INTEGRATED WASTE MANAGEMENT BOARD

FINAL REPORT

SAMPLING, TESTING, AND EVALUATION OF RECYCLABLE AND RECYCLED LATEX PAINT

DECEMBER 1995

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Final Report

SAMPLING, TESTING, AND EVALUATION OF RECYCLABLE AND RECYCLED LATEX PAINT

Prepared for

California Integrated Waste Management Board
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Los Angeles Society for Coatings Technology
Southern California Paint & Coatings Association
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EXECUTIVE SUMMARY

This report presents the accomplishments of a three-year study, also called the Cal Poly Project, on sampling, testing, and evaluation of recyclable and recycled latex paint. The term "recyclable" pertains to usable latex paints as received at household hazardous waste or paint collection events while the term "recycled" pertains to recyclable paint that has been adjusted by a paint manufacturer to meet specific performance specifications. In those instances where collected paints are made available to consumers without intermediate modification of paint properties by a paint manufacturer, the paint is called "consolidated" or "reusable".

Representative Samples From Seven Collection Sites

Seven household hazardous waste collection (HHWC) sites representing various California communities participated in this project. Samples were collected three times per year and sent to Cal Poly where they were tested for hazardous constituents and evaluated as raw materials for the manufacture of high quality recycled latex paint.

Metal and Cyanide Contamination Is Low

Cyanide was not detected in any of the first 28 collections at a concentration greater than an established detection limit of 1.0 ppm and analysis for this analyte was discontinued after the fourth collection round. The Consumer Product Safety Commission's limit of 600 ppm for lead in dried paint films was exceeded slightly by only one (603 ppm) out of 61 collected samples. The average lead content was approximately 40 ppm adjusted to a dried paint film basis. The EPA limit of 200 ppm mercury for interior paints was exceeded in one sample out of 61 collections. (Santa Monica, Spring 1993, 236 ppm). Of the 16 other metals tested for, none were found in amounts exceeding the OSHA Worker's Safety Standard. All of the collected paints contain mercury at a level averaging 70 ppm and exceed the Title 22 total threshold limit concentration of 20 ppm making them hazardous wastes if they were to be disposed of in a landfill (Table A). The presence of mercury in excess of the Title 22 limit emphasizes the importance of recycling since the mercury level is not in excess of any standards applicable to use of the paint as a consumer

product. All of the collected paints meet the certification standard of Green Seal, a non-profit, environmental labeling and consumer education organization. Title 22 limit emphasizes the importance of recycling since the mercury level is

Table A. Average Mercury and Lead Levels for 61 Samples of Recyclable Latex Paint Collected from Various California Household Hazardous Waste Collection Programs.

Metal	Average for 61 Samples, ppm	EPA Limit, ppm	CPSC Limit, ppm	Title 22 Limit, ppm	Green Seal Limit, ppm
Mercury	70	200	None Specified	20	250
Lead	40[a)]	None Specified	600	1000	250
All Other Metals	None above Title 22 Limit	None Specified	None Specified	Various	250[b)]

a) Adjusted to dry paint film basis
b) Arsenic, Beryllium, Cadmium, Chromium-6, Cyanide, Thallium. All well below listed limit.

Organic Compound Contamination Is Low

Low levels of aromatic hydrocarbons were found in most of the collected paints. Benzene was found in 19 of 61 collections at an average level of 11 ppm (low-3 ppm; high-34 ppm) which may make these paints hazardous wastes by Title 22 standards. The levels do not exceed OSHA limits and the resulting recycled paint would not require special labeling. PCB's, phenols, and chlorinated pesticides were not found in any of the 61 collections.

The Importance Of Physical Property Determination

A latex paint is generally defined by its viscosity, solids content, density, and total volatile organic compound (VOC) content. Information on these and other physical characteristics makes it possible to establish a plan for reconstituting the collected recyclable latex paints into a finished recycled latex paint. Almost all of the paints from the 61 collections are slightly low in viscosity, density, and solids content in varying degrees and will require modification in order to convert them into a high quality finished recycled latex paint. All of the collected paints contain filterable solids ranging from slightly above 0 to nearly 1%, indicating that a filtration step will be required in the conversion to a finished product.

Most regulatory limits for all latex paints require that the VOC content be below 250 grams/L minus Water. Federal specifications for recycled latex paint

require the VOC content to be below 200 g/L. The average VOC content on composites of the nine collection rounds was 145 grams/L and ranged from a low of 102 g/L to a high of 168 g/L and therefore meet these requirements.

Producing A Finished Recycled Product And Performance Evaluation

Cal Poly has prepared and performance-tested 36 recycled latex paints using composite collected recyclable latex paint from the various collection rounds. These recycled paints were compared with four commercially available recycled latex paints and several virgin latex paints. It was found that a high quality recycled paint may be obtained by blending with virgin materials and by making adjustments in some of the paint properties - principally the viscosity and pH.

Sorting and Collection Protocols may be Used for Obtaining a High Quality Recycled Latex Paint

This study examined the methods which may be used for obtaining specific and reproducible colors of recycled latex paint. It is concluded that strict sorting and consolidation protocols by parties collecting the paint, can give specific and reproducible colors. Collection and sorting protocols were also examined to insure that recyclable latex paint does not become contaminated with other potentially hazardous materials.

Material Safety Data Sheets

No hazardous ingredients in excess of 1% by weight were found in any of the 61 samples analyzed by the Cal Poly study. If this trend holds true, an MSDS may not be necessary for recyclable and recycled latex paints. If hazardous substances are found to be present in excess of allowable amounts, a generic MSDS for recyclable latex paint may be an acceptable alternative.

Household and small quantity generated hazardous waste dropped off at a household waste recycling center would not have to be accompanied by an MSDS because the HAZCOM standard excludes hazardous waste from all HAZCOM requirements including MSDS and labeling requirements.

SAMPLING, TESTING, AND EVALUATION OF RECYCLABLE AND RECYCLED LATEX PAINT

INTRODUCTION

In California, both water-based and solvent-based paint, are considered to be a hazardous waste and it is illegal to dispose of paint at municipal landfills, as they are not designed to handle hazardous waste. Primary concerns are associated with the possible leaching of hazardous materials into ground water and possible injury to solid waste workers.

It has been estimated that the average household stockpiles approximately three gallons of waste paint per year.[1] However, a survey conducted by the state of Vermont[2] and an estimate by the National Paint and Coatings Association (NPCA), conclude that the amount of leftover paint generated by homeowners is less than one gallon per year. According to the NPCA, leftover paint and paint products typically represents 40-70 percent of all products collected at household hazardous collection programs in communities nationwide and the majority of the collected paint consists in large part of latex (or water-based) paint.[3] In Santa Barbara, California, the proportion of latex paint collected at its household hazardous waste collection (HHWC) events typically is no more than 20-25 percent of the materials collected. It has been suggested that these reported percentages may vary among different collection programs when latex paint collected at HHWC programs is compared with "recycle only" roundups which do not accept other hazardous waste.[4] Even though latex paint is not classified as a hazardous waste under Federal regulations, many household hazardous collection events, including those in California, accept latex paint to insure that these products are managed properly. The Vermont study has shown that Americans tend to stockpile paint for use at a later date but more often than not, store it for long periods of time without use. On average, households store paint about 4.6 years before getting rid of it.[2]

In California latex paint is considered to be a hazardous waste unless it is recycled or reused. It is a hazardous waste because many of the paints fail the Total Threshold Leaching Concentration (TTLC) tests used for determining

what is and what is not a hazardous waste for purposes of land filling permitted by Title 22, formally known as the California Code of Regulations, Chapter 11, Article 5. A primary contaminant in older latex paints is an unacceptably high level of mercury. Education of consumers and the public agencies that unused latex paints may be recycled could reduce the amount of paint being unnecessarily disposed of as a hazardous waste or being stored for lack of knowing what to do with it. At the present time, one California paint manufacturer (Major Paint Company) accepts unsorted collected latex paints from HHWC collection events and produces a recycled product consisting of 15% post-consumer latex paint, 35% secondary waste or manufacturing wash water, and 50% virgin material. This blending scheme allows the company to produce recycled paints with a fairly wide variety of consistent colors. Another California paint manufacturer (Kelly-Moore Paint Company), sorts the collected paints by color and is presently manufacturing recycled latex paints containing 50% or more of post-consumer content possessing reproducible and defined colors.

Since most of the collected post-consumer latex paints contain filterable solids ranging from almost 0 to nearly 1%, a filtration step is required in the conversion to a finished recycled latex paint that can be applied by spraying. If collected paint is not filtered and its viscosity is not adjusted prior to reuse by consumers, the quality of this paint can vary greatly. Some HHWC programs, rather than using the expertise of a paint manufacturer for reprocessing collected paint, simply collect latex paint and give it away "as-is" in original containers. Sometimes they consolidate various colors to get a larger volume of material which might be placed in 5-gallon buckets condition prior to giving it away. The quality of this paint therefore depends entirely on the sophistication of sorting protocols that are in place at the collection site. When collected paint is converted to reprocessed or recycled paint by a manufacturer, the product normally carries a guarantee of a certain standard of quality. Thus it would appear that high quality reprocessed or recycled latex paint as produced by a paint manufacturer may unjustly obtain a bad reputation if no distinction is made between their recycled paints and those brought to the marketplace by simple consolidation at the collection site.

The California Paint Recycling Task Force (PRTF) was formed in late 1989 to bring together representatives of industry, government, academia and public interest groups with the goal of promoting environmentally responsible

management of surplus or waste paint and related materials. (The term "surplus", for the purposes of the Paint Task Force, is used as defined in Webster's Dictionary as "a quantity over and above what is needed or required").

The Cal Poly Project was developed during meetings of the Paint Recycling Task Force and was assigned the responsibility of determining the composition of recyclable latex paint, including the testing for possible hazardous constituents, and development of methods or techniques for turning the recyclable paint into a high quality recycled or reprocessed latex paint that would be accepted in the marketplace. The Cal Poly Project began its work in May 1992 and was funded in June 1992.

Purpose and Scope

The purpose of this report is to present the accomplishments of the Cal Poly project on sampling, testing, and evaluation of recyclable and recycled latex paint. The study was conducted from May 1992 through September 1995. For purposes of this report, the following definitions are used:

• recyclable	Usable latex paint as received at HHWC events.
• recycled	Recyclable latex paint that has been adjusted, generally by a paint manufacturer, to meet specific performance specifications .
• reprocessed	Same as "recycled".
• consolidated	Collected latex paints made available to consumers without intermediate modification of paint properties by a paint manufacturer or other party.
• reusable	Same as "consolidated".

Report Organization

This report reviews the sampling of recyclable latex paints collected by seven HHWC programs, discusses the sampling of collected paints for hazardous ingredient testing, presents the results of hazardous ingredient

testing, presents the results of physical testing of recyclable latex paints, discusses the formulation of finished recycled latex paints, presents possible collection and sorting protocols which may be used by HHWC personnel and presents material safety data sheets which were prepared for use in the handling of recyclable and recycled latex paints.

