Sacramento subsequently tested the same water taps and found no evidence of leaching. The only known member of the Citizens for Safe Drinking Water, by the way, is a public relations representative for the Plastic Pipe & Fitting Association, a trade association which has worked closely with the Society of the Plastics Industry. This front organization has never announced the conduct or the results of any permeation studies.

Q. ASIDE FROM LABORATORY TESTING, WHERE HAS PERMEATION OCCURRED?

A. It may have occurred at the Coyote Hills tract near the McColl hazardous waste site in Fullerton. Further testing needs to be conducted there to know for certain. The most dramati perme-ation episode occurred at Lekkerkerk, a town in the Netherlands. There, 800 inhabitants were evacuated when 270 homes were contaminated by toxics in the soil which permeated plastic pipes and conduit. All other known instances have been in the U.S. The East Bay Municipal Utility District has reported 12 episodes of gasoline permeating PB pipe, two episodes of gasoline permeation of PB pipe have been reported by the Marin Municipal Water District in Corte Madera, one identical episode has been reported by the North Marin County Water District in Novato, Tetrachloroethylene (PCE) has permeated PE pipe in Delaware, gasoline distillates permeated PE pipe in Columbus, Ohio, and gasoline permeated plastic water service lines in Chattancoga. Undoubtedly, there have been a number of other permeation episodes that have gone unrecognized or unreported.

Q. AREN'T THE PLUMBERS SIMPLY OPPOSING PLASTIC PIPE BECAUSE THE INSTALLATION OF PLASTIC PIPE REDUCES LABOR COSTS?

A. The advocates of plastic pipe want you to think that is the reason. Actually, there are minimal economic considerations related to the plastic pipe issue. As you know, SRI International (formerly Stanford Research Institute) is currently producing an environmental impact report (E.I.R.) for the Department of Housing & Community Development which relates to the expanded uses of plastic plumbing pipe. The initial review draft produced by SRI (the final report will not be completed until next year) reports on page IV.F-1 that the proposed expanded use of plastics in home construction would amount to a labor savings of only about $50 per single family residence. The E.I.R. does not include a review of the permeation phenomena, so no accurate costs are available on the labor cost differential between the installation of underground plastic pipe and the installation of alternative materials. However, since plumbing the interior of a house is much more complicated than simply laying pipe in a trench, we can assume that the impact on labor costs -- if subsurface plastic water lines were to be restricted -- would be negligible.

Q. WHY THEN, ARE THE PLUMBERS SO CONCERNED ABOUT PERMEATION?

A. Members of the plumbing trades drink water too. Historically, our membership has been very active in the promotion of technologies to deliver pure water and to provide adequate sanitation. Our initial examination into the plastic pipe issue had been prompted by a fear that the health of plumbers had been severely endangered by the use of adhesives required for the bonding of plastic pipe, just as, 30 years ago, our fear that working with asbestos was causing cancer amongst our membership led to our investigation into the dangers of that material. Our continuing examination of plastic has uncovered the other dangers of the material, i.e., permeation, leaching, and fire toxicity.

Q. HOW COME THE E.I.R. DOES NOT INCLUDE AN EXAMINATION OF THE PERMEATION ISSUE?

A. We think it should. Unfortunately the proponents of the E.I.R. were unaware of the permeation issue when the scope of the study was being determined by the E.I.R. Task Force membership (although at least two of the participants, the Department of Health Services representative and the Society of the Plastics Industry spokesperson, were apparently well aware of the issue but chose not to reveal it) and it was therefore never included in the E.I.R.'s original work plan. When permeation eventually became a public issue, various environmental and labor organizations, some legislators, and even the Department of Health Services requested that an evaluation of pipe permeation be included in the E.I.R. Despite the strong evidence that this problem needs a careful analysis, the Department of Housing & Community Development acceded to the demands of the plastic industry and refused to permit the inclusion of a permeation study.

Q. WHAT REASONS DID THE DEPARTMENT OF HOUSING & COMMUNITY DEVELOPMENT GIVE FOR REFUSING TO INCLUDE PERMEATION TESTING AS AN ELEMENT OF THE E.I.R?

A. The department contended that underground pipes are outside of their jurisdiction. That contention is not true. While water mains are the responsibility of the Department of Health Services, the subsurface pipes which carry water from the meter (usually at the property line) to the structure are within the jurisdiction of DHCD. Clearly, if a plastic water main can be permeated, so can a plastic service line carrying water under a residential yard. DHCD has frequently sided with the plastic industry representatives during E.I.R. Task Force disputes, so the department's refusal was not surprising.

Q. WHAT IS THE MAGNITUDE OF THE PROBLEM?

A. No one can know for sure, but we believe it can be a problem with enormous consequences. Until a comprehensive test is completed, we can not know with absolute certainty which chemicals will permeate plastic pipe, which soil conditions contribute to it, nor how long it takes for permeation to reach truly hazardous levels. The vetoed study could have given us those answers. Its possible, however, to speculate with some assurance about the magnitude of the problem:

The E.I.R. draft prepared by SRI estimates that over 25% of all Californians will live in homes plumbed by plastic pipe within the next 25 years if the proposed new uses of plastic are approved. It is safe to estimate that at least that many, and probably many more, will also be served by underground pipe systems which include at least some plastic. (The manager of the San Juan Suburban Water District in Sacramento County has estimated that 98% of the new homes in his district have plastic water lines from the house to the main.) Consider also that there are thousands of recorded toxic spills each year in California (every one of them could eventually trigger some permeation activity), that there are now tens of thousands of California homes near hazardous waste sites (such as the Coyote Hills tract near McColl), and that many new communities are projected for development on land which had formerly been contaminated by pesticides. The potential for extreme danger is high; its time for clear answers.

Q. IS ANYONE BESIDES THE CALIFORNIA PIPE TRADES COUNCIL ACTIVELY SUPPORTING PERMEATION TESTING?

A. There is, of course, considerable support within the Legislature. Additionally, the California Pipe Trades Council is part of a coalition of organizations which have been actively pushing for permeation testing. Other members of the coalition include the Citizens for a Better Environment, the Consumer Federation of California, the Friends of the Earth, and the Natural Resources Defense Council. Additionally, the Sierra Club has taken strong supportive positions.

The Merck Index. 9th Edition, Merck and Company, Inc., New Jersey, 1976.

1,2-Dichloropropane-Uses: solvent, dry cleaning fluids, degreaser, insecticidal fumigant mixtures

1,1,1-Trichloroethane-Uses: metal cleaning

Trichloroethylene(TCE)-Uses: solvent, paints, degreaser, dry cleaning

Benzene-Uses: solvent, varnishes, petroleum products

Butane-Uses: petroleum products; synthetic rubber

Toluene-Uses: solvent, insecticidal fumigant mixtures, petroleum products

Xylene-Uses: solvent, insecticidal fumigant mixtures, petroleum products

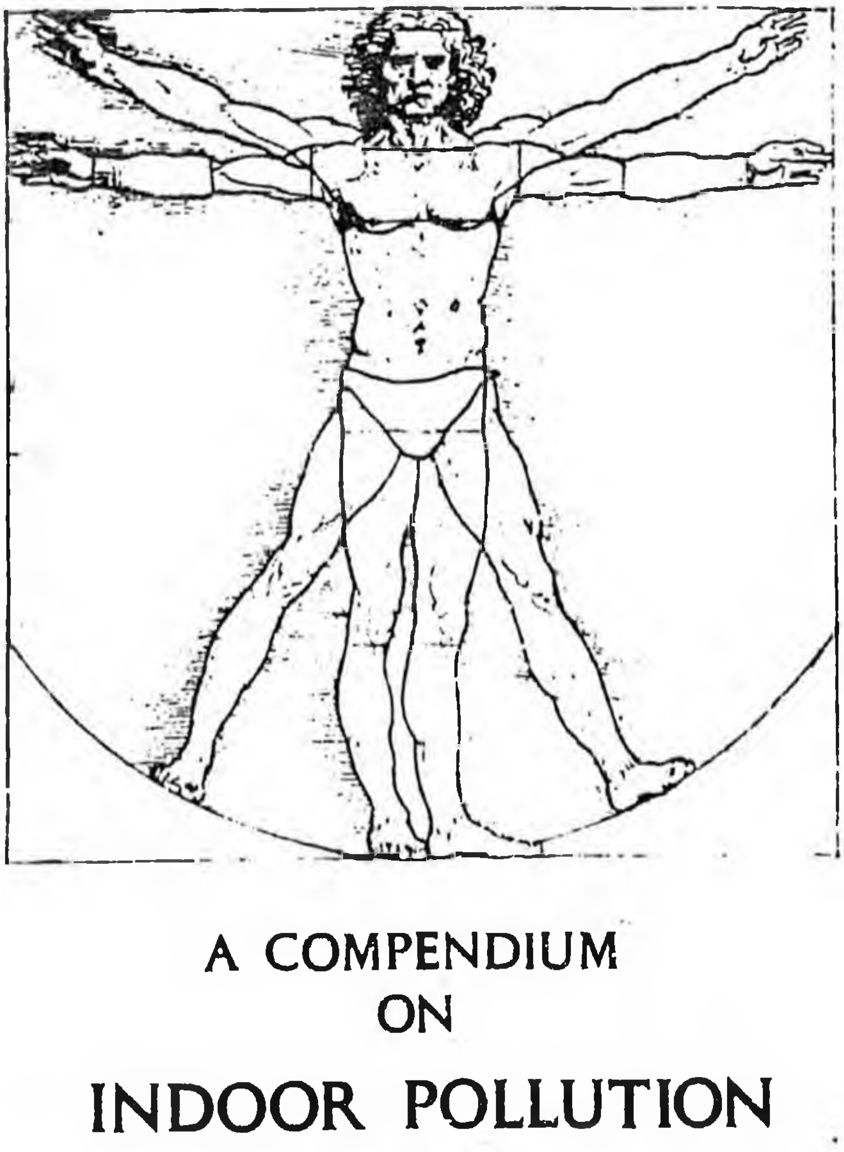
Chloroform-Uses: solvent, cleaning agent

Trimethylbenzene: found in petroleum products

Tetramethylbenzenes: found in petroleum products

Ethylbenzene: found in petroleum products

CLEAN YOUR ROOM!



A COMPENDIUM
ON
INDOOR POLLUTION

DEPARTMENT OF CONSUMER AFFAIRS

Chapter III.N

PLASTIC PIPE FOR POTABLE WATER

1. SUMMARY

The general topic of the quality of potable water is beyond the scope of this study. However, a new kind of piping is being introduced that raises questions about the quality of the potable water that it delivers. Recent tests suggest that such water may contain organic chemicals, principally plasticizers and solvents, most of which were introduced into the environment within the last generation. Several are known or suspected carcinogens. Plastic pipe represents a specific example of the generic way in which we are restructuring our indoor environment. Thus, a discussion of this topic belongs in our consideration of indoor environment quality. What, if any, government actions are called for is a timely challenge.

2. BACKGROUND

Residential plumbing contractors in certain parts of the country are beginning to utilize plastic pipe for potable water distribution. Polyvinyl chloride (PVC) plastic pipe is used from the property line to the house, and chlorinated polyvinyl chloride (CPVC) plastic pipe is used for potable water distribution within a residence. Each of these pipes requires a host of formulations called primers, degreasers and sealant cements which contain organic solvents (for installation). These formulations rely principally on four major solvents for their major constituents - methyl ethyl ketone (MEK), dimethylformamide (DMF), cyclohexanone (CH) and tetrahydrofuran (THF). Other chemicals are substituted from time to time, such as methyl butyl ketone. Government agencies have not yet examined the safety or purity of ingredients in these formulations.

Because of sporadic, unexplained symptomatology reported by some plumbers who install plastic pipe,* the California Health Services Department (DHS) conducted exhaustive bibliographic research on the toxicology of the solvents. Tentative association between symptoms and toxic effects on the liver and central nervous system (CNS) prompted concern. An article indicating that plastic pipe leaches its solvents into drinking water was uncovered.

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* The pipes are cut, usually at the construction site, and installed by way of primers and cements, through various configurations and joints. The joint per foot of pipe for CPVC (inside residences) averages 1 joint per 1-1/2 foot of pipe.

DHS was unable to find any further research on this subject. Because plastic pipe for potable water in California is in the initial stages of code approval by the State's Housing Commission and by one model code organization, and because of the potential for consumer exposure to toxic chemcials, DHS decided that more comprehensive research on the leaching phenomenon was necessary.

3. THE MONTGOMERY STUDY ON PVC & CPVC PLASTIC PIPE

DHS commissioned the Montgomery Testing Laboratory (MTL) to conduct the first government-authorized study to measure the amount of solvents that leached into drinking water from plastic pipe (2). These tests provided the first substantive evidence that certain plastic pipe for potable water systems may pose a health hazard for consumers.

Two exposure conditions were simulated in the study. The first, using static systems, simulated leaching in newly constructed plumbing systems (PVC and CPVC) in which water is allowed to remain stagnant for a period of time prior to the occupation of a new dwelling, or during any prolonged absence from a dwelling.

The second condition, simulating normal household usage, employed CPVC pipe. Hot and cold water were used for both sets of tests, as well as "good" and "poor" joints*and various types of water (3).

The precision of the analytic instruments was reduced by the high concentration of solvents found in the system. Also, the study design itself underestimated average joint per running foot of pipe. Thus, DHS estimated that laboratory values understated true exposure by as much as 50 percent.

3.A. TEST RESULTS

Results of the MTL tests were analyzed by DHS (4). Since none of the solvents had previously been found in potable water, DHS developed long-term and short-term exposure limits by reference to available literature, mostly based on industrial exposure. (Table I)

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* Care was taken to prevent any excess of primers and cements in the "good" joints. Normal installation procedures were used for "poor" joints.

TABLE I

California Department of Health Suggested Maximum Acceptable Concentration of Solvents in Potable Water (in ppm)

	Long-term Exposure	Short-term Exposure
A. Methyl ethyl ketone (MEK)	36 ppm	360 ppm
B. Tetrahydrofuran (THF)	36 ppm	360 ppm
C. Cyclohexanone (CH)	17 ppm	170 ppm
D. Dimethylformamide (DMF)	1.8 ppm	3.6 ppm

NOTE: Concentration expressed in parts per billion are 1,000 times these values.

Based on DHS exposure criteria, the combined concentrations of the major solvents came to within 75 and 80 percent of the suggested short-term maximum acceptable concentration (STMAC). Assuming a possible underestimation of 50 percent, the true values may actually be above the suggested STMAC. Both THF and DMF actually exceeded the short-term maximum acceptable concentration suggested by DHS (5).

According to data analysis by DHS, in "worst case" formulations (ingestion of powdered infant formula prepared with tap water), the suggest STMAC (18 ppm) is greatly exceeded by measured values -- as much as twenty-fold -- in the case of THF (375 ppm). DMF also exceeded the "worst case" suggested STMAC (0.2 ppm) by twenty-one fold (4.3 ppm). The DHS found this amount to suggest a "substantial potential hazard for infants in newly-plumbed, unflushed homes."*

While the carcinogenicity of DMF has not been sufficiently studied, the National Cancer Institute plans a three-year carcinogenicity test to assess the

* There has been considerable scientfic debate on the question of whether flushing newly plumbed systems decreases or increases the risk of exposures. Statistical evidence varies depending on the variables of elapsed time and dwell time, as well as the chemical's solubility or insolubility. Moreover, as discussed below, what may happen with the components of the formulations may be the reverse for volatile organics.

potential of DMF for producing cancer. Similar testing is planned by the National Institute for Occupational Safety and Health (NIOSH) on the toxicity of THF and CH.

III.B. HALOGENATED COMPOUNDS FOUND

In addition to solvents, the MTL data show that water that has been left standing for two weeks can accumulate over 100 ppb (the EPA standard) of the trihalogenated methanes. DHS hypothesized that these compounds may have come from the pipe itself and not from the solvent (See Table II).

Preliminary epidemiological studies prepared by the Environmental Protection Agency (EPA) for the Council on Environmental Quality (CEQ) have considerably strengthened the evidence linking elevated risks of cancer with chloroform, bromoform, dichlorobromomethane and dibromochloromethane (6,7,8). Moreover, EPA suggests a water quality criterion for total trihalomethanes in ambient water at zero (0). Because of technological and economic feasibility factors, however, the proposed criterion is set at 0.19 ppb. If this measurement is followed, the average total trihalomethanes (77.8 ppb) represents a 409-fold increase over the EPA suggested criterion. In one pipe test system, the amount of total trihalomethanes (152.7 ppb) represents a level equal to 803 times the suggested criterion. (see Figure I)

III.C. CARBON TETRACHLORIDE, TETRACHOLOROETHENE AND TRICHOLOROETHANE

Excessive levels of these chemicals were also found in the MTL data (see Table III). Because of the cancer risks associated with all of these chemicals, EPA suggests zero as the safe, i.e. non-threshold assumption level.

The EPA suggested water quality criterion under the Clean Water Act is 0.4 ppb for carbon tetrachloride (9), 0.8 ppb for tetrachloroethene (10) and 2.7 ppb for

TABLE II

FOUR VOLATILE HALOGENATED COMPOUNDS IN WATER (TWO WEEKS STATIC SAMPLES)
CONCENTRATED (ug/l) (ppb)[1]

TEST SYSTEM	TEST VARIABLES	CHLOROFORM	DICHLORO-BROMOMETHANE	DIBROMO-CHLOROMETHANE	BROMOFORM	TOTAL TRI-HALOMETHANES*	
1	CPVC/Good/ Hot Pasadena	92	3.0	2.4	0.7	98.1	(31.5)++
2	CPVC/Poor/ Hot Pasadena	69	3.3	3.0	1.3	76.6	(31.5)++
3	CPVC/Good/ Cold Pasadena	78	3.5	2.9	0.9	85.3	(32.6)++
4	CPVC/Poor/ Cold Pasadena	146	3.3	2.6	0.8	152.7	(32.6)++
5	PVC/Good/ State Project	3.1	0.2	0.1	ND	3.4	(0.1) ++
6	PVC/Good/ Colorado River	25	12	11	2.4	50.4	(53) ++
TOTAL (average)						77.83 +++	
EPA/CALIFORNIA STANDARD						100	
EPA SUGGESTED WATER QUALITY CRITERIA[2]		0.19				0.19	

\+ Value represents a 1.5-fold increase over the EPA/California Standard and a 768-fold increase over the EPA Suggested Water Quality Criterion.

++ Values in parentheses represent total of all four individually listed trihalomethanes from control samples, i.e. not passed through pipe system.

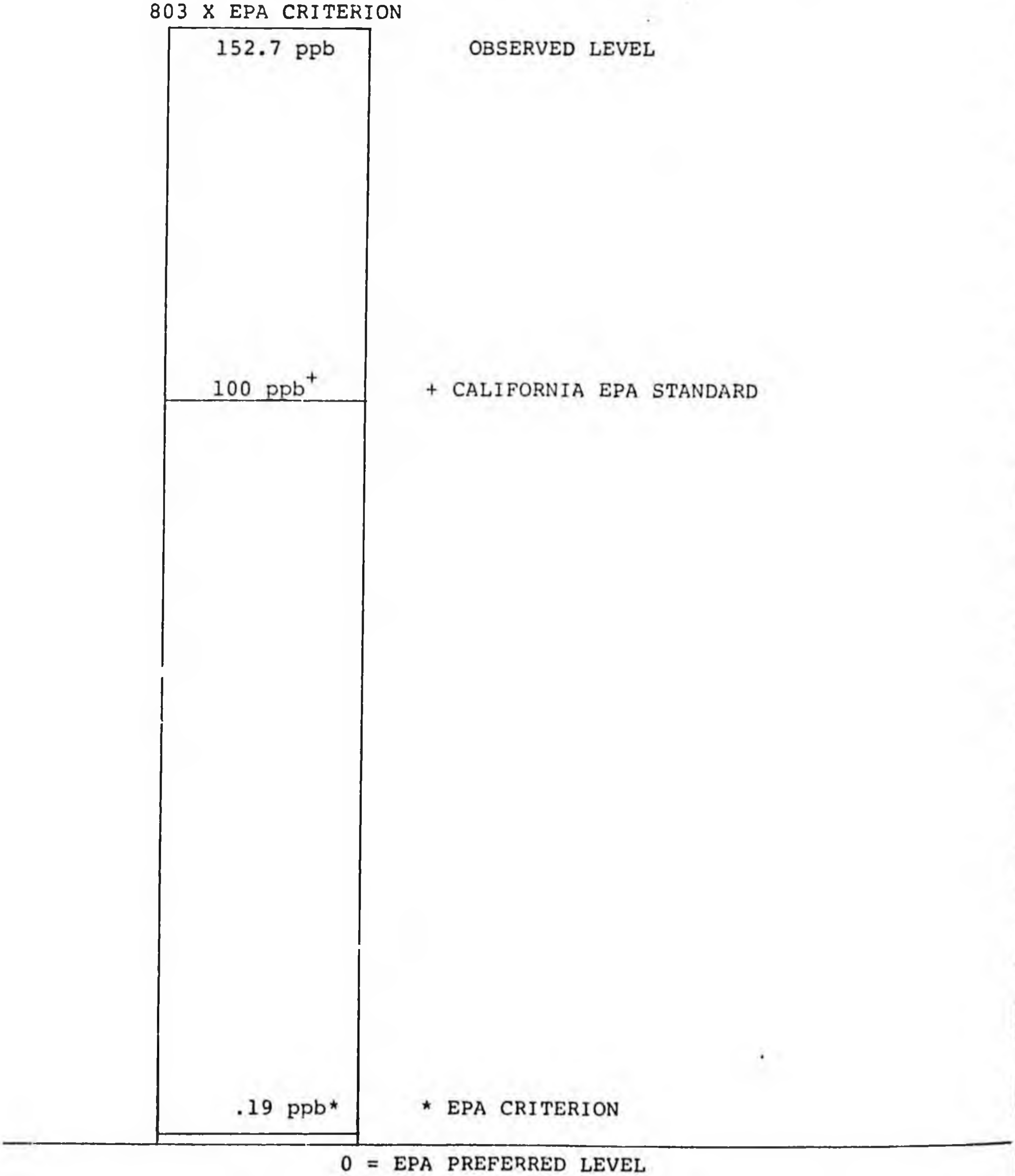
+++ The average total trihalomethanes (77.83) represents a 409-fold increase over the EPA Suggested Water Quality Criterion.

(1) All data in table are from Appendix XI, p.2 of DHS Report. Please see footnote 3 for an explanation of test systems 1-6. Figures shown in boxes exceed either the EPA/California Standard, EPA Suggested Water Quality Criterion, or both.

(2) EPA Suggest Water Quality Criterion, estimated at 10^{-6}. This means that at the stated level of concentration, one person in a million would be expected to get cancer.

FIGURE I

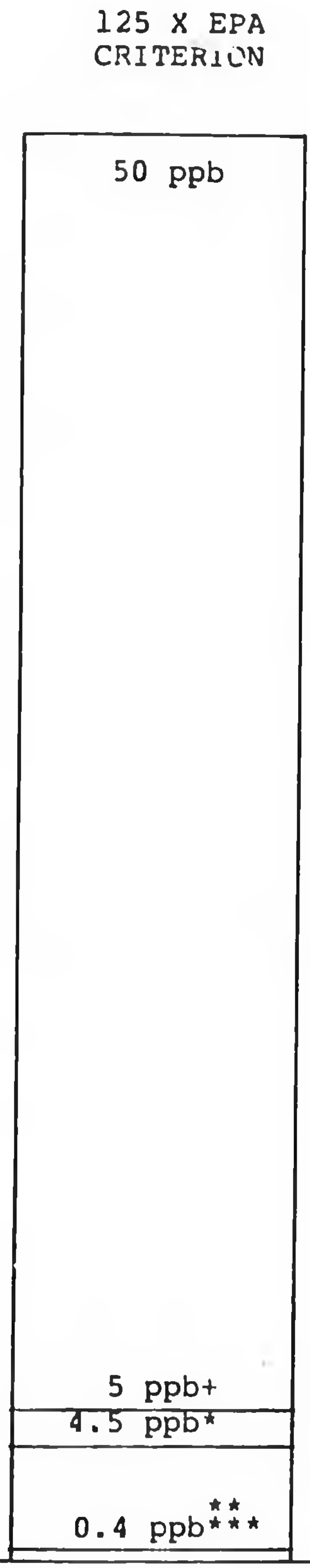
TOTAL TRIHALOMETHANES
(includes CHLOROFORM, DICHLOROBROMOMETHANE, DIBROMOCHLOROMETHANE and BROMOFORM)



EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTECTION OF HUMAN HEALTH.

FIGURE II. Test 4 Result

CARBON TETRACHLORIDE



OBSERVED LEVEL

\+ CALIFORNIA ACTION LEVEL

* NATIONAL ACADEMY OF SCIENCES SNARL (SNARL = Suggested No Affect Response level)

** EPA CANCER ASSESSMENT GROUP SNARL

*** EPA CRITERION

NOTE: The EPA Cancer Assessment Group SNARL and the EPA Criterion are indentical for this compound.

0 = SAFE LEVEL

EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTECTION OF HUMAN HEALTH trichloroethene. The MTL data illustrates an increase as high as 125-fold over the EPA-suggested level for carbon tetrachloride (see Figure II), a 12-fold increase for tetrachloroethene (see Figure III), and in one test system, an excessive level of trichloroethene. (See Table III Test System 5). By California's own action level (5 ppb), the increase is 10-fold for carbon tetrachloride and over 2-fold for tetrachloroethene (see Figures II and III).

III.D. DI-(2-ETHYLHEXYL)PHTHALATE (DEHP)

Recent studies by EPA (11), partially relying on data from the National Cancer Institute, demonstrate the carcinogenicity of DEHP in animals. The EPA study suggests a risk assessment threshold of 3.8 ppb from DEHP-contaminated drinking water.* Although this suggested criterion does not yet have regulatory force, levels up to 246 ppb of DEHP were found in the state's tests 144 hours after filling a CPVC pipe segment. This represents a 64-fold increase over the EPA recommended criterion (see Figure IV). Moreover, preliminary evidence suggests that DEHP and dibutyl phthalate (also found in the MTL tests) migrate more slowly into water after days or weeks of pipe use. The migration is independent of whether the initial joint was "good" or "bad." This suggests an increased appearance of these compounds with time, perhaps due to the aging or fatiguing of the pipe.