SAMPLE COLLECTION

Seven HHWC sites were asked to participate in this program. The collection sites were selected in order to obtain a representative cross section of Northern and Southern, rural and urban, and coastal and inland communities. Selection of the seven sites was made by the Paint Recycling Task Force (PRTF) in consultation with the Department of Toxic Substances Control (DTSC) and the California Integrated Waste Management Board (CIWMB). The collection sites included:

1. City of Santa Monica Household Hazardous Waste Collection Facility
2. Contra Costa County Household Hazardous Collection Program
3. County of Marin, Marin Recycling Center
4. Kern County Latex Paint Recycling Program
5. Sacramento County Household Hazardous Waste Event
6. San Diego Regional Household Hazardous Materials Program
7. San Francisco Household Hazardous Waste Collection Facility

Collection Protocols

At the outset of this project, a detailed set of collection protocols were put in place by the PRTF. These protocols were presented to the seven participating HHWC programs to be used by them in this study. The original protocols as prepared by the PRTF are presented in Appendix E.

First round recyclable latex paint samples were collected from the seven participating HHWC programs in May 1992. The second round of collections was made in September 1992. CIWMB and DTSC staff assisted with these initial collection rounds and then turned the responsibility over to participating local governments. Collections were made in accordance with the collection protocols established by the PRTF.

The third round of collections (Winter 1993 Collection) were carried out by staff at the participating HHWC programs during January, 1993. Fourth round samples of recyclable latex paints (Spring 1993 Collection) were collected in May 1993. Due to the difficulties encountered with the shipper during the Winter, 1993, collection, each of the seven fourth round samples was packaged in four individual new 1-gallon paint cans. When the samples arrived at Cal

Poly, they were mixed by shaking for 4 minutes on a standard paint shaker. A 1-gallon composite was then made from each of the four 1-gallon samples sent to Cal Poly from each of the collection sites. After making these composites, they were further sampled to provide the laboratory analysis samples for hazardous ingredient testing.

Taking the laboratory analysis sample at Cal Poly, rather than at the collection site, represented a change in the original collection protocols and those used for the first two collection rounds. The change was made because mixing the larger collected samples in order to obtain a smaller, homogeneous sample for laboratory analysis could be carried out at the Cal Poly laboratory with greater precision than was possible by field sampling. A duplicate sample for hazardous ingredient testing, as specified in the initial collection protocols, was not taken during the second and third year collections because the new Cal Poly protocols for preparing the samples for hazardous ingredient testing insured sample uniformity.

The remaining five collection rounds (Fall 1993 through Winter 1995) were conducted in the same manner as the Spring 1993 collection round. Winter sample were normally taken in the month of January, Spring samples in April/May, and Fall samples in September/October. Sacramento County did not participate in the Cal Poly study during the last two collection rounds (Fall 1994 and Winter 1995). The total number of samples collected was therefore reduced from an original anticipated 63 to 61.

Photo Documentation

As indicated in the collection protocols (Appendix E), each sample taken was photo documented, showing the number of the sample (1 of 10, 2 of 10, etc.), the date, time and sampling location. A DTSC or CIWMB official photographed the first two sampling events. Local collection site personnel have photographed subsequent sampling rounds. The complete set of photo documentation and field notes of each of the collections is archived as supplemental information of the Cal Poly Project.

HAZARDOUS MATERIALS TESTING

Each of the recyclable latex paint samples collected to date was analyzed for metals content by the California EPA Northern California Hazardous Materials Laboratory, Berkeley. Each of the samples was also analyzed for volatile and semivolatile organic compounds by the California EPA Hazardous Materials Unit Southern California Laboratory, Los Angeles. In addition to analyzing for 54 possible volatile compounds by EPA Method 8260, and 65 possible semivolatile compounds by EPA Method 8270, the Southern Laboratory was asked specifically to identify possible contamination by PCB's, phenols, and chlorinated pesticides. The analytes found represent the analysis of 61 samples from nine collection rounds carried out from Spring 1992 through Winter 1995.

Metals and Cyanide

All collected samples were analyzed for arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, molybdenum, nickel, lead, selenium, thallium, vanadium, and zinc using EPA Method 6010. Separate analytical procedures were performed for mercury (EPA Method 7470), chromium-6 (EPA Method 7196 or IC Dionex 4000 i), and cyanide (EPA Method 9010).[5] The data in the tables and figures which follow summarize the results. In a conference call on 10/19/93 of the Cal Poly subcommittee, it was decided to discontinue testing for cyanide and chromium-6 after the fourth collection round (Spring 1993). The rationale for this decision was based on results for the first four collection rounds, representing 28 collected samples in which virtually no cyanide was found in any of the samples (see Table 15) and in which the chromium-6 content was exceedingly low or non-detectable (see Table 2) .

The results for mercury (Table 1) indicate that 57 of the 61 collected paints would be considered a hazardous waste if they became a waste. This is demonstrated by the Title 22 TTLC value (Total Threshold Limit Concentration) for mercury.

Table 1. Mercury in ppm(mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	114	93	96	116	90	33	21	172	64	89
Contra Costa	81	102	109	61	74	150	70	100	162	101
Sacramento	58	40	109	28	93	91	48	a	a	67
San Francisco	53	60	114	56	128	59	98	99	81	83
Santa Monica	48	31	20	**236**	6	68	21	41	16	54
San Diego	72	55	96	73	76	84	73	72	62	74
Kern	48	45	20	33	20	1	22	28	6	25
Average	68	61	80	86	69	69	51	85	65	70

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 20 ppm
- Green Seal - Must Not Exceed 250 ppm
- OSHA - Covers Labeling and MSDS Identification for Hazardous Ingredients Greater than 10,000 ppm and Carcinogens Greater than 1000 ppm
- EPA - Interior Latex Paints Must Not Exceed 200 ppm

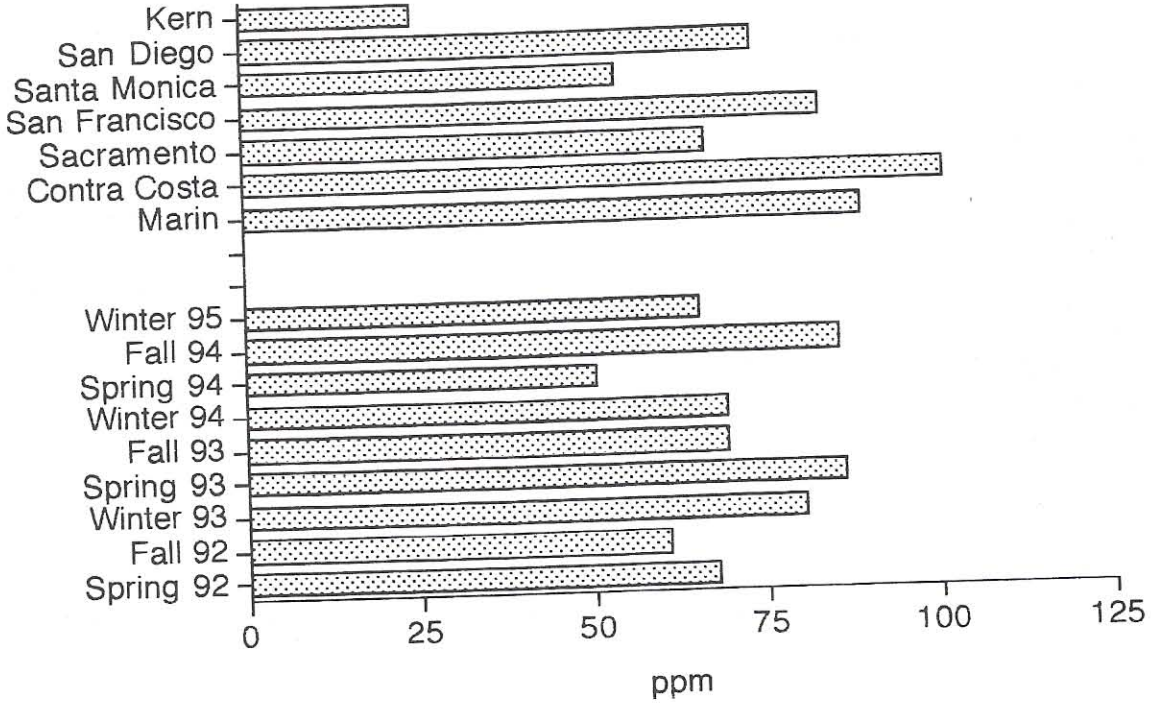
Title 26 (Proposition 65) does not apply to mercury since mercury is not one of the listed chemicals. The EPA limit for mercury is exceeded in only one of the 61 collected samples. Since this one sample (Santa Monica, Spring 1993) was a pure white latex paint with excellent physical property characteristics, it is suspected that this paint may not have been a post-consumer waste at all and may have originated from some one source, possibly because of prior knowledge of its mercury content.

Green Seal is a non-profit, environmental labeling and consumer education organization that certifies products designed and manufactured in an environmentally responsible manner. Green Seal conducts an evaluation of a product's environmental impacts from manufacture, through consumer use, to ultimate disposal. The 250 ppm maximum for mercury and selected other metals is their value for a proposed environmental standard for household paints, both exterior and interior. The standard does not include stains, clear finishes, or paints sold in aerosol cans.

Figure 1 presents the mercury content as individual site averages for each of the collection rounds to date and as seasonal or quarterly averages of the combined sites. It should be noted that the range of values is smaller for the combined quarterly collection averages than it is for the individual site averages. This suggests that there is no obvious seasonal variation in the

amount of mercury found. The data collected do not suggest that there is a coastal versus inland variation in mercury levels.

Figure 1. Mercury Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the collected latex paints of the first 28 collections exceed the Title 22 TTLC maximum limit for chromium-6. The amounts detected are well below the allowed TTLC maximum.

Table 2. Chromium-6 in ppm (mg/kg) for the First 28 Collections.

	Spring 92	Fall 92	Winter 92	Spring 93	Fall 93	Winter 94
Marin	0	12.0	8.7	0	*	*
Contra Costa	0	0	10.1	0	*	*
Sacramento	0	0	0	0	*	*
San Francisco	0	0	0	0	*	*
Santa Monica	0	0	0	0	*	*
San Diego	0	0	0	7.3	*	*
Kern	0	0	24.7	6.2	*	*
Average	0	1.7	6.2	1.9	*	*

* Discontinued after Spring 1993 collection.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 500 ppm
- Green Seal - Must Not Exceed 250 ppm

None of the collected latex paints of the 61 collections exceed the Title 22 TTLC maximum limit for lead of 1000 ppm. The amounts detected are well below the allowed TTLC maximum.