III.E. POLYBUTYLENE (PB) TESTS

Polybutylene (PB) does not require solvent formulations for installation. Preliminary tests on this type of pipe were conducted for the same administrative proceeding of the California Housing Commission. The tests were not as comprehensive as the tests on PVC and CPVC. These initial tests were conducted on PB pipe itself, on the assumption that if a chemical were not in the pipe, it would not be found in the water. California Analytical Labs (C.A.L.) conducted two sets of tests on PB pipe. The first test reported 50-500 ppm (mg/kg) of DEHP and a similar amount of butylated hydroxy-toluene (BHT) in the pipe itself. The subsequent test by C.A.L. reported 20-30 ppm (mg/kg) of DEHP. The manufacturer of PB resin (used to manufacture the pipe) sponsored tests on PB pipe by Radian

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* Assuming a person consumes two liters of water per day with an average weight of 70 kg and 100 percent absorption, at a risk of 1×10^{-6}.

TABLE III

Three Volatile Halogenated Compounds in Water (Two Week Static Samples)
Concentration (µg/l) (ppb)

TEST SYSTEM	TEST VARIABLES	CARBON TETRACHLORINE	TETRA-CHLORETHENE	TRI-CHLORETHENE
1	CPVC/Good/Hot Pasadena	32	9.7 ++	0.7
2	CPVC/Poor/Hot Pasadena	21	5.4	0.3
3	CPVC/Good/Cold Pasadena	32	7.6	0.7
4	CPVC/Poor/Cold Pasadena	50 +	7.5	0.7
5	PVC/Good/State Project	0.4	0.1	4.0
6	PVC/Good/Colorado River	0.5	0.1	1.1
CALIFORNIA ACTION LEVEL		5.0	4.0	4.0
EPA SUGGESTED WATER QUALITY CRITERIA		0.4	0.8	2.7

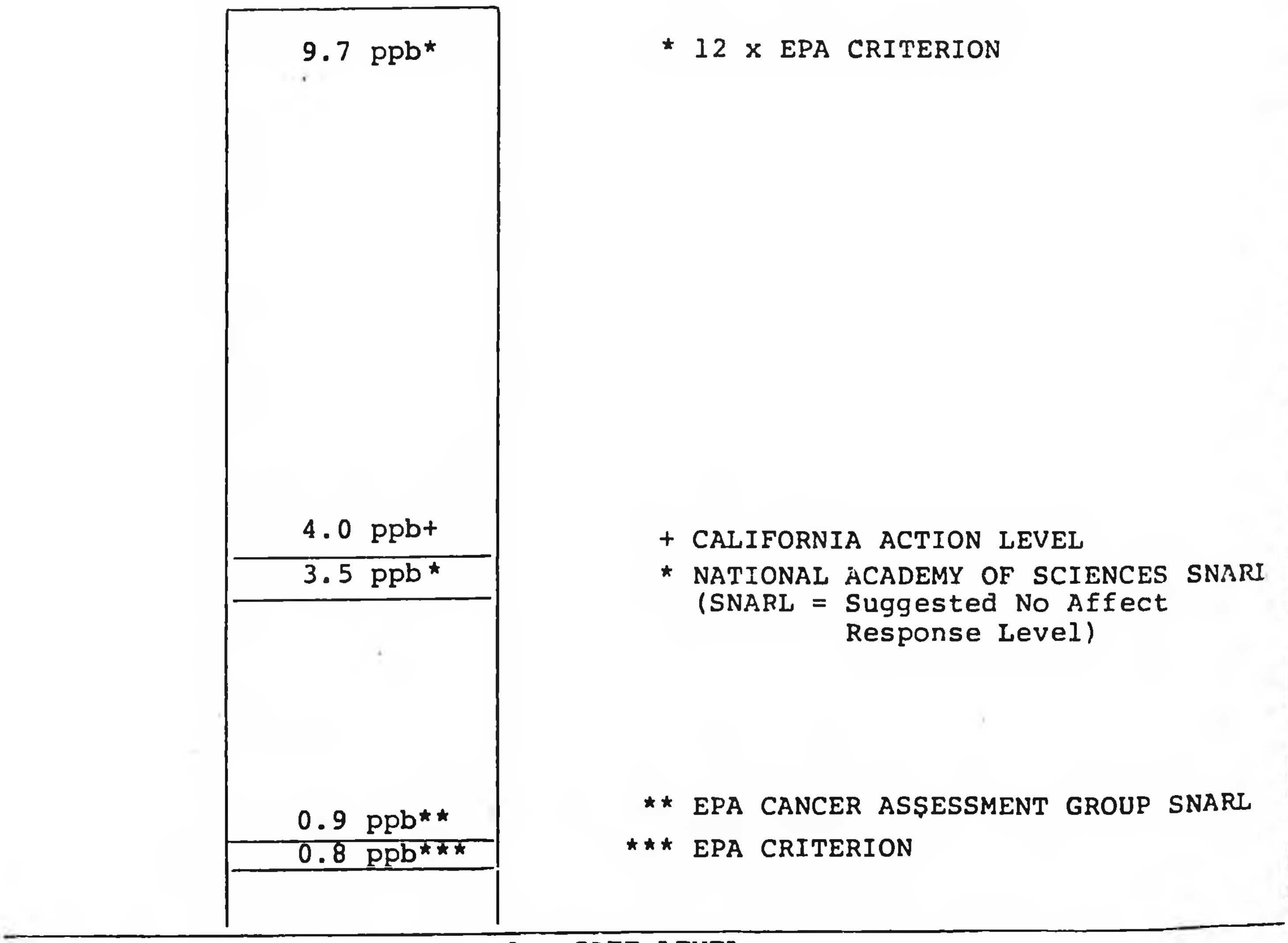
\+ Value represents a ten-fold increase over the California Action Level and 125-fold increase over the EPA Suggested Water Quality Criterion.

++ Value represents a 2-fold increase over the California Action Level and a 12-fold increase over the EPA Suggested Water Quality Criterion.

Note: See reference for decription of test systems. Tests 1-4 were on CPVC, while 5 and 6 were for PVC pipe. Other difference tested were joints and water sources. Figures shown in boxes exceed either the EPA Criterion or the California Action Level.

FIGURE III. Test 1 Result

TETRACHLOROETHENE

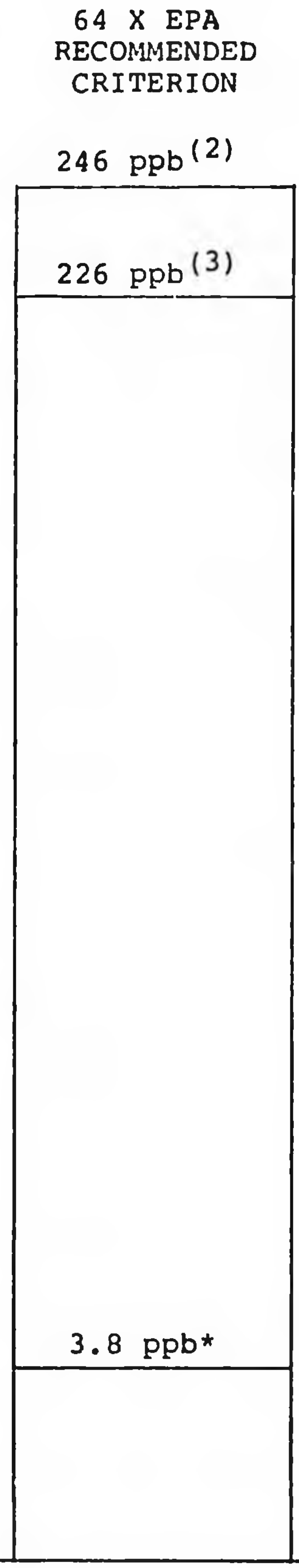


0 = SAFE LEVEL

EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTECTI[ON] OF HUMAN HEALTH

FIGURE IV

Di-(2-ethylhexyl)phthalate (DEHP)
VOLATILE COMPOUND LEVELS FOUND IN TWO STATIC SAMPLES
CONCENTRATION ($\mu g/l$) (ppb) (1)



* EPA SUGGESTED SAFETY LEVEL ESTIMATED AT 1×10^{-6}

(1) Data from Table 3-11 of the Montgomery Study entitled: "Concentration of Volatile Organic and Base Neutral and Acid Extractible Compounds in the Static CPVC/Poor Joints/ Cold Water System." (See Footnote 2.)

(2) Data derived from 144-hour sample time with 24-hour dwell time.

(3) Data derived from 48-hour sample time with 24-hour dwell time.

Laboratories of Sacramento, California and Austin, Texas. These tests stand in stark contrast to tests by C.A.L. Radian's tests reported negligible levels (1 ppm) of DEHP in extracts of PB pipe. Radian also reported the presence of alkylbenzene sulfonate (13). This chemical and BHT (12) are commonly used antioxidants and are currently receiving increased toxicological attention for possible consumer hazards. Simultaneous analysis of samples by both lab groups has not been done. The controversy is unresolved. However, testing of PB pipe in a manner similar to the comprehensive tests on PVC and CPVC will be conducted in the near future under the authority of the California Department of Housing.

4. CONCLUSIONS

Recent tests in California on plastic pipe are the first comprehensive tests run by any government agency. These tests provide a valuable beginning for a complete understanding of the leaching of certain chemicals, some of them known carcinogens, into drinking water from these pipes. Until such time as rigorous investigations are completed, consumers should know that newly installed plastic pipe or water left standing in plastic pipe may well present a potentially serious health hazard.*

Test Results Indicate:

1. A 20-fold increase of THF over the suggested short-term maximum acceptable concentration in "worst case" formulations.

2. A 21-fold increase of DMF over the suggested short-term maximum acceptable concentration in "worst case" formulations.

3. Because of the toxicity of DMF, the California Health Services Department found a substantial potential health hazard for infants in newly plumbed, unflushed homes.

4. Trihalogenated methanes exceeded the EPA action level (100 ppb) in water that has been left standing

---

* The DHS has determined elsewhere that metals from iron or copper pipes are unlikely to pose a human health problem in California residences (14). However, since the report on iron or copper pipes is not a parallel study to this plastic pipe analysis, direct comparisons cannot be made.

for two weeks. Average levels exceed suggested EPA criterion for ambient water by 409-fold and in one instance by 803-fold.

5. Carbon tetrachloride and tetrachloroethene, both suspected human carcinogens, exceeded the EPA suggested criteria by 125-fold and 12-fold, respectively.

6. DEHP, a known animal carcinogen, exceeded the EPA suggested action level by 64-fold.

7. All the reported levels in the Montgomery tests may well have been underestimated by 50 percent because of the concentration of chemicals in the testing equipment and because the test system's pipe configuration did not fully reflect average joint per running foot of pipe.

8. Two tests on polybutylene pipe for potable water systems by C.A.L. reported DEHP in the pipe in varying amounts, in one test up to 500 ppm (mg/kg). Radian Labs reported negligible amounts of DEHP in four (4) tests. The California Department of Housing will conduct further, more comprehensive tests in the near future.

9. Polybutylene pipe appears to contain butylated hydroxy-toluene (BHT) and alkylbenzene sulfonate. Recent toxicological studies raise the question of possible toxic effects of long term ingestion of these compounds.

LIST OF WORKS CONSULTED

1. Wang, T.C., and Bricker, J.L.: "2-Butanone and Tetrahydrofuran contamination in the water supply." Bull. Environ. Contam. Toxicol. 23, 620-623 (1979).

2. James M. Montgomery, Consulting Engineers, Inc.: "Solvent Leaching From Potable Water Plastic Pipes." Final Report of the Hazard Alert System, California Department of Health Services/Department of Industrial Relations. October 1980.

3. The following information outlines the specific differences between the variables included in the six Montgomery test systems mentioned in the text and incorporated into the accompanying tables and charts. Each system is described by pipe system, joint and water source:

Test System 1:	CPVC/Good/Hot Pasadena
Test System 2:	CPVC/Poor/Hot Pasadena
Test System 3:	CPVC/Good/Cold Pasadena
Test System 4:	CPVC/Poor/Cold Pasadena
Test System 5:	PVC/Good/State Project
Test System 6:	PVC/Good/Colorado River

4. "Final Report on Potential Health Hazards Associated With the Use of Plastic Pipe in Potable Water Systems." Hazard Evaluation System and Information Service, Department of Health Services/Department of Industrial Relations. October 17, 1980.

5. Throughout the tables and charts of this chapter, reference is made to "standards," "maximum acceptable levels," "action levels," "suggested water quality criterion," "suggested no-affect response levels" (SNARLS) and "suggested maximum acceptable concentrations" (STMAC). All of these measurements are helpful to a greater understanding of the relative toxicity and potential carcinogenicity of the chemicals in question. They have varying degrees of legal relevance and scientific usefulness.

Only "standards" have binding legal, i.e. mandatory effect. These standards are sometimes called "action levels" or "maximum acceptable levels." The others are suggestive scientific measurements, many times made as "recommendations" for a standard-setting proceeding. It is critical to note that "standards" (and its synonyms) are a combination of recommended scientific levels for safety and economic feasibility factors that are based on the status of current technological equipment. In short, "water quality criteria" and "SNARLS" are the most specific scientific measurement as it relates directly to health and safety for people who drink the water.