Table 3. Lead in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	23	63	73	21	25	1	0	13	1	25
Contra Costa	3	6	71	35	2	4	10	5	0	15
Sacramento	4	17	10	1	248	3	26	a	a	44
San Francisco	1	3	4	2	12	2	5	1	1	3
Santa Monica	2	2	5	2	11	2	1	0	0	3
San Diego	36	21	2	78	4	0	11	20	8	20
Kern	17	6	215	92	2	0	3	3	0	38
Average	12	17	54	33	43	2	8	7	2	20

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 1,000 ppm
- Green Seal - Must Not Exceed 250 ppm
- CPSC (Consumer Product Safety Commission) - Must not exceed 600 ppm in Dried Paint Film

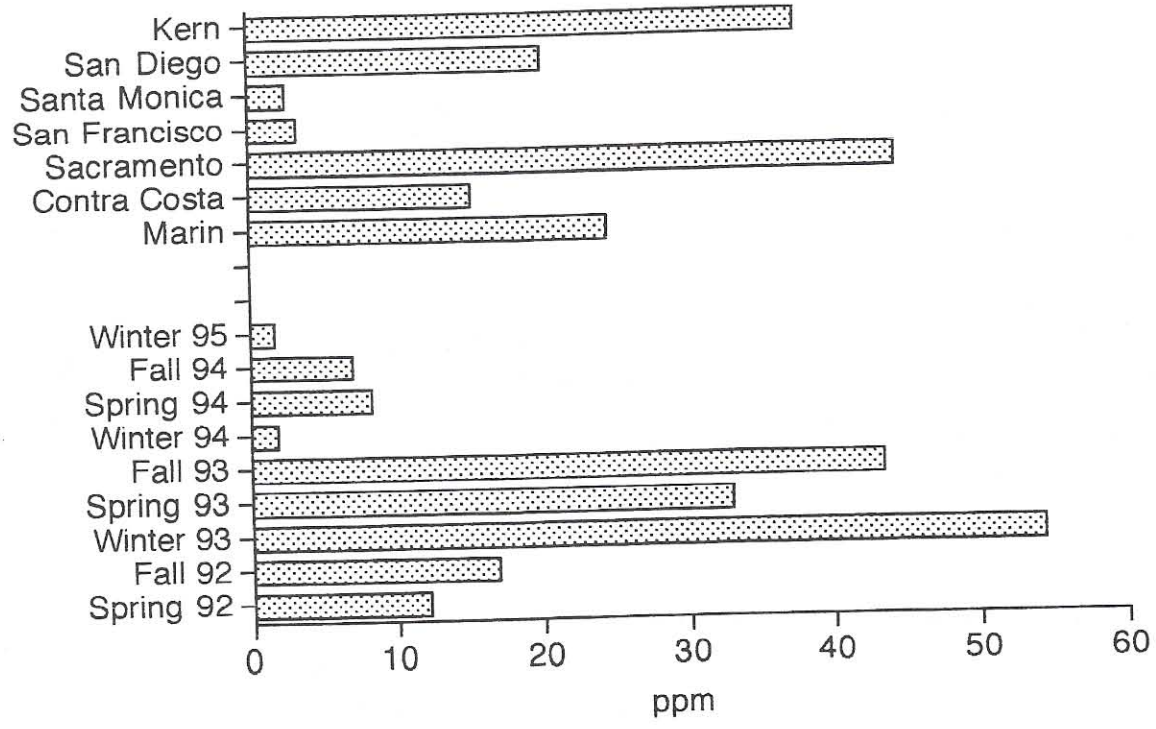
Fifty-nine of the 61 latex paints are well below the allowed CPSC maximum of 600 ppm lead in dried paint films. The value of 215 ppm for the Winter 1993 Kern County collection becomes 519 ppm when adjusted to a dried paint film basis and is therefore below the allowed CPSC maximum. The value of 248 ppm for the Fall 1993 Sacramento collection becomes 603 ppm when adjusted to a dried film basis and is therefore very slightly in excess of the allowed CPSC maximum. The dried film value is obtained by dividing the reported wet-basis value of Table 3 by the solids fraction. An example of this calculation is as follows:

Lead (wet basis) = 215 ppm; Solids Content (from Table 22) = 41.4%

Lead (dried paint film) = 215/0.414 = 519 ppm

A comparison of the average lead values on a quarterly collection basis and site basis are presented in Figure 2. As with the mercury results, there is insufficient data to suggest that there might be a seasonal variation in lead content nor is there sufficient data to suggest that there might be geographical variation in lead levels.

Figure 2. Lead Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for arsenic. The amounts detected are well below the allowed TTLC maximum.

Table 4. Arsenic in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	0	0	0	1.5	0	0	0	0	1.4	0.3
Contra Costa	0	0.7	0	1.6	0	0	0	0	0	0.3
Sacramento	0	0	0	1	0	0	0	a	a	0.1
San Francisco	0	0.6	0	2.3	0	0	0	0	1.4	0.5
Santa Monica	0	0	0	1.1	0	0	0	0	1.4	0.3
San Diego	0	0.7	0	1	0	0	0	0	1.7	0.4
Kern	0	0	0	1.3	0	0	0	0	1.2	0.3
Average	0	0.3	0	1.4	0	0	0	0		0.2
	0	0.3	0	1.4	0	0	0	0	1.1	0.3

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 500 ppm
- Green Seal - Must Not Exceed 250 ppm

None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for beryllium. The amounts detected are well below the allowed TTLC maximum and the allowed OSHA maximum.

Table 5. Beryllium in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	0.02	0.03	0	0.05	0.04	0.06	0.05	0.05	0.04	0.04
Contra Costa	0.01	0.03	0.06	0.04	0.05	0.06	0.03	0.04	0.11	0.05
Sacramento	0	0.02	0	0	0.02	0.05	0.03	a	a	0.02
San Francisco	0.01	0.04	0	0.04	0.03	0.05	0	0.05	0.03	0.03
Santa Monica	0	0.02	0.09	0.03	0	0.09	0.03	0.03	0.04	0.04
San Diego	0	0.03	0	0.02	0	0	0.04	0.03	0.05	0.02
Kern	0	0	0	0	0	0.08	0	0.05	0	0.01
Average	0.01	0.02	0.02	0.03	0.02	0.06	0.03	0.04	0.05	0.03

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 75 ppm
- Green Seal - Must Not Exceed 250 ppm
- OSHA - Covers Labeling and MSDS Identification for Hazardous Ingredients Greater than 10,000 ppm and Carcinogens Greater than 1000 ppm

None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for barium. The amounts detected are well below the allowed TTLC maximum.

Table 6. Barium in ppm (mg/kg) for All Collections.

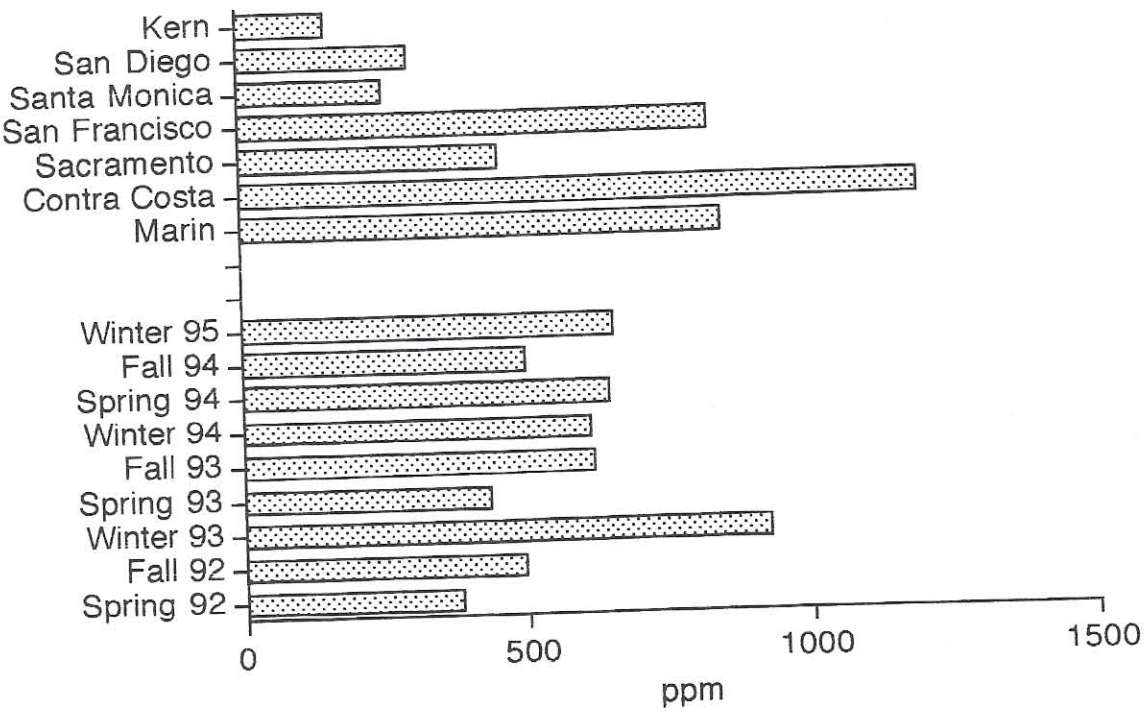
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	916	792	1980	1200	1080	187	144	667	628	844
Contra Costa	463	696	1260	918	903	2230	503	936	2820	1192
Sacramento	257	434	676	93	606	1060	67	a	a	456
San Francisco	83	193	1090	230	1300	720	2540	1210	71	826
Santa Monica	134	883	1220	4	18	10	2	10	6	254
San Diego	471	367	100	395	395	49	389	140	384	299
Kern	336	97	132	169	13	6	642	13	11	158
Average	380	495	923	430	616	609	612	496	653	579

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 10,000 ppm
- Green Seal - None

Figure 3. Barium Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for cadmium. The amounts detected are well below the allowed TTLC maximum and the allowed OSHA maximum.

Table 7. Cadmium in ppm (mg/kg) for All Collections.

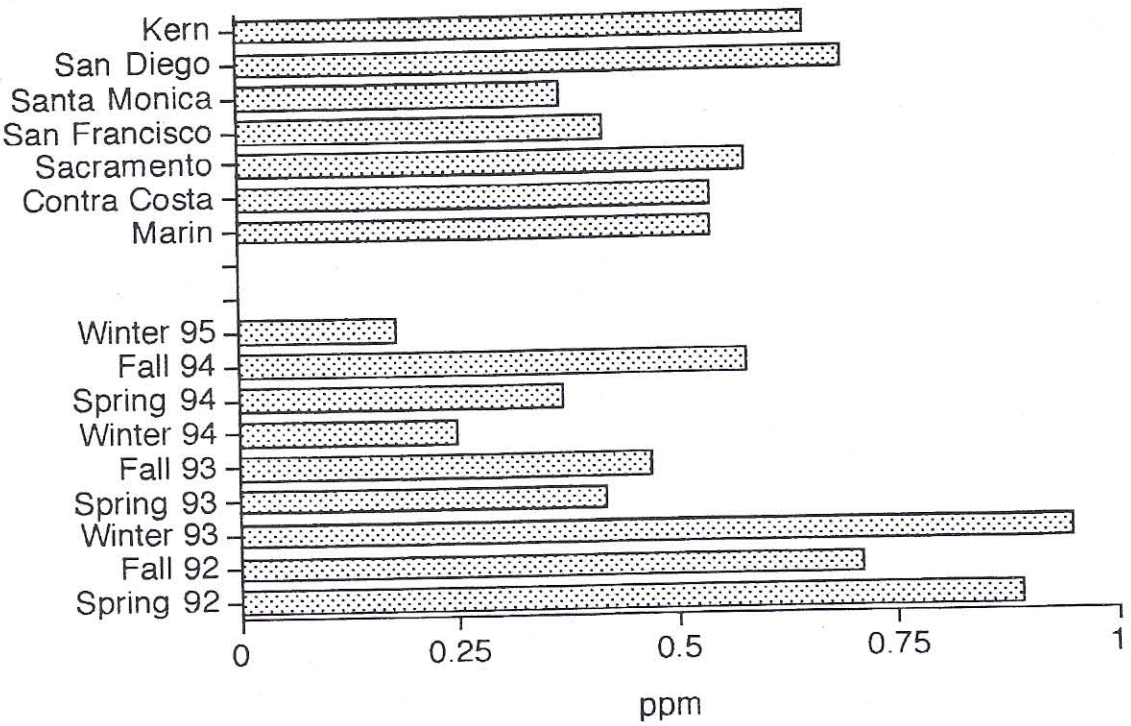
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	0.76	0.89	1.06	0.73	0.41	0.13	0.13	0.66	0.10	0.54
Contra Costa	0.73	0.61	1.12	0.49	0.49	0.36	0.24	0.5	0.28	0.54
Sacramento	0.26	0.53	1.37	0.44	0.35	0.47	0.62	a	a	0.58
San Francisco	0.28	0.39	1.16	0.16	0.8	0.18	0.49	0.25	0.09	0.42
Santa Monica	0.79	1.05	0.32	0.11	0.36	0.26	0.12	0.22	0.14	0.37
San Diego	0.75	0.87	0.7	0.58	0.6	0.16	0.6	1.61	0.31	0.69
Kern	2.63	0.6	0.89	0.45	0.27	0.16	0.41	0.26	0.16	0.65
Average	0.89	0.71	0.95	0.42	0.47	0.25	0.37	0.58	0.18	0.53

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 100 ppm
- Green Seal - Must Not Exceed 250 ppm
- OSHA - Covers Labeling and MSDS Identification for Hazardous Ingredients Greater than 10,000 ppm and Carcinogens Greater than 1000 ppm

Figure 4. Cadmium Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for cobalt. The amounts detected are well below the allowed TTLC maximum.

Table 8. Cobalt in ppm (mg/kg) for All Collections

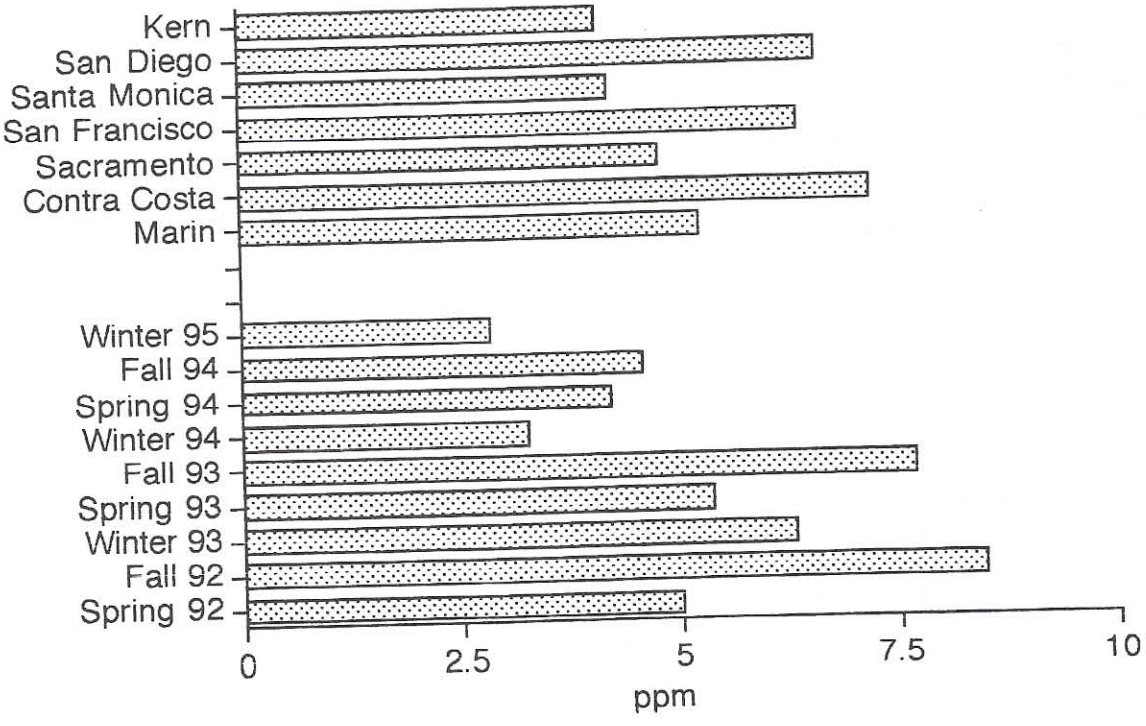
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	7.3	5.7	7.8	5.5	5.8	1.6	0.9	7.3	5.2	5.2
Contra Costa	5.5	9.3	9.7	5.7	6.3	12.0	6.3	6.9	3.2	7.2
Sacramento	2.8	5.2	7.4	3.8	2.8	5.9	5.6	a	a	4.8
San Francisco	1.8	14.2	7.4	7.5	14.3	1.4	7.0	2.6	1.0	6.4
Santa Monica	3.8	11.4	1.7	0.5	17.3	1.7	0.0	1.4	0.0	4.2
San Diego	9.0	8.8	5.4	8.9	5.0	8.9	5.0	5.8	2.6	6.6
Kern	4.9	4.7	4.8	5.5	2.2	2.1	4.4	3.3	5.0	4.1
Average	5.0	8.5	6.3	5.4	7.7	4.8	4.2	4.6	2.8	5.5

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 8,000 ppm
- Green Seal - None

Figure 5. Cobalt Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for chromium. The amounts detected are well below the allowed TTLC maximum.

Table 9. Chromium in ppm (mg/kg) for All Collections.

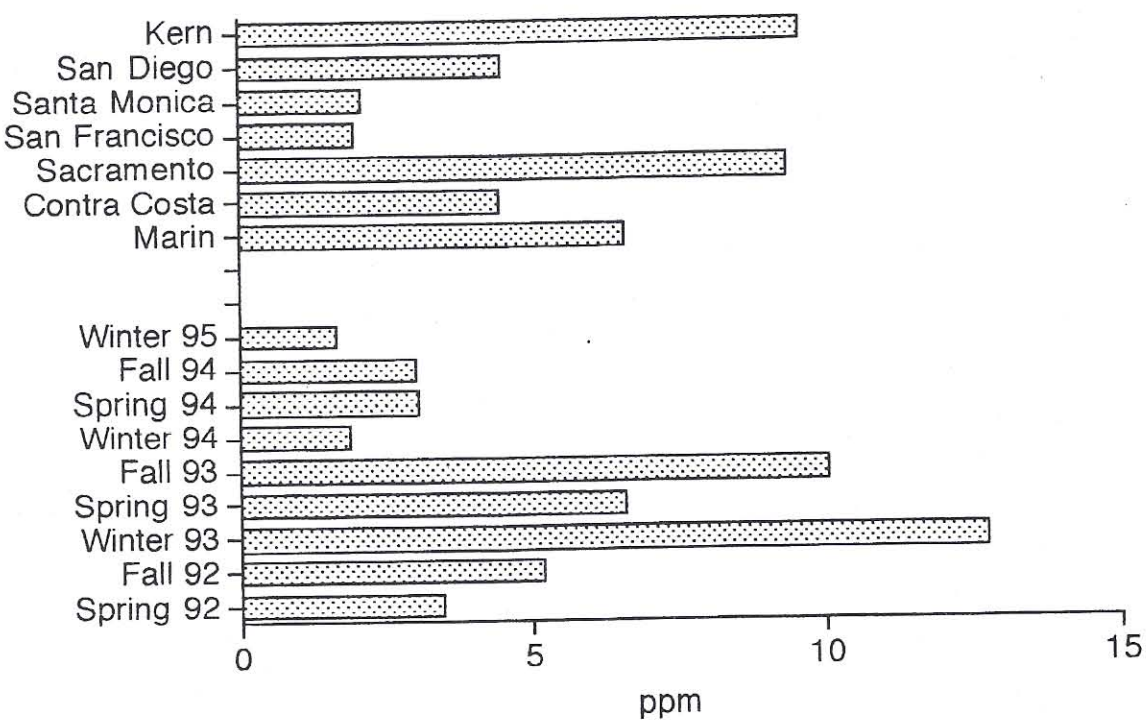
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	3.18	16.8	16.9	6.27	7.85	1.68	1.96	3.38	1.15	6.57
Contra Costa	1.76	1.92	16.6	5.02	3.62	2.75	4.01	2.05	2.39	4.46
Sacramento	1.05	1.54	4.3	1.75	50.4	2.1	4.47	a	a	9.37
San Francisco	0.69	1.14	3.86	1.3	3.21	1.49	3.02	1.39	1.23	1.93
Santa Monica	1.54	7.71	0	2.56	0.62	1.78	0.93	1.84	1.90	2.10
San Diego	10.9	5.14	1.71	8.86	2.82	0	3.39	5.73	2.04	4.51
Kern	5.14	1.97	46	20.4	1.58	3.09	3.47	3.52	1.13	9.59
Average	3.47	5.17	12.77	6.59	10.01	1.84	3.04	2.99	1.64	5.28

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 2,500 ppm
- Green Seal - None

Figure 6. Chromium Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for copper. The amounts detected are well below the allowed TTLC maximum.

Table 10. Copper in ppm (mg/kg) for All Collections.

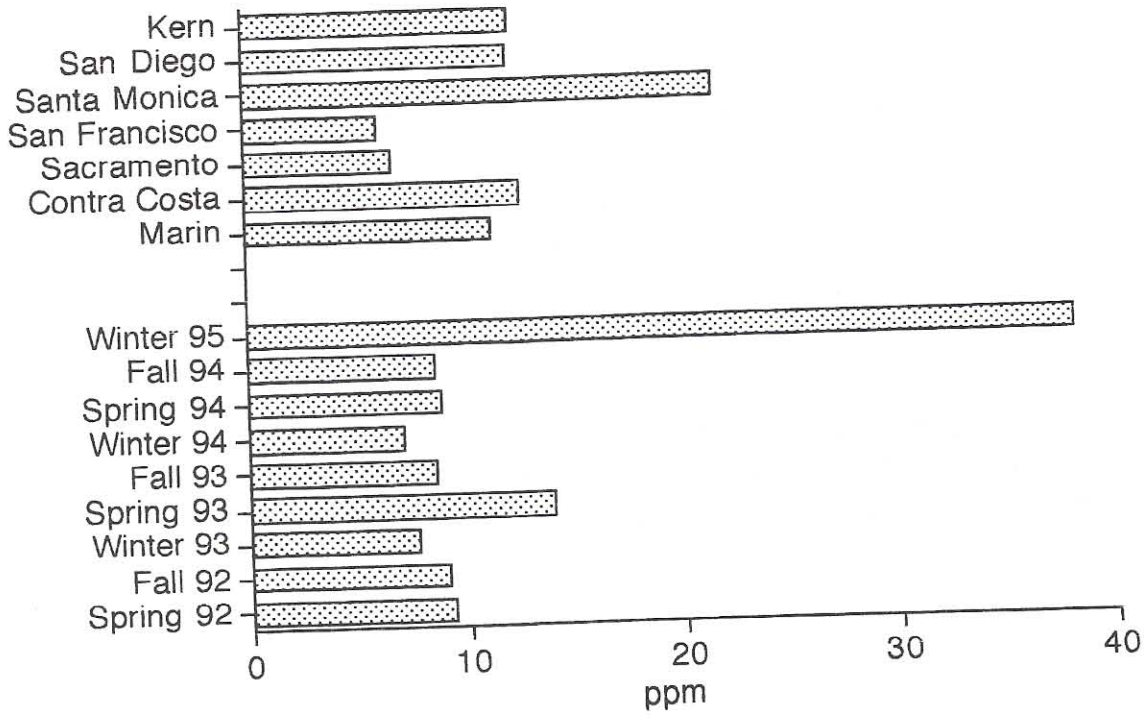
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	13.1	6.4	9.4	45.7	13.3	0.8	1.1	11.4	0.9	11.3
Contra Costa	12.7	12	9.5	8.5	5.5	17.7	22.9	10.4	15.5	12.7
Sacramento	5.7	4.8	6.2	4.3	6.7	11.1	8.4	a	a	6.7
San Francisco	0.7	2.8	13	3	17	4.3	10.8	0.9	2.5	6.1
Santa Monica	9.6	18.3	2.1	1.7	4.8	1.6	1.0	14.3	141.0	21.6
San Diego	14.3	17.2	5.6	16.6	6.9	0.7	12.2	8	27.5	12.1
Kern	8.7	1.8	8	17.9	6.3	13.6	5.6	6.7	41.7	12.3
Average	9.3	9.0	7.7	14.0	8.6	7.1	8.9	8.6	38.2	12.4

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 2,500 ppm
- Green Seal - None

Figure 7. Copper Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for nickel. The amounts detected are well below the allowed TTLC maximum.