Further, "criteria" developed by EPA under the Clean Water Act are normally relevant to ambient water, not tap water. However, if chemicals found in ambient water, e.g. streams, ground water, etc., are not affected by water treatment or may enter potable water systems after treatment, these "criteria" are highly relevant to safety considerations for the consuming public.

Lastly, "criteria" and "SNARLS," whether developed by the National Academy of Science or EPA's Cancer Assessment Group, are usually not aimed at the greatest risk portion of the population, i.e. young children and pregnant women. Rather, they are geared to a general adult population base. As a result, the author has chosen these criteria and SNARLS at a risk level for cancer at 1 X 10-6. In the words of EPA, "the ambient water concentration should be zero based on the non-threshold assumption for (these) chemicals."

Comprehensive public policy assessment of safety factors for drinking water as it affects human health should take all of the above into consideration.

6. "Contamination of Ground Water by Toxic Organic Chemicals." Council on Environmental Quality. January 1981.

7. "Drinking Water and Cancer." Review of Recent Findings and Assessment of Risks." Prepared by Science Research Systems, Inc., for the Council on Environmental Quality. December 1980.

8. "Ambient Water Quality Criteria for Halomethanes.," U.S.E.P.A. 440/5-80-051.

9. "Ambient Water Quality Criteria for Carbon Tetrachloride." U.S.E.P.A. 440/5-80-026, October 1980.

10. "Ambient Water Quality Criteria for Tetrachloroethene." U.S.E.P.A. 440/5-80-026, October 1980.

11. "Priority Review Level 1-Di-(2-ethylhexyl)phthalate (DEHP)." Office of Toxic Substances, U.S.E.P.A. November 28, 1980.

12. Vorhess, C.V., *et al.*: "Developmental neurobehavioral toxicity of butylated hydroxytoluene in rats." *Food Cosmet. Toxicol.* 19, 153-162 (1981).

13. Pigott, G.H., and Ishmael, J. "A comparison between *in vitro* toxicity of PVC powders and their tissue reaction in *in vivo*." *Ann. Occup. Hyg. 22*, 111-119 (1979)

14. DHS Report, *op. cit.* p. 37 (footnote).

Shell Chemical Company
A Division of Shell Oil Company
P.O. Box 7637
Stockton, CA 95207

June 6, 1983

Senator Paul Fisher
Pouch V
Juneau, Alaska 99811

ATTENTION: Elieen Glenn
Administrative Assistant

Dear Ms. Glenn:

I am writing this letter at the suggestion of C. Chuck Dummann of du Alaska Company, Inc. Chuck has informed me that Senator Fisher has introduced Bill #SB-214 that is of great interest to Shell Chemical Company.

The Bill would adopt the 1982 Uniform Plumbing Code as the required Code for the State. Currently the State operates under the 1979 version. While there are several minor changes between 1979 and 1982, there is a major change of importance to us. This change appears in Section 1004. It incorporates the use of polybutylene as an approved plumbing pipe along with the more traditional materials such as copper and galvanized pipe.

For your general information I am enclosing a selection of literature on the subject of polybutylene. As you can see, it is a versatile material capable of performing in many severe conditions.

In addition to these proven performance characteristics there are several reasons particular to the State of Alaska that make the passing of Bill #SB-214 important:

1. The mobile home industry has for years used polybutylene. We estimate over 80 percent of all mobile homes are plumbed with polybutylene. The manufactured housing industry outside of Alaska has a distinct cost advantage over the Alaska based manufacturer. The Alaska builder does not have the advantage of polybutylene's low cost.

2. The low installed cost of polybutylene puts the Alaska builder at a disadvantage to a major portion of the remainder of the United States. Mobile home and manufactured housing builders in other states have the advantage of using polybutylene. This puts the Alaska builder in an uncompetitive situation.

3. In addition to polybutylene's advantages in plumbing application, its use is rapidly growing in fire sprinklers. Polybutylene is now listed by Factory Mutual. Approval of polybutylene in plumbing application would greatly assist its development in the fire sprinkler installation.

4. Given the Alaska climate, polybutylene has a special feature of being freeze resistant. Simply put, properly installed polybutylene will not rupture as will conventional material when frozen.

Thank you for your effort thus far. Polybutylene is a proven material around the United States and around the world and belongs as a material available to the people of Alaska.

I am ready to come to Juneau to testify or speak to anyone on the subject if it would be helpful.

I hope that Senator Fisher will make every effort possible to move this Bill forward.

Very truly yours,

M. J. O'Brien/ja

M. J. O'Brien
Regional Sales Manager
Polybutylene Department

MJO/ja

Enclosures

cc: Chuck Dummann
Gordon Evans
Ely, Guess and Rudd
Juneau, Alaska

Bill No. Senate Bill 214   Date April 12, 1983

Title "An Act relating to the Plumbing Code."   Contact: Judy Knight
465-2700
Bob Bacolas

Every three years, the International Association of Plumbing and Mechanical Officials revises its minimum standards for the installation of plumbing to incorporate technological advances. The 1982 code described in this bill is the most recent effort in this regard. The 1979 code presently in effect for the State of Alaska is therefore outdated and will not be reprinted by the International Association of Plumbing and Mechanical Officials.

Adoption of the 1982 Uniform Plumbing Code would bring Alaska's minimum standards into conformity with those commonly accepted and used by industry across the nation. The latest edition of the Uniform Plumbing Code is also commonly adopted by political subdivisions in the state as the minimum standards enforced under their building inspection programs.

The Department of Labor support passage of this bill. It would not have any fiscal impact.

APPROVED:

[signature]

POSITION PAPER/Department of Labor

Table V-1

RELATIVE DEGREE OF CONCERN REGARDING
POTENTIAL ENVIRONMENTAL IMPACTS*

	Potable Water				Drain, Waste, and Vent			
	Plastic		Metal		Plastic		Metal	
Impact Area	PB/PE	PVC/CPVC	Copper	Galv. Steel	ABS	PVC/CPVC	Copper/ Gal.Steel	Ca Ir
Public Health	3	4	3	3	0	0	0	[illegible]
Worker Safety	1	2	4	2	2	2	3+	[illegible]
Worker Health	0	3	4	2	4	4	3+	[illegible]
Fire Safety	3	2	0	0	5	4	0	[illegible]
Smoke Toxicity	1	3	0	0	3	5	0	[illegible]
Other Impacts	0	0	0	0	1	1	0	[illegible]

*Key:
0 - No concern
1 - Considerably less concern than average
2 - Less concern than average
3 - About average concern
4 - More concern than average
5 - Considerably more concern than average

Note: High relative concern does not necessarily imply high absolute concern; significance of ratings depends on mitigation measures taken.

+More for copper, less for galvanized.

P.O. BOX 1079 SACRAMENTO 95805
1500 5TH STREET, SACRAMENTO 95814 • DEPARTMENT OF GENERAL SERVICES • STATE OF CALIFORNIA • EDMUND G. BROWN JR., GOVERNOR

Office of the State Architect

OFFICE OF THE STATE ARCHITECT
ADVISORY BULLETIN

DECEMBER 31, 1982

TO: ARCHITECTS, ENGINEERS, SCHOOL DISTRICTS AND COUNTY SUPERINTENDENTS

RE: USE OF PLASTIC PIPE IN PUBLIC SCHOOL BUILDINGS

The Structural Safety Section of the Office of the State Architect (OSA/SSS), which is charged with administering the "Field Act", has responded as follows to inquiries regarding the use of plastic piping in public school construction:

1. The current State Building Standard which applies to plumbing systems in public schools is the State Plumbing Code, Part 5 of Title 24, CAC, issued in Register 68, No. 41 dated November 2, 1968.

2. The restrictions on materials which can be used for piping and fittings for drainage systems, vent systems or water distribution systems are contained in Article P2 of Part 5, Title 24. In addition to the specific materials listed in Section P208, P211, P212 and P215 of Article P2, provision is made for use of "other approved materials" as determined by the enforcing authority.

3. The State Architect had determined in 1974 that in public school projects plastic pipe of the appropriate type and class could be used only for vent piping in buildings; waste lines in portable buildings; drains carrying acid wastes from laboratories; and plumbing lines carrying gas, water and drainage wastes underground outside of buildings. This has been the policy enforced by OSA/SSS since that date.

4. On the 10 November 1982 the Division of Codes and Standards of the Department of Housing and Community Development issued an Informational Bulletin No. SH 82-5 regarding plastic piping systems which states in part:

   "The Department of Housing and Community Development (HCD) has undertaken an Environmental Impact Report under the provisions of the California Environmental Quality Act before authorizing the expanded use of plastic pipe.

The Environmental Impact Report is required because a significant controversy exists, and because evidence exists, although disputed, that plastic pipe may cause actual or potential significant adverse environmental or public health effects by leaching hazardous or carcinogenic chemicals, and/or may pose fire safety or worker safety hazards. The types of pipe being studied are PVC, CPVC, and PB for potable water and ABS and PVC for drain, waste and vent.

The Environmental Impact Report will also evaluate existing uses of plastic and metal pipe. Until the Environmental Impact Report is completed and reviewed, the expanded use of plastic pipe is not approved by the state* beyond the uses adopted by the state in 1979**."

* (For residential uses.)
** (Uniform Plumbing Code, 1979 Edition)

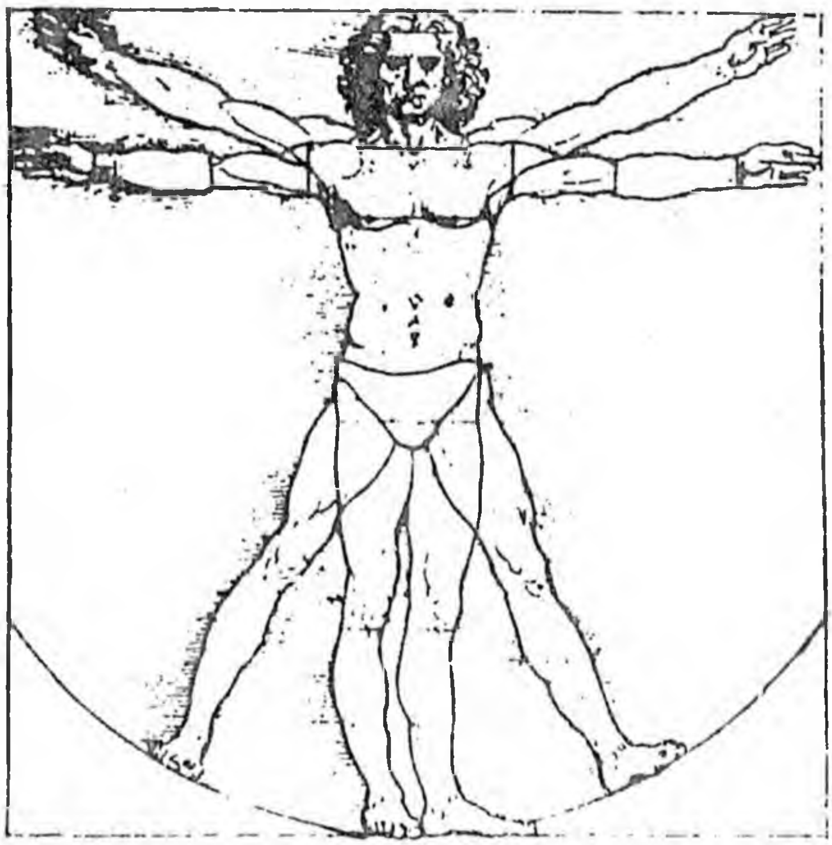
5. Because of the particular concerns raised regarding the potential health hazards that may exist when plastic pipe is used in transporting potable water for use by school age children the Office of the State Architect is recommending that plastic pipe not be used on school sites for potable water distribution systems until the Environmental Impact Report being prepared by HCD is completed and reviewed.

6. Until the results of the Environmental Impact Report are reviewed and evaluated the OSA/SSS will continue to limit the use of plastic pipe for plumbing systems in public school projects to vent piping in buildings, waste lines in portable buildings and drains carrying acid wastes from laboratories.

Barry J. Wasserman
State Architect
(916) 445-4167

DKJ:dw

CLEAN YOUR ROOM!



A COMPENDIUM ON INDOOR POLLUTION

DEPARTMENT OF CONSUMER AFFAIRS

N. PLASTIC PIPE FOR POTABLE WATER

A new kind of piping is being introduced that raises questions about the quality of potable water that it delivers. Recent tests suggest that such water may contain organic chemicals, principally plasticizers and solvents, most introduced into the environment within the last generation.

Chemical analyses have raised serious questions about the health effects of known carcinogens in certain types of plastic pipe. For example, tests of one kind of plastic pipe showed toxic chemicals leaching from the pipe in amounts greatly exceeding federal water quality criteria. The Federal Environmental Protection Agency's level for chloroform was exceeded by up to 800 times, carbon tetrachloride by up to 125 times, tetrachloroethene by up to 12 times, and DEHP by up to 64 times. In addition to being carcinogenic, DEHP can cause serious reproductive and birth defects.