Table 11. Nickel in ppm (mg/kg) for All Collections.

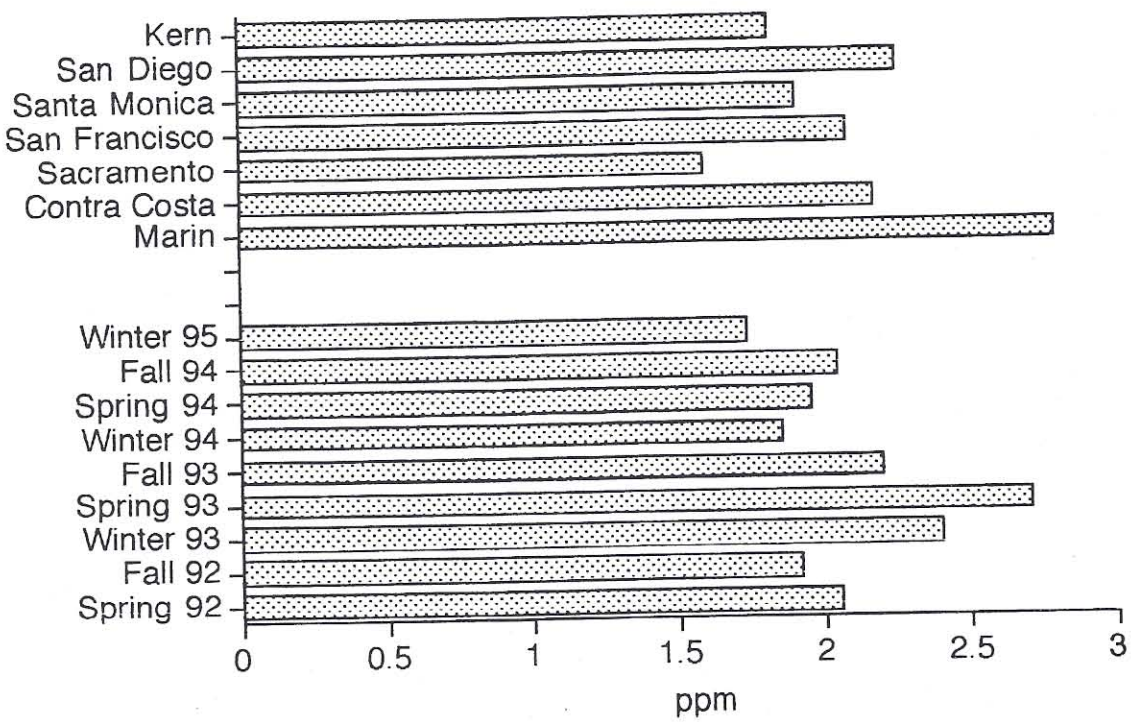
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	2.2	1.7	5.3	6.1	3.6	1.6	1.8	1.7	1.1	2.8
Contra Costa	2.1	1.2	4.0	2.4	1.9	1.7	1.6	2.3	2.4	2.2
Sacramento	0.9	1.6	1.8	1.1	2.0	2.4	1.4	a	a	1.6
San Francisco	1.3	1.5	1.7	2.2	2.5	2.1	4.7	1.6	1.2	2.1
Santa Monica	4.3	3.1	0.0	2.6	1.7	2.2	1.0	2.3	0.0	1.9
San Diego	1.9	2.8	1.8	2.4	1.7	0.9	1.9	2.6	4.4	2.3
Kern	1.8	1.5	2.1	2.2	2.0	2.1	1.4	1.9	1.3	1.8
Average	2.1	1.9	2.4	2.7	2.2	1.9	2.0	2.1	1.7	2.1

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 2,000 ppm
- Green Seal - None

Figure 8. Nickel Content for All Collection Rounds Represented by Site and Collection Average (ppm).



Molybdenum was not detected in any of the latex paints of the 61 collections.

Table 12. Molybdenum in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<1.50
Contra Costa	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<1.50
Sacramento	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<0.60	a	a	<1.50
San Francisco	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<1.50	<0.60	<0.60	<1.50
Santa Monica	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<1.50
San Diego	<0.3	<0.3	<1.50	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<1.50
Kern	<0.3	<0.6	<1.50	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<1.50
Average	<0.3	<0.6	<1.50	<0.60	<0.60	<0.60	<1.50	<0.60	<0.60	<1.50

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 3,500 ppm
- Green Seal - None

None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for selenium. The amounts detected are well below the allowed TTLC maximum.

Table 13. Selenium in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	<0.8	<0.8	<3.00	2.03	<1.60	<1.60	<1.60	<1.60	<1.60	<3.00
<1.60	<0.8	<0.8	<3.00	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60	<3.00
Sacramento	<0.8	<0.8	<3.00	1.78	<1.60	2.11	<1.60	a	a	<3.00
San Francisco	<0.8	<0.8	<3.00	<1.60	<1.60	<1.60	<3.00	<1.60	<1.60	<3.00
Santa Monica	<0.8	<0.8	<3.00	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60	<3.00
San Diego	<0.8	<0.8	<3.00	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60	<3.00
Kern	<0.8	<1.6	<3.00	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60	<3.00
Average	<0.8	<1.6	<3.00	<2.03	<1.60	<2.11	<3.00	<1.60	<1.60	<3.00

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 100 ppm
- Green Seal - Must not exceed 250 ppm

Thallium was not detected in any of the latex paints of the 61 collections.

Table 14. Thallium in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<6.00
Contra Costa	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<6.00
Sacramento	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<3.00	a	a	<6.00
San Francisco	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<6.00	<3.00	<3.00	<6.00
Santa Monica	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<6.00
San Diego	<1.5	<1.5	<6.00	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<6.00
Kern	<1.5	<3.0	<6.00	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<6.00
Average	<1.5	<3.0	<6.00	<3.00	<3.00	<3.00	<6.00	<3.00	<3.00	<6.00

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 700 ppm
- Green Seal - Must not exceed 250 ppm

The values for cyanide represented in Table 15 indicate that no cyanide was detected in 27 of the first 28 latex paints which were collected. The value of 0.21 ppm found in the Winter 1993 San Francisco collection is essentially a negligible value.

Table 15. Cyanide in ppm (mg/kg) for All Collections.

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94
Marin	<1.00	<1.00	<0.19	<0.50	*	*
Contra Costa	<1.00	<1.00	<0.19	<0.50	*	*
Sacramento	<1.00	<0.20	<0.19	<0.50	*	*
San Francisco	<0.40	<1.00	0.21	<0.50	*	*
Santa Monica	<0.40	<1.00	<0.19	<0.50	*	*
San Diego	<0.40	<1.00	<0.19	<0.50	*	*
Kern	<0.40	<0.40	<0.19	<0.50	*	*
Average	<0.40	<1.00	<0.19	<0.50	*	*

* Discontinued after Spring 1993 collection.

Regulatory and Advisory Standards:

- Green Seal - Must not exceed 250 ppm

None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for vanadium. The amounts detected are well below the allowed TTLC maximum.

Table 16. Vanadium in ppm (mg/kg) for All Collections.

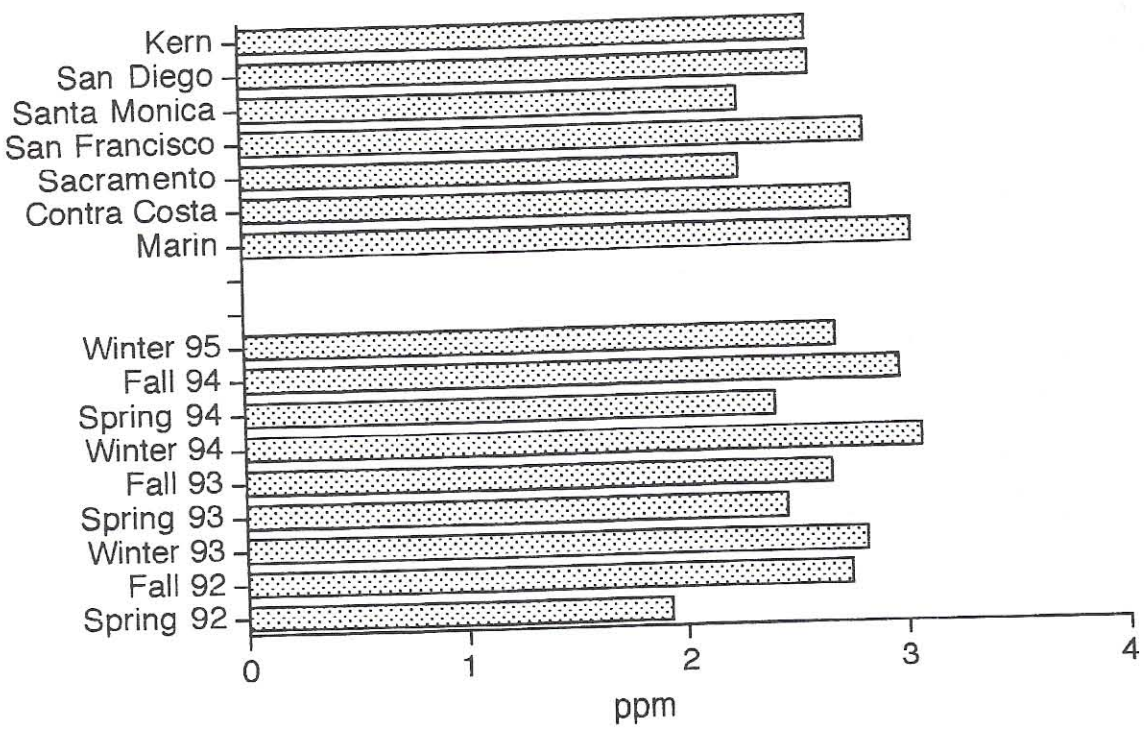
	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	2.5	3.4	3.2	3.2	2.9	3.2	3.2	3.0	2.8	3.0
Contra Costa	2.0	3.4	2.6	2.8	3.0	2.5	2.1	2.3	4.2	2.8
Sacramento	1.4	2.2	2.9	1.1	3.4	2.8	2.2	a	a	2.3
San Francisco	1.7	2.3	3.2	2.7	3.3	3.8	2.8	3.1	2.7	2.8
Santa Monica	1.7	2.4	2.0	2.4	1.6	3.2	2.1	2.5	2.4	2.3
San Diego	2.3	3.0	3.6	2.6	2.6	1.3	2.7	2.7	2.6	2.6
Kern	1.8	2.5	2.3	2.5	1.9	4.7	1.9	4.2	1.4	2.6
Average	1.9	2.7	2.8	2.5	2.7	3.1	2.4	3.0	2.7	2.6

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 2,400 ppm
- Green Seal - None

Figure 9. Vanadium Content for All Collection Rounds Represented by Site and Collection Average (ppm).



None of the 61 collected latex paints exceed the Title 22 TTLC maximum limit for zinc.

Table 17. Zinc in ppm (mg/kg) for All Collections.