Plastic pipe represents a specific example of the generic way in which we are restructuring our indoor environment. Thus, a discussion of this topic belongs in our consideration of indoor environmental quality.

4 01 07 5

Chapter III.N

PLASTIC PIPE FOR POTABLE WATER

1. SUMMARY

The general topic of the quality of potable water is beyond the scope of this study. However, a new kind of piping is being introduced that raises questions about the quality of the potable water that it delivers. Recent tests suggest that such water may contain organic chemicals, principally plasticizers and solvents, most of which were introduced into the environment within the last generation. Several are known or suspected carcinogens. Plastic pipe represents a specific example of the generic way in which we are restructuring our indoor environment. Thus, a discussion of this topic belongs in our consideration of indoor environment quality. What, if any, government actions are called for is a timely challenge.

2. BACKGROUND

Residential plumbing contractors in certain parts of the country are beginning to utilize plastic pipe for potable water distribution. Polyvinyl chloride (PVC) plastic pipe is used from the property line to the house, and chlorinated polyvinyl chloride (CPVC) plastic pipe is used for potable water distribution within a residence. Each of these pipes requires a host of formulations called primers, degreasers and sealant cements which contain organic solvents (for installation). These formulations rely principally on four major solvents for their major constituents - methyl ethyl ketone (MEK), dimethylformamide (DMF), cyclohexanone (CH) and tetrahydrofuran (THF). Other chemicals are substituted from time to time, such as methyl butyl ketone. Government agencies have not yet examined the safety or purity of ingredients in these formulations.

Because of sporadic, unexplained symptomatology reported by some plumbers who install plastic pipe,* the California Health Services Department (DHS) conducted exhaustive bibliographic research on the toxicology of the solvents. Tentative association between symptoms and toxic effects on the liver and central nervous system (CNS) prompted concern. An article indicating that plastic pipe leaches its solvents into drinking water was uncovered.

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* The pipes are cut, usually at the construction site, and installed by way of primers and cements, through various configurations and joints. The joint per foot of pipe for CPVC (inside residences) averages 1 joint per 1-1/2 foot of pipe.

DHS was unable to find any further research on this subject. Because plastic pipe for potable water in California is in the initial stages of code approval by the State's Housing Commission and by one model code organization, and because of the potential for consumer exposure to toxic chemcials, DHS decided that more comprehensive research on the leaching phenomenon was necessary.

3. THE MONTGOMERY STUDY ON PVC & CPVC PLASTIC PIPE

DHS commissioned the Montgomery Testing Laboratory (MTL) to conduct the first government-authorized study to measure the amount of solvents that leached into drinking water from plastic pipe (2). These tests provided the first substantive evidence that certain plastic pipe for potable water systems may pose a health hazard for consumers.

Two exposure conditions were simulated in the study. The first, using static systems, simulated leaching in newly constructed plumbing systems (PVC and CPVC) in which water is allowed to remain stagnant for a period of time prior to the occupation of a new dwelling, or during any prolonged absence from a dwelling.

The second condition, simulating normal household usage, employed CPVC pipe. Hot and cold water were used for both sets of tests, as well as "good" and "poor" joints*and various types of water (3).

The precision of the analytic instruments was reduced by the high concentration of solvents found in the system. Also, the study design itself underestimated average joint per running foot of pipe. Thus, DHS estimated that laboratory values understated true exposure by as much as 50 percent.

3.A. TEST RESULTS

Results of the MTL tests were analyzed by DHS (4). Since none of the solvents had previously been found in potable water, DHS developed long-term and short-term exposure limits by reference to available literature, mostly based on industrial exposure. (Table I)

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* Care was taken to prevent any excess of primers and cements in the "good" joints. Normal installation procedures were used for "poor" joints.

TABLE I

California Department of Health Suggested Maximum Acceptable Concentration of Solvents in Potable Water (in ppm)

	Long-term Exposure	Short-term Exposure
A. Methyl ethyl ketone (MEK)	36 ppm	360 ppm
B. Tetrahydrofuran (THF)	36 ppm	360 ppm
C. Cyclohexanone (CH)	17 ppm	170 ppm
D. Dimethylformamide (DMF)	1.8 ppm	3.6 ppm

NOTE: Concentration expressed in parts per billion are 1,000 times these values.

Based on DHS exposure criteria, the combined concentrations of the major solvents came to within 75 and 80 percent of the suggested short-term maximum acceptable concentration (STMAC). Assuming a possible underestimation of 50 percent, the true values may actually be above the suggested STMAC. Both THF and DMF actually exceeded the short-term maximum acceptable concentration suggested by DHS (5).

According to data analysis by DHS, in "worst case" formulations (ingestion of powdered infant formula prepared with tap water), the suggest STMAC (18 ppm) is greatly exceeded by measured values -- as much as twenty-fold -- in the case of THF (375 ppm). DMF also exceeded the "worst case" suggested STMAC (0.2 ppm) by twenty-one fold (4.3 ppm). The DHS found this amount to suggest a "substantial potential hazard for infants in newly-plumbed, unflushed homes."*

While the carcinogenicity of DMF has not been sufficiently studied, the National Cancer Institute plans a three-year carcinogenicity test to assess the

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* There has been considerable scientfic debate on the question of whether flushing newly plumbed systems decreases or increases the risk of exposures. Statistical evidence varies depending on the variables of elapsed time and dwell time, as well as the chemical's solubility or insolubility. Moreover, as discussed below, what may happen with the components of the formulations may be the reverse for volatile organics.

potential of DMF for producing cancer. Similar testing is planned by the National Institute for Occupational Safety and Health (NIOSH) on the toxicity of THF and CH.

III.B. HALOGENATED COMPOUNDS FOUND

In addition to solvents, the MTL data show that water that has been left standing for two weeks can accumulate over 100 ppb (the EPA standard) of the trihalogenated methanes. DHS hypothesized that these compounds may have come from the pipe itself and not from the solvent (See Table II).

Preliminary epidemiological studies prepared by the Environmental Protection Agency (EPA) for the Council on Environmental Quality (CEQ) have considerably strengthened the evidence linking elevated risks of cancer with chloroform, bromoform, dichlorobromomethane and dibromochloromethane (6,7,8). Moreover, EPA suggests a water quality criterion for total trihalomethanes in ambient water at zero (0). Because of technological and economic feasibility factors, however, the proposed criterion is set at 0.19 ppb. If this measurement is followed, the average total trihalomethanes (77.8 ppb) represents a 409-fold increase over the EPA suggested criterion. In one pipe test system, the amount of total trihalomethanes (152.7 ppb) represents a level equal to 803 times the suggested criterion. (see Figure I)

III.C. CARBON TETRACHLORIDE, TETRACHOLOROETHENE AND TRICHOLOROETHANE

Excessive levels of these chemicals were also found in the MTL data (see Table III). Because of the cancer risks associated with all of these chemicals, EPA suggests zero as the safe, i.e. non-threshold assumption level.

The EPA suggested water quality criterion under the Clean Water Act is 0.4 ppb for carbon tetrachloride (9), 0.8 ppb for tetrachloroethene (10) and 2.7 ppb for

TABLE II

FOUR VOLATILE HALOGENATED COMPOUNDS IN WATER (TWO WEEKS STATIC SAMPLES)

CONCENTRATED (ug/l) (ppb)[1]

TEST SYSTEM	TEST VARIABLES	CHLOROFORM	DICHLORO-BROMOMETHANE	DIBROMO-CHLOROMETHANE	BROMOFORM	TOTAL TRI-HALOMETHANES*	
1	CPVC/Good/ Hot Pasadena	92	3.0	2.4	0.7	98.1	(31.5)++
2	CPVC/Poor/ Hot Pasadena	69	3.3	3.0	1.3	76.6	(31.5)++
3	CPVC/Good/ Cold Pasadena	78	3.5	2.9	0.9	85.3	(32.6)++
4	CPVC/Poor/ Cold Pasadena	146	3.3	2.6	0.8	152.7	(32.6)++
5	PVC/Good/ State Project	3.1	0.2	0.1	ND	3.4	(0.1) ++
6	PVC/Good/ Colorado River	25	12	11	2.4	50.4	(53) ++
TOTAL (average)						77.83 +++	
EPA/CALIFORNIA STANDARD						100	
EPA SUGGESTED WATER QUALITY CRITERIA[2]		0.19				0.19	

* Value represents a 1.5-fold increase over the EPA/California Standard and a 768-fold increase over the EPA Suggested Water Quality Criterion.

++ Values in parentheses represent total of all four individually listed trihalomethanes from control samples, i.e. not passed through pipe system.

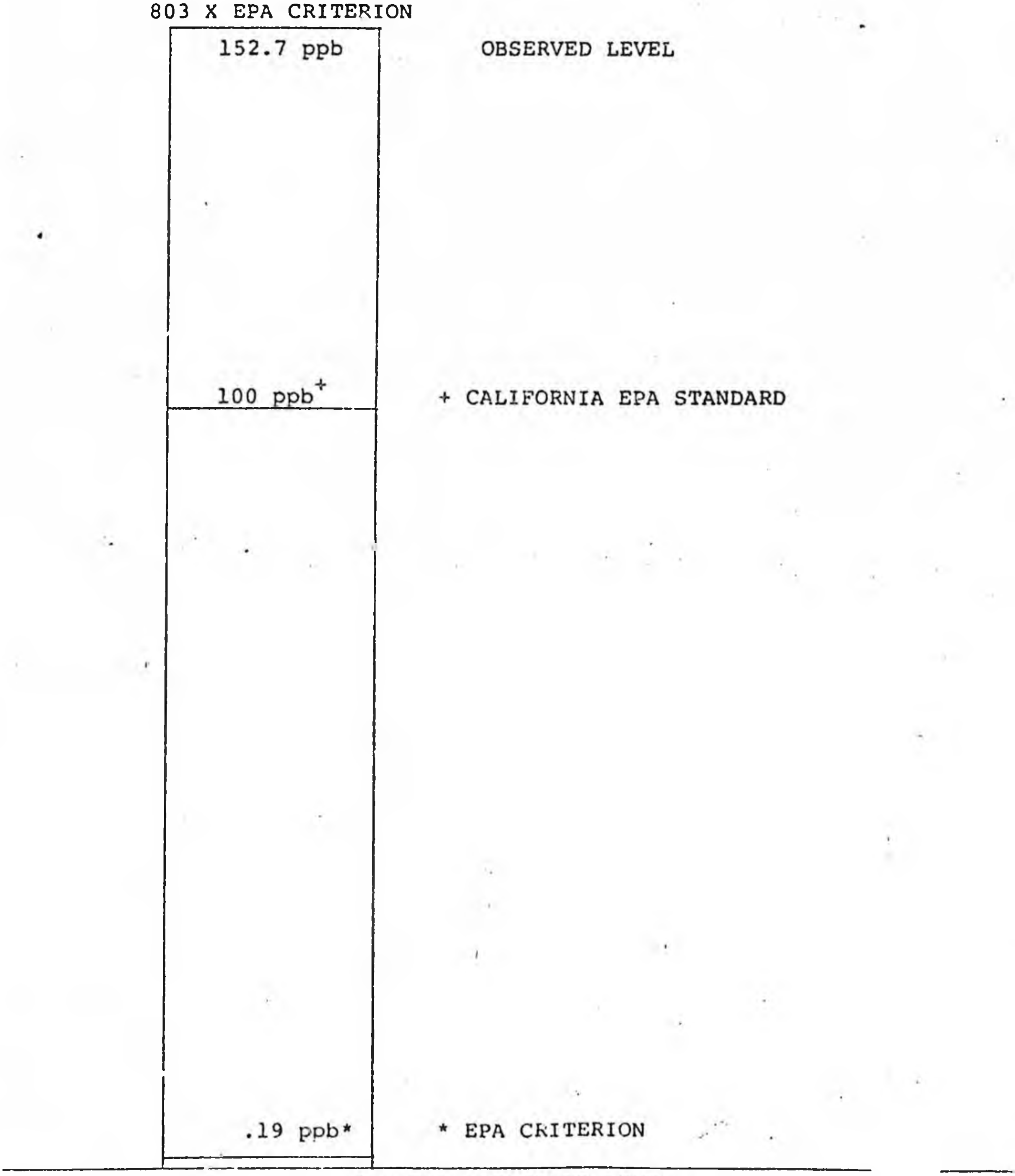
+++ The average total trihalomethanes (77.83) represents a 409-fold increase over the EPA Suggested Water Quality Criterion.

(1) All data in table are from Appendix XI, p.2 of DHS Report. Please see footnote 3 for an explanation of test systems 1-6. Figures shown in boxes exceed either the EPA/California Standard, EPA Suggested Water Quality Criterion, or both.

(2) EPA Suggest Water Quality Criterion, estimated at 10^{-6}. This means that at the stated level of concentration, one person in a million would be expected to get cancer.

FIGURE I

TOTAL TRIHALOMETHANES
(includes CHLOROFORM, DICHLOROBROMOMETHANE,
DIBROMOCHLOROMETHANE and BROMOFORM)

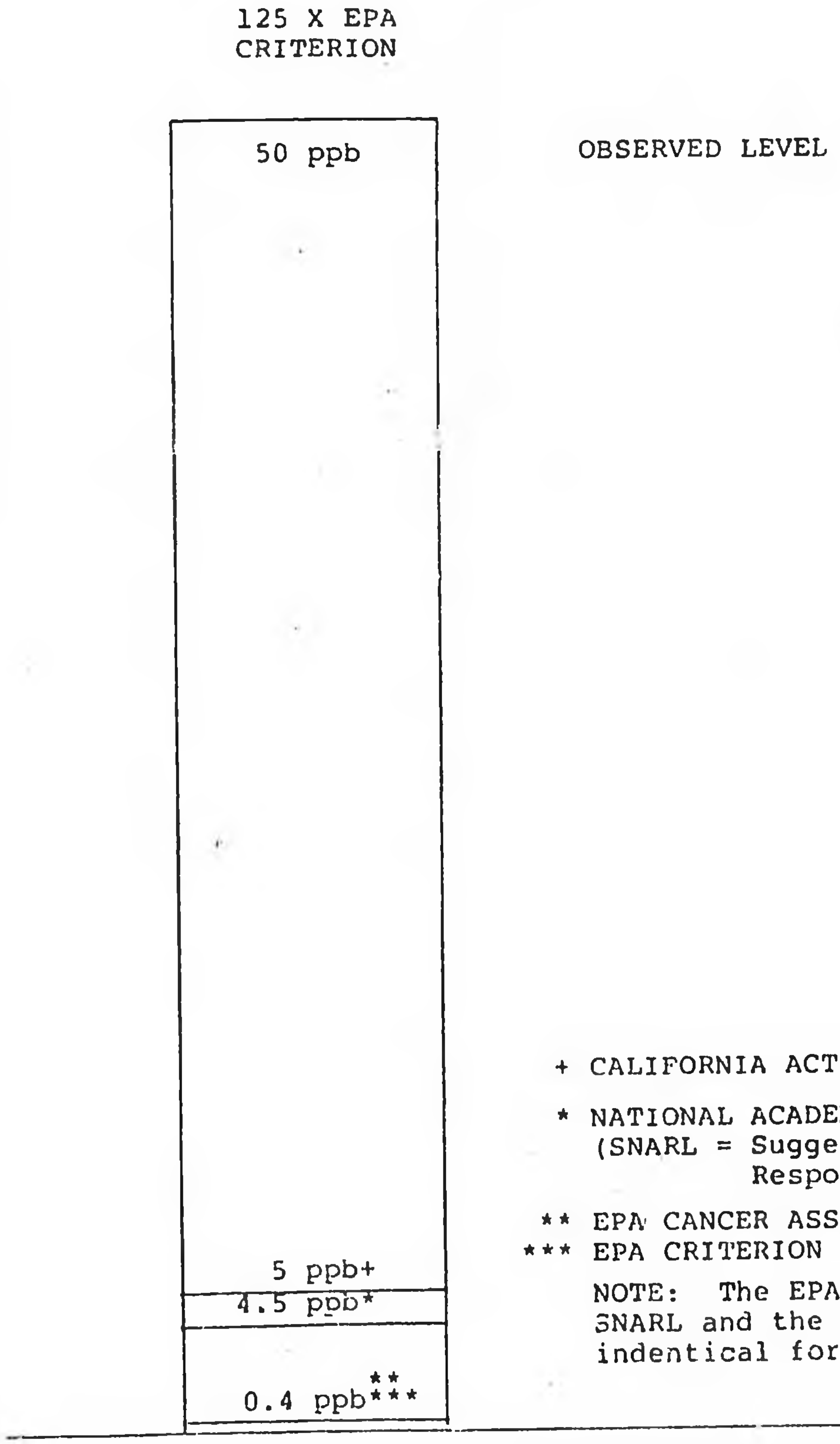


0 = EPA PREFERRED LEVEL

EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTECTI
OF HUMAN HEALTH.

FIGURE II. Test 4 Result

CARBON TETRACHLORIDE



\+ CALIFORNIA ACTION LEVEL

* NATIONAL ACADEMY OF SCIENCES SNARL (SNARL = Suggested No Affect Response level)

** EPA CANCER ASSESSMENT GROUP SNARL

*** EPA CRITERION

NOTE: The EPA Cancer Assessment Group SNARL and the EPA Criterion are indentical for this compound.

0 = SAFE LEVEL

EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTECTI(OF HUMAN HEALTH trichloroethene. The MTL data illustrates an increase as high as 125-fold over the EPA-suggested level for carbon tetrachloride (see Figure II), a 12-fold increase for tetrachloroethene (see Figure III), and in one test system, an excessive level of trichloroethene. (See Table III Test System 5). By California's own action level (5 ppb), the increase is 10-fold for carbon tetrachloride and over 2-fold for tetrachloroethene (see Figures II and III).

III.D. DI-(2-ETHYLHEXYL)PHTHALATE (DEHP)

Recent studies by EPA (11), partially relying on data from the National Cancer Institute, demonstrate the carcinogenicity of DEHP in animals. The EPA study suggests a risk assessment threshold of 3.8 ppb from DEHP-contaminated drinking water.* Although this suggested criterion does not yet have regulatory force, levels up to 246 ppb of DEHP were found in the state's tests 144 hours after filling a CPVC pipe segment. This represents a 64-fold increase over the EPA recommended criterion (see Figure IV). Moreover, preliminary evidence suggests that DEHP and dibutyl phthalate (also found in the MTL tests) migrate more slowly into water after days or weeks of pipe use. The migration is independent of whether the initial joint was "good" or "bad." This suggests an increased appearance of these compounds with time, perhaps due to the aging or fatiguing of the pipe.

III.E. POLYBUTYLENE (PB) TESTS

Polybutylene (PB) does not require solvent formulations for installation. Preliminary tests on this type of pipe were conducted for the same administrative proceeding of the California Housing Commission. The tests were not as comprehensive as the tests on PVC and CPVC. These initial tests were conducted on PB pipe itself, on the assumption that if a chemical were not in the pipe, it would not be found in the water. California Analytical Labs (C.A.L.) conducted two sets of tests on PB pipe. The first test reported 50-500 ppm (mg/kg) of DEHP and a similar amount of butylated hydroxy-toluene (BHT) in the pipe itself. The subsequent test by C.A.L. reported 20-30 ppm (mg/kg) of DEHP. The manufacturer of PB resin (used to manufacture the pipe) sponsored tests on PB pipe by Radian

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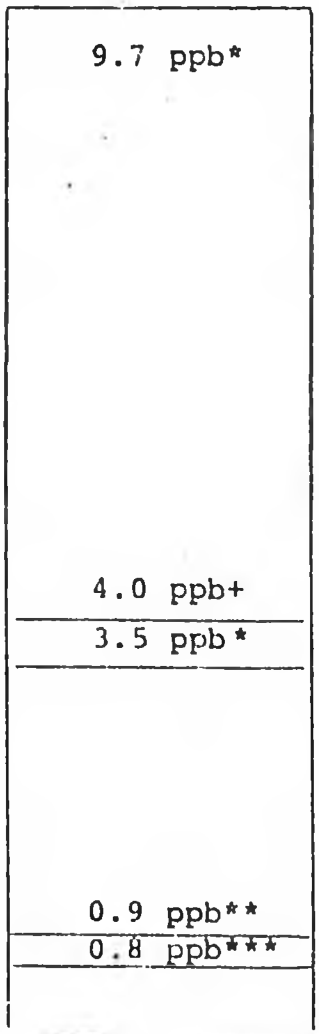
* Assuming a person consumes two liters of water per day with an average weight of 70 kg and 100 percent absorption, at a risk of 1 X 10-6.

FIGURE III. Test 1 Result

TETRACHLOROETHENE



* 12 x EPA CRITERION

\+ CALIFORNIA ACTION LEVEL

* NATIONAL ACADEMY OF SCIENCES SNAR
(SNARL = Suggested No Affect Response Level)

** EPA CANCER ASSESSMENT GROUP SNARL

*** EPA CRITERION

0 = SAFE LEVEL

EPA SUGGESTED AMBIENT WATER CONCENTRATION SHOULD BE 0 FOR MAXIMUM PROTEC OF HUMAN HEALTH

TABLE III

Three Volatile Halogenated Compounds in Water (Two Week Static Samples)
Concentration (μg/l) (ppb)

TEST SYSTEM	TEST VARIABLES	CARBON TETRACHLORINE	TETRA-CHLORETHENE	TRI-CHLORETHENE
1	CPVC/Good/Hot Pasadena	32	9.7 ++	0.7
2	CPVC/Poor/Hot Pasadena	21	5.4	0.3
3	CPVC/Good/Cold Pasadena	32	7.6	0.7
4	CPVC/Poor/Cold Pasadena	50 +	7.5	0.7
5	PVC/Good/State Project	0.4	0.1	4.0
6	PVC/Good/Colorado River	0.5	0.1	1.1
CALIFORNIA ACTION LEVEL		5.0	4.0	4.0
EPA SUGGESTED WATER QUALITY CRITERIA		0.4	0.8	2.7

+ Value represents a ten-fold increase over the California Action Level and 125-fold increase over the EPA Suggested Water Quality Criterion.

++ Value represents a 2-fold increase over the California Action Level and a 12-fold increase over the EPA Suggested Water Quality Criterion.

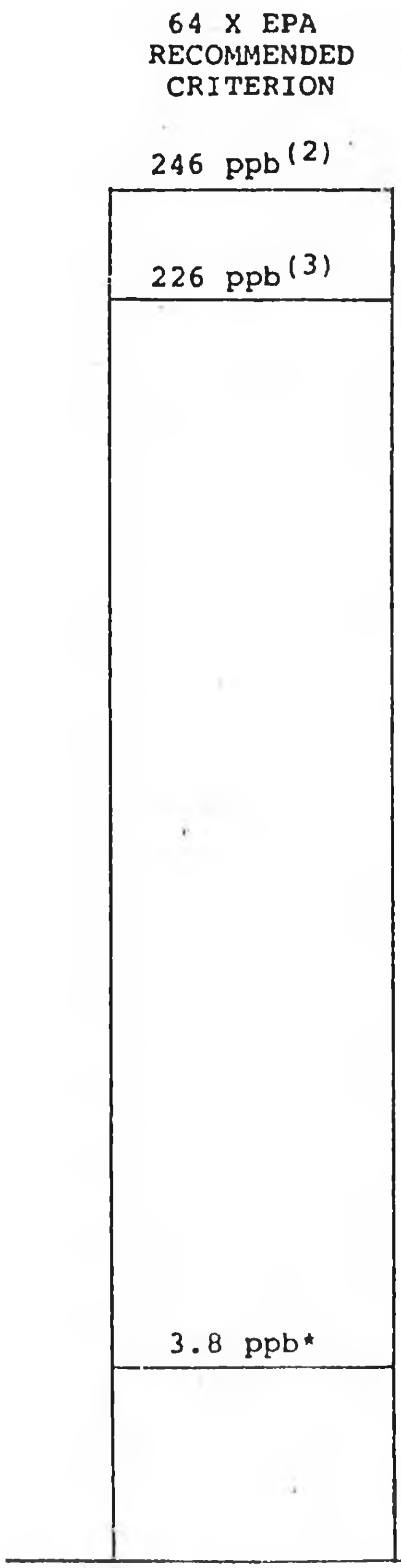
Note: See reference for decription of test systems. Tests 1-4 were on CPVC, while 5 and 6 were for PVC pipe. Other difference tested were joints and water sources. Figures shown in boxes exceed either the EPA Criterion or the California Action Level.

FIGURE IV

Di-(2-ethylhexyl)phthalate (DEHP)

VOLATILE COMPOUND LEVELS FOUND IN TWO STATIC SAMPLES

CONCENTRATION (μg/l) (ppb) (1)



* EPA SUGGESTED SAFETY LEVEL ESTIMATED AT 1 X 10^{-6}

(1) Data from Table 3-11 of the Montgomery Study entitled: "Concentration of Volatile Organic and Base Neutral and Acid Extractible Compounds in the Static CPVC/Poor Joints/ Cold Water System." (See Footnote 2.)

(2) Data derived from 144-hour sample time with 24-hour dwell time.

(3) Data derived from 48-hour sample time with 24-hour dwell time.

Laboratories of Sacramento, California and Austin, Texas. These tests stand in stark contrast to tests by C.A.L. Radian's tests reported negligible levels (1 ppm) of DEHP in extracts of PB pipe. Radian also reported the presence of alkylbenzene sulfonate (13). This chemical and BHT (12) are commonly used antioxidants and are currently receiving increased toxicological attention for possible consumer hazards. Simultaneous analysis of samples by both lab groups has not been done. The controversy is unresolved. However, testing of PB pipe in a manner similar to the comprehensive tests on PVC and CPVC will be conducted in the near future under the authority of the California Department of Housing.

4. CONCLUSIONS

Recent tests in California on plastic pipe are the first comprehensive tests run by any government agency. These tests provide a valuable beginning for a complete understanding of the leaching of certain chemicals, some of them known carcinogens, into drinking water from these pipes. Until such time as rigorous investigations are completed, consumers should know that newly installed plastic pipe or water left standing in plastic pipe may well present a potentially serious health hazard.*

Test Results Indicate:

1. A 20-fold increase of THF over the suggested short-term maximum acceptable concentration in "worst case" formulations.