	Spr 92	Fall 92	Wtr 93	Spr 93	Fall 93	Wtr 94	Spr 94	Fall 94	Wtr 95	Avg
Marin	1010	510	792	938	788	44	40	1090	795	667
Contra Costa	429	762	1350	398	948	1410	316	281	98	666
Sacramento	262	282	384	381	344	1080	4500	a	a	1033
San Francisco	108	2680	533	135	404	73	508	540	1370	706
Santa Monica	555	240	34	2	3730	249	16	4680	2	1056
San Diego	538	980	475	577	1030	772	216	1010	779	709
Kern	61	262	117	477	18	21	418	455	855	298
Average	423	817	526	415	1037	521	859	1343	650	732

a) Did not participate in study, Fall 1994 and Winter 1995.

Regulatory and Advisory Standards:

- Title 22 (TTLC) - Must Not Exceed 5,000 ppm
- Green Seal - None

Figure 10. Zinc Content for All Collection Rounds Represented by Site and Collection Average (ppm).

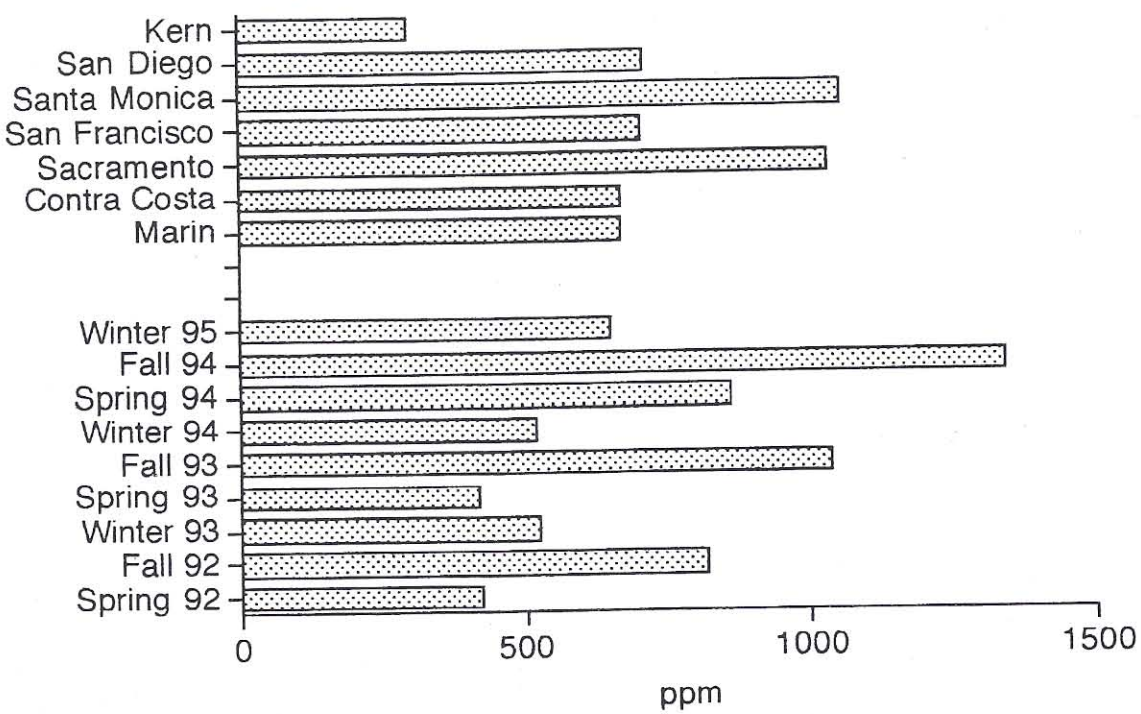


Table 18 (continued).

	Marin County	Contra Costa	Sacra-mento	SnFrn-cisco	Santa Monica	San Diego	Kern County
Toluene							
Spring 92	62	ND	84	ND	28	210	55
Fall 92	26	34	18	41	205	265	6
Winter 93	80	83	150	13	ND	160	70
Spring 93	51	40	ND	7	ND	84	34
Fall 93	27	44	26	15	4	63	13
Winter 94	ND	37	17	10	14	96	ND
Spring 94	27	25	18	3	24	150	10
Fall 94	3	27	a	9	3	11	ND
Winter 95	ND	ND	a	ND	20	ND	56
Ethyl-benzene							
Spring 92	22	23	82	31	32	120	41
Fall 92	16	52	25	91	66	56	118
Winter 93	21	76	37	250	ND	38	91
Spring 93	7	18	ND	ND	ND	61	28
Fall 93	11	36	27	34	59	52	41
Winter 94	10	38	31	9	ND	86	ND
Spring 94	ND	15	33	4	ND	78	48
Fall 94	5	13	a	ND	12	14	ND
Winter 95	ND	ND	a	ND	ND	ND	34
Trimethyl-benzenes							
Spring 92	22	20	80	ND	17	269	79
Fall 92	21	137	65	278	85	118	77
Winter 93	83	283	122	350	19	120	88
Spring 93	24	58	64	8	ND	177	52
Fall 93	29	116	118	103	10	74	45
Winter 94	ND	92	109	14	ND	234	ND
Spring 94	ND	100	170	18	17	111	710
Fall 94	13	62	a	14	4	21	12
Winter 95	23	56	a	9	ND	36	28
Xylenes							
Spring 92	100	41	214	110	112	347	176
Fall 92	58	205	63	480	87	184	53
Winter 93	82	350	138	950	ND	155	450
Spring 93	33	73	26	ND	ND	136	117
Fall 93	49	176	166	150	3	190	131
Winter 94	51	78	93	39	ND	440	ND
Spring 94	7	80	91	19	ND	43	470
Fall 94	18	58	a	15	74	29	5
Winter 95	ND	ND	a	13	ND	28	45

a) Did not participate in study, Fall 1994 and Winter 1995.

Table 18 (continued).

	Marin County	Contra Costa	Sacra-mento	SnFrn-cisco	Santa Monica	San Diego	Kern County
Propyl-benzenes							
Spring 92	ND	ND	ND	ND	ND	80	ND
Fall 92	ND	20	ND	61	14	13	4
Winter 93	11	57	17	135	ND	16	12
Spring 93	ND	8	1	ND	ND	33	ND
Fall 93	6	21	22	28	ND	14	12
Winter 94	ND	ND	22	ND	ND	20	ND
Spring 94	ND	41	38	2	ND	14	130
Fall 94	ND	12	a	ND	5	ND	ND
Winter 95	ND	ND	a	ND	ND	ND	ND
Naphth-alene							
Spring 92	ND	ND	ND	ND	ND	22	8
Fall 92	ND	ND	46	11	ND	64	ND
Winter 93	ND	ND	ND	ND	ND	ND	13
Spring 93	ND	ND	ND	ND	ND	14	ND
Fall 93	ND	26	29	ND	ND	ND	ND
Winter 94	ND	ND	7	ND	ND	ND	ND
Spring 94	ND	12	20	ND	ND	ND	14
Fall 94	ND	12	a	ND	ND	ND	ND
Winter 95	ND	ND	a	ND	ND	ND	ND
Benzoic Acid							
Spring 92	220	265	163	52	194	106	193
Fall 92	109	169	124	105	184	195	ND
Winter 93	ND	ND	ND	100	270	ND	ND
Spring 93	210	150	270	55	650	ND	140
Fall 93	64	93	ND	63	ND	ND	ND
Winter 94	ND	250	ND	ND	ND	ND	ND
Spring 94	ND	ND	ND	ND	ND	ND	ND
Fall 94	260	160	a	408	426	259	170
Winter 95	ND	ND	a	ND	ND	ND	ND
Phthalate Esters							
Spring 92	50	434	53	ND	ND	ND	41
Fall 92	330	19	284	69	45	535	129
Winter 93	ND	38	36	ND	ND	155	ND
Spring 93	54	ND	ND	ND	ND	66	33
Fall 93	ND	ND	ND	32	ND	ND	54
Winter 94	ND	ND	ND	ND	ND	436	152
Spring 94	ND	ND	ND	ND	ND	ND	ND
Fall 94	150	ND	a	39	ND	ND	ND
Winter 95	ND	72	a	13	ND	ND	ND

ND = None Detected; a) Did not participate in study, Fall 1994 and Winter 1995.

Volatile and Semi-Volatile Organic Compounds

All collected samples were analyzed for 54 possible volatile compounds by EPA Method 8260 and 65 possible semivolatile compounds by EPA Method 8270. Separate specific analytical procedures were requested for phenols, PCB's, and chlorinated pesticides if detected by EPA Methods 8260 and 8270. The complete analytical test results for volatile and semivolatile organic compounds are on file at Cal Poly and the Department of Toxic Substances Control and are available on request.

Discussion

Polychlorinated biphenyls (PCB's), phenols and chlorinated pesticides were not found in any of the 61 samples collected. The most frequently found compounds consisted of aromatic hydrocarbons, phthalate esters and benzoic acid. These are summarized in Table 18. Miscellaneous, or less frequently found compounds, are summarized in Table 19.

Table 18. Summary of Frequently Found Volatile and Semivolatile Organic Compounds in Latex Paint Samples for All Nine Collection Rounds (Spring 1992 through Winter 1995). Results are in mg/kg (ppm).

	Marin County	Contra Costa	Sacra-mento	SnFrn-cisco	Santa Monica	San Diego	Kern County
Benzene							
Spring 92	ND	ND	ND	ND	15	18	14
Fall 92	ND	ND	ND	ND	ND	ND	4
Winter 93	ND	10	ND	ND	ND	ND	ND
Spring 93	7	ND	ND	ND	32	10	ND
Fall 93	5	5	4	6	ND	9	ND
Winter 94	ND	ND	ND	ND	ND	ND	ND
Spring 94	ND	ND	ND	3	ND	11	ND
Fall 94	6	4	a	ND	34	5	ND
Winter 95	ND	ND	a	ND	ND	ND	ND

a) Did not participate in study, Fall 1994 and Winter 1995.

Table 19. Miscellaneous Volatile and Semi-Volatile Organic Compounds in Latex Paint Samples for the Nine Collection Rounds (Spring 1992 through Winter 1995). Results are in mg/kg (ppm).a)

Compound	Collection	ppm	Site
Methylene chloride	Spring 1992	15	San Francisco
	Spring 1992	13	San Diego
1,1-Dichloroethene	Winter 1993	2,700	Santa Monica
Tetrachloroethene	Spring 1992	19	Kern
	Spring1993	7	San Diego
	Winter 1994	25	Santa Monica
	Fall 1994	5	Marin
	Fall 1994	4	San Diego
1,1,1-Trichloroethane	Spring 1992	17	San Francisco
	Spring 1993	21	San Diego
Butanone	Spring 1992	850	San Diego
Styrene	Spring 1993	8	Contra Costa
	Fall 1993	7	Marin
	Fall 1994	4	Marin
Benzyl Alcohol	Spring 1992	16	Marin
	Spring 1992	43	San Diego
	Fall 1992	46	San Diego
	Winter 1994	180	San Diego
	Fall 1994	45	San Diego
	Winter 1995	14	Marin
PNAHC b)	Spring 1992	91	San Diego
sec-Butylbenzene	Spring 1994	11	Sacramento
	Spring 1994	57	Kern
	Spring 1994	9	Sacramento
	Spring 1994	22	Kern
1,4-Dichlorobenzene	Fall 1994	22	Santa Monica

a) Those sites not listed in Table 19 gave a value of zero or non-detected for the represented analyte.

b) PNAHC= polynuclear aromatic hydrocarbons and includes 26 ppm naphthalene, 11 ppm acenaphthene, 6 ppm fluorene, 26 ppm phenanthrene, 12 ppm fluoranthene, and 10 ppm pyrene. This finding was judged to have to have resulted from a contaminated sampling device which was allowed to contact hot asphalt rather than the collected paint.