2. A 21-fold increase of DMF over the suggested short-term maximum acceptable concentration in "worst case" formulations.

3. Because of the toxicity of DMF, the California Health Services Department found a substantial potential health hazard for infants in newly plumbed, unflushed homes.

4. Trihalogenated methanes exceeded the EPA action level (100 ppb) in water that has been left standing

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* The DHS has determined elsewhere that metals from iron or copper pipes are unlikely to pose a human health problem in California residences (14). However, since the report on iron or copper pipes is not a parallel study to this plastic pipe analysis, direct comparisons cannot be made.

for two weeks. Average levels exceed suggested EPA criterion for ambient water by 409-fold and in one instance by 803-fold.

5. Carbon tetrachloride and tetrachloroethene, both suspected human carcinogens, exceeded the EPA suggested criteria by 125-fold and 12-fold, respectively.

6. DEHP, a known animal carcinogen, exceeded the EPA suggested action level by 64-fold.

7. All the reported levels in the Montgomery tests may well have been underestimated by 50 percent because of the concentration of chemicals in the testing equipment and because the test system's pipe configuration did not fully reflect average joint per running foot of pipe.

8. Two tests on polybutylene pipe for potable water systems by C.A.L. reported DEHP in the pipe in varying amounts, in one test up to 500 ppm (mg/kg). Radian Labs reported negligible amounts of DEHP in four (4) tests. The California Department of Housing will conduct further, more comprehensive tests in the near future.

9. Polybutylene pipe appears to contain butylated hydroxy-toluene (BHT) and alkylbenzene sulfonate. Recent toxicological studies raise the question of possible toxic effects of long term ingestion of these compounds.

LIST OF WORKS CONSULTED

1. Wang, T.C., and Bricker, J.L.. "2-Butanone and Tetrahydrofuran contamination in the water supply." Bull. Environ. Contam. Toxicol. 23, 620-623 (1979).

2. James M. Montgomery, Consulting Engineers, Inc.: "Solvent Leaching From Potable Water Plastic Pipes." Final Report of the Hazard Alert System, California Department of Health Services/Department of Industrial Relations. October 1980.

3. The following information outlines the specific differences between the variables included in the six Montgomery test systems mentioned in the text and incorporated into the accompanying tables and charts. Each system is described by pipe system, joint and water source:

Test System 1:	CPVC/Good/Hot Pasadena
Test System 2:	CPVC/Poor/Hot Pasadena
Test System 3:	CPVC/Good/Cold Pasadena
Test System 4:	CPVC/Poor/Cold Pasadena
Test System 5:	PVC/Good/State Project
Test System 6:	PVC/Good/Colorado River

4. "Final Report on Potential Health Hazards Associated With the Use of Plastic Pipe in Potable Water Systems." Hazard Evaluation System and Information Service, Department of Health Services/Department of Industrial Relations. October 17, 1980.

5. Throughout the tables and charts of this chapter, reference is made to "standards," "maximum acceptable levels," "action levels," "suggested water quality criterion," "suggested no-affect response levels" (SNARLS) and "suggested maximum acceptable concentrations" (STMAC). All of these measurements are helpful to a greater understanding of the relative toxicity and potential carcinogenicity of the chemicals in question. They have varying degrees of legal relevance and scientific usefulness.

   Only "standards" have binding legal, i.e. mandatory effect. These standards are sometimes called "action levels" or "maximum acceptable levels." The others are suggestive scientific measurements, many times made as "recommendations" for a standard-setting proceeding. It is critical to note that "standards" (and its synonyms) are a combination of recommended scientific levels for safety and economic feasibility factors that are based on the status of current technological equipment. In short, "water quality criteria" and "SNARLS" are the most specific scientific measurement as it relates directly to health and safety for people who drink the water.

Further, "criteria" developed by EPA under the Clean Water Act are normally relevant to ambient water, not tap water. However, if chemicals found in ambient water, e.g. streams, ground water, etc., are not affected by water treatment or may enter potable water systems after treatment, these "criteria" are highly relevant to safety considerations for the consuming public.

Lastly, "criteria" and "SNARLS," whether developed by the National Academy of Science or EPA's Cancer Assessment Group, are usually not aimed at the greatest risk portion of the population, i.e. young children and pregnant women. Rather, they are geared to a general adult population base. As a result, the author has chosen these criteria and SNARLS at a risk level for cancer at 1 X 10-6. In the words of EPA, "the ambient water concentration should be zero based on the non-threshold assumption for (these) chemicals."

Comprehensive public policy assessment of safety factors for drinking water as it affects human health should take all of the above into consideration.

6. "Contamination of Ground Water by Toxic Organic Chemicals." Council on Environmental Quality. January 1981.

7. "Drinking Water and Cancer." Review of Recent Findings and Assessment of Risks." Prepared by Science Research Systems, Inc., for the Council on Environmental Quality. December 1980.

8. "Ambient Water Quality Criteria for Halomethanes.," U.S.E.P.A. 440/5-80-051.

9. "Ambient Water Quality Criteria for Carbon Tetrachloride." U.S.E.P.A. 440/5-80-026, October 1980.

10. "Ambient Water Quality Criteria for Tetrachloroethene." U.S.E.P.A. 440/5-80-026, October 1980.

11. "Priority Review Level 1-Di-(2-ethylhexyl)phthalate (DEHP)." Office of Toxic Substances, U.S.E.P.A. November 28, 1980.

12. Vorhess, C.V., et al.: "Developmental neurobehavioral toxicity of butylated hydroxytoluene in rats." Food Cosmet. Toxicol. 19, 153-162 (1981).

13. Pigott, G.H., and Ishmael, J. "A comparison between in vitro toxicity of PVC powders and their tissue reaction in in vivo." Ann. Occup. Hyg. 22, 111-119 (1979)

14. DHS Report, op. cit. p. 37 (footnote).

LEGISLATIVE PROPOSAL ANALYSIS

Subject of Proposed Bill:

"Adoption of 1982 Uniform Plumbing Code"

Background Information:

Every third year, the International Association of Plumbing and Mechanical Officials adopts a revised plumbing code incorporating advances and improvements in technology. During the Twelfth Legislature, the department did not propose legislation to adopt the 1982 version of the Uniform Plumbing Code because there were conflicts between the Uniform Plumbing Code and the Uniform Building Code. The Department of Public Safety (Fire Marshall's Office) will propose legislation to adopt the most recent edition of the Uniform Building Code which is consistent with the 1982 Uniform Plumbing Code.

Summary:

The most noticeable changes in the plumbing code are as follows:

Section 108 allows for a larger grease interception to serve one or more fixtures. Section 203(d) states that copper tubing used for water service shall have a weight of not less than Type L.

Table 4-3, footnote #4. Evidence indicates that a three-inch horizontal waste will effectively handle discharge from three water closets; thus the code change, so that only four water closets or six unit traps are allowed on any vertical stack, and not to exceed three water closets or six unit traps on any horizontal branch or drain.

Section 601 changes will not allow cold storage rooms, refrigerators, cooling counters, etc. designed to hold food or drink, or sinks for washing or preparation of food, to be directly connected to a waste or vent pipe. All drains shall discharge through an air gap into a open drain or approved receptor.

Section 1004 is one of the major changes, and allows Poly Butylene (PB) water pipes to be used for hot and cold water distribution tubing systems, using inserts for connectors. It also inserts language to assure that when metal pipe is used as a building ground, it will be replaced by metal pipe when repairs are made to these pipes.

Also adopted were insulation standards for cold water service and yard piping. These standards were for Poly Vinyl Chloride (PVC), asbestos cement pressure piping and Poly Butylene (PB).

Those groups most affected by this change will be plumbers, contractors, local governments and state agencies issuing building permits.

Estimated Fiscal Impact: (FY '83 - FY '87)

To the state: -0-

To others: -0-

MAR 31 1983

V CEQA SUMMARY

This chapter covers various information not presented earlier but required by the California Environmental Quality Act (CEQA) for Environmental Impact Reports. As this document is a preliminary environmental review, this section has not been fully developed. When the draft and final versions of the EIR are proposed, it is likely to expand and some of the findings will undoubtedly change or at least be stated more confidently.

A. Significant Unavoidable Environmental Impacts

For this preliminary environmental review of a very subtle and complex proposal, SRI chose to describe our current overall conclusions about the proposed plumbing code changes and our reasons for them, without making definitive findings of significance except where they were clearcut.

First, we discovered nothing to suggest that the issues discussed earlier as the prime ones are insignificant or that other issues are dominant. The only new issue of potential significance that surfaced was the permeation of buried plastic pipe by contaminants in soil and the resulting possible public health impacts. Although the possibility that such effects could occur from permeation of water supply lines from the meter to the house is plausible, any potential problem would also occur--probably in much greater proportion--from the public water distribution system. This problem should be re-examined when better understood and if found significant should influence state policies with respect to plastic use in both public and residential systems. With adequate education of building inspectors on the permeation issue, improper installation of plastic water service in contaminated soils should be rare.

As to public health impacts from chemicals leaching from water pipe into potable water, we find that significant impacts are possible but unproven, both for plastic pipes--especially the chlorinated varieties--and for metal ones, specifically copper systems. If the upper ranges of possible concentrations of leachates are regularly reached, the cumulative risks to public health may be high enough to be of concern by typical standards of acceptable risk, for example, a lifetime cancer risk of one in a million. The chemicals of concern are lead from the solder in copper pipes, possibly leading to neurologic disorders, and carbon tetrachloride, perchloroethylene, and trichloroethylene from plastic (especially PVC and CPVC) pipes, possibly resulting in cancer.

Two major considerations limit the significance of the findings. First, the status of information about long-term levels of leachates is exceedingly flimsy. Reasonable further testing could resolve at least part of the uncertainty (see Section VI). Second, the risk assessment procedure is moderately conservative. If risks still appear to be of concern after concentrations are better known, more attention would need to be devoted to assuring that the assessment procedure took into account detailed properties of the chemical. Finally, thorough initial flushing would effectively mitigate the effects of the rapidly leaching materials, especially the solvents used with plastic pipe. Overall, current information does not establish an environmental preference between copper and plastic pipe, with neither clearly likely to cause a great number of deaths or serious illnesses.

For worker safety and health, a similar situation exists. Both lead from solder fumes in installing copper pipe and solvents from installing ABS, PVC, and CPVC pipe could be hazardous if plumbers have high exposures by inhalation; dermal absorption could also be significant in the case of solvents. The diseases of concern for solder fumes are related to the lead exposure and are neurologic. The solvents may also cause nerve damage, and they may be involved in liver damage or reproductive problems as well. However, they are not implicated in cancer unless benzene is more common than thought. Unless the NIOSH report about to be released resolves the range of exposures satisfactorily, further testing would be useful before completing the EIR. Safety issues generally favor plastic over metal, which appears to lead to more burns (hot solder and especially flux) and strains and contusions (from heavier metal pipes). PB (like PE, although its uses are not proposed for change) poses little if any worker safety and health concern. Use of gloves, other protective equipment, ventilation, and simple care will significantly reduce any potential hazards from either plastic or metal pipe, but these practices have not achieved widespread acceptance among plumbers.

Fire safety is a very real concern with plastic DWV pipe; ABS is combustible, and PVC and CPVC will at least soften and slump in lines. If these plastics are installed as direct substitutes for metal, as they already are in non-fire-rated residences, they will degrade the fire resistance of structures. The gaskets in no-hub cast iron will also fail in fires and cause the pipe to fall, leaving fire passages. But the proposed code changes apply to fire-rated, fire-resistive construction that could retain its fire rating if appropriate installation procedures are developed and enforced. In such conditions, no degradation of fire resistance would occur. This issue thus turns on enforcement, not science. The potable water pipes, kept cooler by the water inside and of much lower mass, are not a significant fire safety issue.

As with fire safety, smoke toxicity is an issue in which plastic can only be less environmentally acceptable than metal. However, whether the difference is significant is less certain. Both ABS, which seems likely to contribute the majority of pipe mass in California, and the polyolefins PB and PE produce combustion products that are not highly toxic; few if any additional fatalities or serious injuries would be likely from their combustion. PVC and CPVC both produce significant quantities of hydrogen chloride vapor in fire environments, and this corrosive material could, under certain circumstances, make a difference in the probability of human survival in lines. The frequency of such occurrences is clouded by lack of a generally accepted test for smoke toxicity. This problem is currently being addressed both by the State of California Department of Industrial Relations and by the State of New York. We believe DHCD should pay close attention to results from those studies, but does not need to delay a decision solely on those grounds.

No other significant adverse impacts are likely to result from the expanded use of plastic plumbing pipe if relatively simple mitigation measures are taken. Plastic drain pipes may be slightly noisier than cast iron pipe. See the following section (V-B) for further elaboration.

Overall, the SRI study team sees little evidence that expanded use of plastic plumbing pipe would cause significantly greater environmental problems than the materials it would replace. Unfortunately, lack of evidence is not the same as lack of hazard. We believe it is especially important to gather more information on leaching of chemicals from both plastic and metal pipe systems into potable water and on the exposures of plumbers to material from plastic (ABS, PVC, CPVC) and metal (copper) plumbing systems.