PHYSICAL PROPERTIES OF THE COLLECTED PAINT

A latex paint is generally defined by its viscosity, solids content, density, and minimum particle size of suspended pigments. Other considerations include biological contamination and the total volatile organic compound (VOC) content. Information on these and other physical characteristics makes it possible to establish a plan for reconstituting the collected recyclable latex paints into a finished recycled latex paint of high quality. For example, if the density, viscosity, and solids content of a collected paint is excessively low this would indicate that dilution with water had occurred during its history as a consumer product and blending with a virgin material would be required to bring these physical characteristics back to an acceptable specification. These characteristics include the following:

- Many of the paints from the 61 collections are low in viscosity, density, and solids content in varying degrees and will require modification in order to convert them into a finished, high quality recycled latex paint.
- Biological contamination has not been observed in any of the collected paints.
- Most of the collected paints contain filterable solids ranging from almost 0 to nearly 1% indicating that a filtration step will be required in the conversion to a finished product in order to obtain paint that can be applied by spraying. If it were possible to segregate those paints with a very low (almost zero) filterable solids content, the filtration step could be omitted. If collected paint is not filtered and its viscosity is not adjusted prior to reuse by consumers, the quality of this paint may well be quite variable.
- Since some of the collection programs simply consolidate collected latex paint and give it away for reuse in an "as-is" condition, its quality depends entirely on the sophistication of sorting protocols that are in place at the consolidation site. When collected paint is converted to recycled paint by a paint manufacturer or other entity to bring it up to specific performance specifications and standards, the product normally carries a guarantee of a certain level of quality. Thus it would appear that high quality recycled latex paint as produced by a paint manufacturer or other similar professional, may unjustly obtain a bad reputation if no

distinction is made between their recycled paints and those brought to the marketplace by simple consolidation.

In order to determine the total VOC content of a latex paint, it is necessary to determine the water content, solids content, and density of that paint. In the course of this study, an improved method for determination of water, involving quantitative removal of water by azeotropic distillation was developed.[6] This method was used as one of the three methods required for determination of the total VOC content of the collected paints. Most regulatory limits for latex paints require that the VOC content be below 250 grams/(L minus Water).

The majority of the common physical properties have been determined for the latex paints obtained from the nine collection rounds and are presented in Tables 20-26. Both Federal and State of California bid specifications exist for virgin latex paints and similar specifications exist or are being formulated for recycled latex paint. A brief layman's explanation for each of the physical properties is presented at the end of each of the tables describing a particular property.

Table 20. Density in Pounds per Gallon of Recyclable Latex Paint.[7]

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin	10.69	10.86	10.67	10.21	9.97	10.70	10.90	10.50	10.50
Contra Costa	10.71	10.66	10.30	10.52	10.18	10.32	10.41	10.36	11.46
Sacramento	10.30	10.14	10.38	**9.29**	9.98	10.03	10.14	a	a
San Francisco	11.00	10.89	10.86	11.20	10.39	10.75	11.04	11.07	10.48
Santa Monica	10.46	10.02	10.35	**11.82**	10.59	10.26	10,58	10.55	10.44
San Diego	10.81	10.70	10.92	10.40	9.83	10.48	10.44	10.33	10.21
Kern	10.60	9.88	10.02	9.77	9.63	9.85	10.39	9.53	10.06
Composite	10.49	10.38	10.25	10.40	9.99	10.31	10.43	10.39	10.61

a) Did not participate in study, Fall 1994 and Winter 1995.

Water has a **weight or density** of 8.33 pounds per gallon. Since latex paint is made by combining very heavy (or dense) pigments and a binder (glue) with water, latex paint density is normally greater than water (normal latex paint densities are usually between 10 and 12 pounds per gallon). Low density (such as the bold-face 9.29 pounds per gallon for the Sacramento Spring 1993 collection) of a latex paint indicates high water content and would make the paint runny and would probably lower its hiding capacity. A high density such

as the bold-face 11.82 would indicate a low water content. Density is relatively easy to measure and might be used as a criterion for sorting latex paint. In order to measure other paint characteristics such as VOC content, a density determination is required.

The State of California bid specification for recycled flat latex exterior paint lists a minimum value of 10.5 lbs/gal for density. The Federal recycled paint specification (TT-P-2846) does not have a density requirement. Twenty-six of the 61 collected samples meet the State of California specification. Blending with proper virgin latex materials would insure that this specification is met for all of the collected paints.

Table 21. Viscosity in Krebs Units of Recyclable Latex Paint.[8)]

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin	75	70	72	66	78	88	94	70	84
Contra Costa	82	75	74	71	84	72	75	72	95
Sacramento	75	68	68	**55**	71	65	71	a	a
San Francisco	74	96	74	84	80	78	93	91	84
Santa Monica	81	61	70	**97**	87	68	78	99	77
San Diego	84	78	91	80	67	81	75	72	70
Kern	70	69	61	66	69	61	83	65	66
Composite	76	65	81	71	77	74	77	81	82

a) Did not participate in study, Fall 1994 and Winter 1995.

Viscosity is a measure of the thickness or consistency("runniness") of a paint. A paint viscosity of approximately 85 to 100 Krebs units (KU) describes a paint which would tend not to run down a vertical wall after application while retaining enough "runniness" to allow the paint film to flow enough to eliminate brush marks before complete drying occurs. The Federal specification for recycled latex paint (TT-P-2846) is 80-100 KU and represents normal latex paint viscosity though values slightly higher than 100 are sometimes encountered.

The State of California bid specification for recycled flat latex exterior paint gives a minimum viscosity value of 74 KU. Thirty-four (56%) of the 61 raw collected paints meet this specification (See table 21). Increasing the paint viscosity can be achieved by blending with virgin latex paint or by adding a small quantity of thickener. Since a large proportion (27 out of 61 samples) of the collected paints are low in viscosity, efforts to simply consolidate or reuse the collected paint could result in a runnier paint and give the user the perception that the paint is poor in quality.

Table 22. Weight Percent Solids of Recyclable Latex Paint.[9)]

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin	48.1	47.5	45.9	45.0	47.6	50.4	51.3	47.3	48.3
Contra Costa	51.2	45.0	42.5	46.8	48.3	45.4	45.5	43.6	56.9
Sacramento	42.9	43.5	45.4	**22.4**	41.1	40.1	42.1	a	a
San Francisco	48.1	52.3	48.5	53.2	53.4	51.2	53.4	52.4	46.9
Santa Monica	43.4	36.0	41.8	**56.5**	48.6	46.1	46.1	48.7	44.7
San Diego	47.0	46.2	48.7	44.5	41.6	47.7	45.4	43.6	43.3
Kern	46.9	33.6	41.4	38.5	37.3	39.7	44.7	33.1	41.8
Composite	46.5	45.4	45.1	46.9	45.7	46.0	44.8	44.8	47.5

a) Did not participate in study, Fall 1994 and Winter 1995.

Percent solids is a measure of what weight of paint remains on a surface after all of the solvents (including water) evaporate. A low solids content generally indicates that the resulting dried paint film would be very thin and could result in poor hiding of the surface being painted. A more precise way of determining what thickness the dried paint film has involves the determination of the solids percent by volume. This determination, however, is quite complicated. In general, the volume percent solids of most normal latex paints can be estimated by multiplying the weight percent solids by the factor 0.75. The Federal specification is 40% by volume minimum for interior recycled latex paints and 30% by volume minimum for exterior recycled latex paint. The Federal specification for virgin latex paint is the same.

The State of California bid specification for recycled flat latex exterior paint gives no minimum for solids. A recommended specification for minimum weight percent solids for recycled latex paint in Seattle, Washington is 45 %. Thirty-seven (61%) of the 61 collected paints meet this minimum and blending with proper virgin latex materials would insure that such a minimum could be met.

Table 23. Volatile Organic Compounds (VOC) of Recyclable Latex Paint, grams/(L minus Water).

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin		137				107	136	138	89
Contra Costa		269				158	199	168	84
Sacramento		186				184	171	a	a
San Francisco		202				128	141	146	107
Santa Monica		220				151	137	156	108
San Diego		198				110	177	215	131
Kern		227				146	161	216	112
Composite	133	163	162	129	136	145	168	165	102

a) Did not participate in study, Fall 1994 and Winter 1995.

VOC or volatile organic compounds is a measure of the relative number of grams of VOC to the total paint volume excluding water. The value is normally expressed in grams / Liter minus Water. For virgin paints the number is normally calculated from the known paint ingredients. For paints of unknown composition, the number must be determined experimentally. The experiment involves the measurement of the amount of water and solids in a known volume of paint of known weight. For example, if 1000 mL of paint weighs 1200 grams and contains 50 weight % water and 40 weight % solids, the remainder of 10% (120g) would be volatile organic compounds and the VOC calculation would be:

VOC = 120 g of VOC divided by (1.0 L paint minus 0.6 L Water)

= 300 grams VOC/(L minus Water)

Water is subtracted so that the VOC for a particular paint is the same no matter what the water content is. Cal Poly has developed new analytical methodology which gives VOC values with precision which is much better than that of the existing analytical methods.[6] Since the VOC maximum for latex paints is regulated and cannot exceed 250 grams/Liter minus Water, the determination must be carried out for recycled latex paints.

The VOC specification for all household latex paint is that the value should not exceed 250 grams/liter (excluding water). The VOC results presented in Table 23 indicate that all but one of the VOC values are below this maximum. The value given for the Fall 1992 Contra Costa collection is slightly higher than 250 g/L. For four of the collection rounds, the VOC value was determined only for the composite sample representing all seven sites and is assumed that the individual values are below the 250 g allowed maximum.

Table 24. Hydrogen Ion Concentration of Recyclable Latex Paint Measured as pH.

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin	7.6	7.2	7.5	8.4	8.3	8.3	8.0	7.7	8.5
Contra Costa	7.0	7.5	7.5	8.1	8.2	8.2	7.8	7.9	8.5
Sacramento	7.2	6.7	7.3	7.6	7.9	7.9	8.4	a	a
San Francisco	7.7	7.9	8.1	7.8	8.4	8.4	8.2	8.2	8.2
Santa Monica	8.1	7.2	7.7	8.2	8.1	8.1	8.2	7.8	7.7
San Diego	7.5	7.3	7.5	7.8	8.0	8.0	7.7	7.6	8.0
Kern	7.4	7.8	7.8	7.9	8.2	8.2	7.9	7.8	8.0
Composite	7.5	7.6	7.5	7.5	8.3	8.0	8.1	7.8	8.1

a) Did not participate in study, Fall 1994 and Winter 1995.

The **pH** is a measure of a paint's acidity (or alkalinity) and is related to the stability and often the viscosity of most latex paints. New latex paints normally have pH's between 7.5 and 9.5 and tend to change to lower alkalinity (lower pH values) while in storage since the volatile amines or ammonia which impart alkalinity evaporate over time. The pH of recyclable paint which has lost alkalinity can be restored by addition of suitable amines or ammonia.

Table 25. Filterable Solids of Recyclable Latex Paint, grams per kilogram.