Table V-1 summarizes our present assessment of our relative environmental concern about pipe systems. There we show our relative degrees of concern for different materials for each of the major areas of impacts. A high rating does not necessarily mean an impact that is significant in the sense of CEQA, but does mean that the material rated seems to us more likely to be environmentally harmful then other materials on that dimension. For example, the chlorinated plastics clearly are of highest concern for smoke toxicity, but may not pose any significantly higher impacts in the proposed new DWV uses (fire-resistive construction).

Table V-1

RELATIVE DEGREE OF CONCERN REGARDING
POTENTIAL ENVIRONMENTAL IMPACTS*

	Potable Water				Drain, Waste, and Vent			
	Plastic		Metal		Plastic		Metal	
Impact Area	PB/PE	PVC/CPVC	Copper	Galv. Steel	ABS	PVC/CPVC	Copper/ Gal.Steel	Ca Ir
Public Health	3	4	3	3	0	0	0	[illegible]
Worker Safety	1	2	4	2	2	2	3+	[illegible]
Worker Health	0	3	4	2	4	4	3+	[illegible]
Fire Safety	3	2	0	0	5	4	0	[illegible]
Smoke Toxicity	1	3	0	0	3	5	0	[illegible]
Other Impacts	0	0	0	0	1	1	0	[illegible]

*Key: 0 - No concern
1 - Considerably less concern than average
2 - Less concern than average
3 - About average concern
4 - More concern than average
5 - Considerably more concern than average

Note: High relative concern does not necessarily imply high absolute concern; significance of ratings depends on mitigation measures taken.

+More for copper, less for galvanized.

B. Insignificant Effects

The following environmental effects of expanded uses for plastic plumbing pipe may occur but are probably insignificant by any reasonable interpretation of CEQA:

- Plastic pipe systems may fail slightly more frequently than metal systems until a body of experience with installation errors has accumulated.
- Plastic pipe will consume slightly more petroleum than metal pipe, but slightly less energy overall.
- Plastic pipe will contribute a slightly different load of pollutants to public waste water treatment systems, but the direction of impact, let alone its magnitude, is uncertain.
- Plastic DWV pipe will be slightly noisier than metal systems if installed so as to contact wall surfaces; this may be more significant than otherwise in the multifamily, fire-rated construction that is affected in the DWV code changes.
- Plastic DWV pipe could be damaged by pipe cleaning equipment, but because of its resistance to corrosion, the frequency of such cleaning should be low.
- Plastic pipe will slightly decrease the life-cycle cost of plumbing and therefore of housing, but not enough to change demand patterns or growth.
- Small shifts in employment from metal pipe manufacturing to plastic pipe manufacturing will occur.
- A small reduction in the work of plumbers will occur, mostly as a result of repair and renovation work by do-it-yourselfers.

C. Effects of Alternative Actions

In addition to the proposed project, e.g., the proposed change to the 1982 Uniform Plumbing Code (UPC) allowing certain new uses of plastic plumbing pipe as described in the Project Description, this environmental review has examined the potential effects of alternatives to the proposed project on the quality of the natural and human environment. The eventual EIR will consider alternatives as well as the project itself to provide a baseline for evaluating the significance of the impacts and to provide possible alternative courses of action should the proposed project create significant adverse impacts that cannot be successfully mitigated. With this goal in mind, the alternatives we have selected for analysis are no changes to the state code, partial approval of plastic pipe use, and complete rejection of all plastic pipe (that is, reversal of earlier provisions allowing certain uses of plastic pipe).

Under the no-action alternative, there would be no changes in the state code regarding the use of plastic plumbing pipe. All currently approved uses for plastic pipe would continue to be permitted and no new uses of plastic pipe would be allowed. None of the impacts attributable to the use of plastic pipe in expanded applications would be observed; any public health and worker safety and health effects of currently allowed plastic and metal piping systems would persist.

The partial approval alternative would amend the state code to permit certain new uses of plastic pipe, but not all of the new uses proposed under the project. Counting cold and hot water supply in a given application as one new use, the proposed project would change the code to permit 11 new uses of plastic pipe (i.e., 1 new use for ABS pipe, 3 for PB pipe, 1 for PVC pipe, and 6 for CPVC pipe). Considering all the possible combinations of these uses, over 2,000 partial approval alternatives are possible.

Our analyses of the environmental consequences of the proposed project have guided our selection of the subset of the partial approval alternatives to be considered in the EIR. That is, we define the partial approval alternative(s) to permit those new uses of plastic plumbing pipe that are least likely to have significant adverse effects on the quality of the natural and human environment. At present, the only partial alternative that seems reasonably certain to meet this requirement is to allow PB for hot and cold water supply both outside buildings and inside buildings that are not fire-rated or within the fire-resistive construction of fire-rated buildings. No other new uses of plastic pipe would be allowed. Parenthetically, there seems little reason to prohibit PB in exposed locations of fire-rated buildings as long as the penetrations of fire-resistant construction are designed to maintain the rating of that construction. The state of information on the impacts of this alternative is generally the same as on those of the metal water pipe currently allowed for these two uses. Although PB will certainly burn and metal will not, the additional risk of fire spread appears minimal, as does that of smoke toxicity. Leachates from PB have not been shown to be risk-free, but neither have those from copper or galvanized steel. Of the two plastic alternatives, PB is somewhat less likely to be a public health hazard than CPVC, although the relative ratings of PB, CPVC, copper, and galvanized steel will not be clear without further testing (see Section VI). PB is clearly a preferred material, from the worker safety and health viewpoint, compared both with metal systems and with plastics that require cementing.

Under the option of disallowing currently allowed uses of plastic pipe, any impacts of these materials would disappear and those of metal systems reappear. The possibility of permeation of water supply piping by organic contaminants would decrease to the extent that PVC and PE supply lines would be replaced by metal with impermeable joints (but even metal pipe joints can be permeable). Leachates from PVC and PB would be replaced by those from copper, with no clear impact, positive or negative, on public health. The metal pipes would be somewhat more likely to corrode in soil than plastic (galvanized steel is not recommended for buried supply lines). Only small changes in worker safety and health would result from the changes in water supply piping.

Any major impacts of disallowing current uses of plastic pipe would be associated with the widespread use of ABS (and less widespread use of PVC) in DWV applications. Fire load and fire spread would be reduced in nonfire-rated construction. It is probable that few fatalities or little property damage would be avoided by this action, but both are possible benefits. Smoke toxins would also decrease somewhat, especially if PVC were replaced. The decrease in plumbers' exposures to solvent cements would be offset by increased work-related injuries from working with cast iron and, to some extent, with soldered joints in copper DWV. Whether the net effect on worker safety and health would be positive or negative is difficult to predict, given the current lack of information on plumbers' exposures.

Finally, the alternative that would disallow current uses of plastic would transfer some profits and jobs from the plastics to the metal pipe industries. Since large quantities of DWV are involved, these impacts would probably be greater than those for the [illegible] project alternative of allowing expanded uses of plastic pipe. Houses could become more expensive, depending on the prices of cast iron and copper, but probably not enough to significantly affect the demand for housing.

In summary, the alternative of approving only the expanded uses of PB appears to pose fewer environmental risks than does the full proposed project given the state of current information. Because metal systems also pose some unique risks and may be comparable to plastic systems in other risk areas, we are not prepared to say that the no-project alternative or the alternative that would disallow current uses of plastic are environmentally preferable to the partial approval alternative, or even to the full proposed project.

D. Cumulative and Long-Term Implications

Increased use of plastic plumbing pipe can contribute to cumulative environmental impacts in two ways.

First, the sum of the environmental impacts of plastic pipe could be significant even when no one individual impact is deemed significant. In the case of plastic pipe, the most plausible example is for the various leachates that could each contribute to public health impacts. For example, no one leachate might reach the level of 10^{-6} lifetime risk for cancer, but the cumulative risk of all leachates acting together might exceed that level. Given the current uncertainties about the public health impacts, especially those concerning the long-term levels of leachates in drinking water, we are unable to determine whether the cumulative impact is significant. A similar situation is found with worker health impacts, where the risk of one solvent might be insignificant, but that of two or more could be significant. For fire safety, the cumulative impact of all the proposed new uses for plastic pipe are likely to be dominated by the new DWV uses; the contribution of PW pipe is likely to be negligible. The same is true of smoke toxicity, except that the combined affect of HCl, CO, and other toxicants could be significant even when the effects of any one alone were not.

A second issue of cumulative impact is the question of whether the expanded use of plastic water pipe would add to the impacts of other similar actions and in total create a significant effect even though the use of plastic water pipe is not itself significant. We can consider two levels of cumulative impacts:

. Cumulative impact of expanded and existing use of plastic plumbing pipe.

. Contribution of plastic plumbing pipe to total use of plastic products.

As has been made clear earlier, the expanded uses of plastic pipe are in many ways rather small in comparison to existing approved use of plastic pipe. Most new California houses are already being plumbed with ABS DWV if they are not fire-rated; the addition of 10% (by weight) more plastic pipe as PB or (less likely) CPVC water pipe will be of little consequence for fire safety, especially as water piping is less sensitive. The increase for plastic pipe in fire-rated construction, of course, is total since no plastic is being used now; however, if ways of maintaining the rating are developed as required by code, little fire safety impact would be expected. Similarly, the cementing of plastic potable water pipe is probably much less of a problem for workers than the cementing of already approved ABS DWV. Thus, the greatest issue of cumulative impact involves public health impacts, in which plastic in residences can add to plastic in public utility distribution systems. We have no way of estimating the relative contribution of each to the total hazard, as the source of contaminants found in the water supply (control) during leaching tests is not known. We doubt that the combined effects of distribution and residential piping would be significant if neither one alone were, but we cannot rule out that possibility. Similarly, permeation of plastic distribution pipes by toxic substances is more likely than it is for residential piping systems, but the significance of either, in terms of an overall risk assessment, will not be clear for a long time.

With regard to plastics in total, the expanded uses of plastic pipe will be a relatively small contribution in most respects. Plastics are by now endemic in our society. Most of the contaminants of PVC and CPVC that could be public health hazards will be ingested in much greater quantities from other PVC products such as food containers or, in the case of some of the chlorinated methanes, simply from waste products reaching the raw water supply. Those from PB and PE are similar to those from PE food contact materials. If plasticizers do contaminate plastic pipe, they will still do so at much lower levels than they do in any number of plasticized products to which people are regularly exposed, such as flexible vinyl upholstery (where they would yield inhalation rather than ingestion exposures). But equally clearly, plastic pipe does contribute to the total load of plastic-related hazards in California--for example, to the total of all combustible plastics in residences. The hazards from the total use of plastics are undoubtedly appreciable, even though nearly impossible to estimate. Whether or not they are greater or less than the hazards of the materials they replace is perhaps even more difficult to state. About all that can be said is that plastic pipe is not an unusually prominent or special case among plastics in general.

CEQA also requires an assessment of whether long-term environmental costs will be incurred as a result of short-term economic or other benefits. Certainly, any public health impacts of plastic pipe that do occur will probably be delayed for decades, as will some of the worker health or smoke toxicity impacts. However, for the purpose of determining the environmental consequences of the expanded uses of plastic pipe, those should be counted as current impacts, and not discounted in comparison with current benefits. We believe that, when it is viewed from this perspective, this CEQA issue is irrelevant to the decision at hand.

E. Significant Irreversible Changes

CEQA also requires an assessment of environmental changes or consumption of resources that would be permanent and irreversible. For example, the mining of a mountain is an essentially irreversible impact, whereas most air pollutants and their impacts would disappear once the source of pollution is removed.

In the case of the expanded use of plastic plumbing pipe, there would be a small permanent commitment of petroleum resources (but not other energy sources) to the manufacture of the pipe constituents. Total energy resources would be conserved to a slight degree. If any deaths occurred as a result of diseases caused by leachates or occupational exposures, or from fire or smoke toxicity, they would also be irreversible. If plastic pipe were later disapproved, the occurrence of new fatalities would gradually disappear. Some of the leachates from plastic pipe are mutagens and some mutations can be heritable. Thus, it is possible that a heritable--and more likely than not adverse--mutation could persist in the population as a result of drinking from plastic water pipes. Neither the specifics of the leachates in water from plastic pipe nor the overall state of the art of genetic risk assessment allows an evaluation of this possibility at present. If the impacts of plastic pipe eventually were judged unacceptable, it is possible that the metal pipe industry would have declined by that time to the point at which it would prove difficult to revive, but that possibility is also extremely speculative. Overall, we believe that the reversibility of the impacts is not as important an issue to resolve as the magnitude and significance of current impacts.

F. Growth-Inducing Impacts

California's population is projected to increase from the 1980 total of 23.8 million people to 25.2 million by 1985 and to 27.5 million by 1990 (California Department of Finance, 1981). The proposed code change is not likely to significantly affect this forecast population growth for the following reasons. First, the reduction in the cost of housing construction that would result from use of the newly permitted plastics in place of currently approved plumbing materials is so small that it would have virtually no effect on the sales price or rent of dwelling units in the state. Therefore, there will be no change in the demand for housing and consequently no additional in-migration of residents who would be attracted by a drop in the price of housing. Second, the plumbing material substitutions that are likely to result from the proposed code change would not significantly affect employment opportunities in the state and so would not affect the in-migration and out-migration forecasts. Nor would either housing prices or employment opportunities significantly affect shifts in population from one part of California to another.