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin			3.5	1.2	1.7		0.2	1.3	0.9
Contra Costa			4.6	2.3	4.3		3.5	4.3	1.0
Sacramento			2.2	0.1	0.7		4.6	a	a
San Francisco			7.9	0.2	0.6		0.1	0.3	0.1
Santa Monica			8.4	0	0.2		0.9	0.5	0
San Diego			7.5	1.5	3.4		4.8	4.9	0.8
Kern			1.3	0.2	1.4		2.1	0.6	1.5
Average			5.0	0.8	1.8		1.8	2.0	0.7

a) Did not participate in study, Fall 1994 and Winter 1995.

Filterable solids were measured by filtering a weighed quantity of collected paint through a 100 mesh nylon filter, washing repeatedly with water and drying for 30 minutes at 110 degrees Celsius. Starting with the Spring 1994 collection, paint was filtered using a Vortisieve vibrating filtration unit and a 150 mesh nylon filter. The quantity of filterable solids defines that portion of paint which is essentially no longer a usable liquid paint and is a measure of the amount of particulate matter consisting principally of dried paint and what appears to be sand, dirt, and other foreign matter in the collected paint. Direct use of these paints would result in a poor quality paint film which would have visible foreign matter as part of the film. Recycling by a paint manufacturer would insure that foreign matter is removed in a filtration step. Virgin paint does not contain filterable solids.

Table 26. Hegman Grind Values of Recyclable Latex Paint.[10)]

	Spring 92	Fall 92	Winter 93	Spring 93	Fall 93	Winter 94	Spring 94	Fall 94	Winter 95
Marin			3.0	3.0	2.5	2.5	3.5	3.5	3.5
Contra Costa			3.0	3.0	1.0	3.0	2.5	3.0	3.5
Sacramento			3.0	2.0	4.0	4.0	3.0	a	a
San Francisco			4.0	4.0	3.0	3.0	3.0	3.5	4.0
Santa Monica			4.0	6.0	4.5	4.0	3.5	4.0	4.5
San Diego			4.0	3.0	4.0	4.0	3.0	3.5	4.0
Kern			5.0	5.0	2.5	3.0	2.5	3.0	3.0
Composite					3.0	3.0	3.0	3.0	3.5

a) Did not participate in study, Fall 1994 and Winter 1995.

The **Hegman grind** value (also called fineness of grind) is a measure of the size of pigment particles in paint and is therefore an indication of its suitability for spray application. Hegman grind values of less than 3 or 4 may clog spray nozzles. A Grind value of 0 indicates a particle size of 4 mils or 100 microns. As the Hegman value increases from 0 to 8, the fineness of grind decreases by 0.5 mil (25 micron) increments until at a value of 8 (the theoretically impossible value of a zero micron particle size) is reached.

As the data of Table 26 show, many of the recyclable latex paints contain a sufficient amount of large particle size material to make them unacceptable for potential spray application in an "as-is" condition. Consultation with the State of California Department of General Services indicated that their bid specifications for a recycled latex paint may include a minimum Hegman Grind value of 4. Of the 47 sample tested, 17 meet this specification.

Discussion

The collected recyclable paints have a lower viscosity, higher amounts of filterable solids, lower per cent solids, lower grind values and lower densities than virgin latex paint. The probable causes of these differences can be attributed to dilution of the original paints with water by the consumer or other parties and drying of the paint while exposed to the atmosphere. For individuals that might use collected paint directly without careful sorting protocols established, it could mean that they would encounter problems with sag, very thin coats of paint and possible poor hiding of the surface being painted. Two of the recyclable latex paints in the above physical properties tables represent extremes (bold face; see density, viscosity, and solids). The Spring 1993 Sacramento collection appears to have been excessively diluted with water, as indicted by extremely low solids, viscosity, and density values. The Spring 1993

Santa Monica collection, on the other hand has properties equivalent to that of a virgin latex paint. Visually, this paint appears to be a pure white while most of the other paints are mixed colors or off-white. It is also interesting to note that the Santa Monica Spring 1993 collection has the highest mercury level (236 ppm) of all paints collected to date.

When paint products originate by simple consolidation at collection programs, where few adjustments to paint quality other than sorting can be made, the quality of the paint can be expected to be variable and may even be unacceptable unless very stringent separation and sorting collection protocols are used. Since most reuse programs are located at (or are done through) the HHWC sites, they serve to divert potential illegal disposal activities and/or processing costs for the jurisdiction. Programs that rely strictly on reuse efforts should consider utilizing strict separation and sorting protocols. The question of whether "reuse" paints should be used as interior paints needs to be critically evaluated from the standpoint of possible mercury or lead levels in these paints.

PERFORMANCE EVALUATION OF FINISHED RECYCLED LATEX PAINT

Prior to September 30, 1992, six California paint companies had agreed to participate in the Cal Poly Project by accepting samples of recyclable paint for the purpose of evaluating it as a raw material for the production of a finished recycled latex paint. Samples of their finished product were then to be sent to Cal Poly for performance evaluation. By June 1993, only two samples of finished recycled latex paint made from a composite of the first collection round (Composite 001, Spring 1992) had been received by Cal Poly for performance testing, one from Triangle Coatings and one from San Luis Paint Company.

The two recycled paints received by Cal Poly were evaluated and compared with the starting recyclable latex paint (Composite 001), with a virgin, vinyl-acrylic, flat, exterior latex paint (San Luis Paint Company "Weathercoat"), and with Major Paint's "Norcal Beige", a "Cycle II " recycled semi-gloss latex paint. It has been pointed out that the comparison of a semi-gloss paint with a flat paint may not be valid. Accordingly, flat recycled latex paints obtained from Major Paint Company and from the Kelly-Moore Paint Company have been tested and compared with virgin flat paints as well as the recycled paints prepared in the Cal Poly study.

The possibility that finished paint samples might be prepared at Cal Poly with technical advice provided by participating paint companies, rather than having them actually made by the paint companies, was discussed at the March 1993 Paint Task Force meeting and was explored further by its Cal Poly Subcommittee. There was general agreement that this was a good idea. A formal request was sent to the CIWMB to change contract language of the original proposal and approvals were put in place for Cal Poly to explore their own formulas for producing a high quality recycled latex paint.

Preparation and Evaluation of Recycled Latex Paints

- **Recycled Paints Prepared by Paint Manufacturers from Collected Material.**

Two recycled paints were evaluated and compared with the starting recyclable latex paint from the first collection round (Spring 1992), with an "off-the-shelf" virgin, vinyl-acrylic, flat, exterior latex paint (San Luis Paint Company

"Weathercoat") selling for $16 per gallon, and with Major Paint Company's "Norcal Beige", a "Cycle II" recycled semi-gloss latex paint. Designations for these paints are as follows:

- 001 — Composite recyclable latex paint from Spring 1992 collection.
- SLO — San Luis Paint Company's finished product made from Composite 001.
- TRI — Triangle Coatings Company's finished product made from Composite 001.
- MP-NB — Major Paint Company's Norcal Beige, a Cycle II semi-gloss, finished recycled latex paint.
- WHC — San Luis Paint Company's "Weathercoat", a virgin vinyl-acrylic flat exterior latex paint.

Table 27. Performance Characteristics of Recycled Latex Paint Prepared from Collected Paints by Triangle Coatings Company and San Luis Paint Company.

Sample	001	SLO	TRI	MP-NB	WHC
Density, lbs/gal	10.49	10.69	10.33	8.88	12.06
Viscosity, KU	76	90	71	81	102
Solids, Wt %	46.5	47.1	47.3	29.4	53.8
Water, Wt %	49.5				
pH	7.5	8.5	8.2	8.3	8.5
Bacterial Contam.	Neg	Neg	Neg		
VOC, g/L-Water	133				80
Scrub Resistance, cycles a)	620	820	930	250	1700
Opacity, V0.98 b)		652	652	661	480
Grind, Hegman	4	5	5	4	5

a) Reference 11.
b) Reference 12

Discussion

No information was provided regarding the strategy used by Triangle Coatings to make their finished product from Composite 001. Judging from the color, weight per gallon and percent solids of their material, it appears that Triangle did nothing to the paint to change the viscosity but did add a substance to raise the pH. San Luis Paint Company indicated that they added AMP-95 (aminomethyl propanol, Angus Company) to increase the pH and both an associative thickener and a cellulosic thickener to increase the viscosity. All of the recycled paints have good opacity (hiding power) which is expressed in

Table 27 as spreading rate or the amount of surface area that can be painted with one gallon of paint to give 98% hiding of the surface under the paint film.

It should be noted that only the first three paints (001, SLO, and TRI) are similar in composition. Conclusions regarding the comparable performance characteristics of these five paints were not attempted at that early stage of the Cal Poly project.

Scrub resistance of a paint is a performance criterion that is normally used to evaluate interior paints but can also be used to evaluate exterior paints. The Green Seal standard contains a 100 cycle (200 separate strokes) minimum for interior paints and does not require this abrasion test for exterior paints. Based on this standard, the one Cycle II paint that we have examined, is well above this limit. The Federal Specification, TT-P-2846, for recycled interior latex paint specifies a 300 cycle minimum for scrub resistance.

Cal Poly has subsequently prepared and performance-tested 36 recycled latex paints using composite collected recyclable latex paint from the 2nd, 3rd, 4th, 6th, 7th, and 9th collection rounds. Seven different commercial virgin latex paints were used as blending material to prepare recycled flat paints. A commercial latex, Ucar 376 (Union Carbide Company), was used to prepare recycled semi-gloss paints.

Four different types of latex paint were developed. The specific types are:

- Type A — made from 100% post-consumer recyclable latex paint
- Type B — made from 50% virgin latex paint mixed with 50% post-consumer recyclable latex paint
- Type C — made from 50% virgin latex paint mixed with 15% post-consumer recyclable latex paint and 35% secondary latex paint (filterable solids and wash water from plant cleaning operations)
- Type D — made from 80% post-consumer recyclable latex paint and 20% virgin latex (Union Carbide Ucar 376)

The virgin materials selected for blending included the following:

- WC — San Luis Paint Company's "Weathercoat", a quality vinyl-acrylic exterior latex paint retailing for $16 per gallon.

- RA San Luis Paint Company's "Rancho", an alkyd-containing vinyl-acrylic latex paint retailing for $14.75 per gallon advertised as barn and fence paint.
- TVE True Value Hardware Company's least expensive "Exterior", a vinyl-acrylic latex paint retailing for $9.98 per gallon.
- TVI True Value Hardware Company's "Master Touch", a vinyl-acrylic interior latex paint retailing for $8.98 per gallon.
- SRS Sears "Weatherbeater", an exterior acrylic latex selling for $10.99 per gallon.
- FOB Fuller O'Brien Company exterior/interior acrylic latex selling for $14.70 per gallon.
- AM Ameritone Company exterior/interior vinyl/ acrylic flat.
- UC Union Carbide Company's Ucar 376, a binder commonly used for making latex paint.

The prices listed for the True Value, Sears, and Fuller O'Brien virgin paints represent the least expensive latex paints available from these companies at the time of purchase and it is assumed that these paints therefore represent the lower end of the performance spectrum. Secondary latex paint used by us was made by mixing virgin latex paint with water in a 1:1 ratio by weight.

In addition to the paints prepared by Cal Poly, four commercial flat recycled paints obtained from Major Paint Company and the Kelly Moore Company were tested and compared with the recycled latex paints prepared in this study. These commercial recycled paints included the following:

- MP-PB Major Paint Company's Cycle II Palomino Beige , a flat recycled paint similar in composition to our Type C paints containing a maximum of 12% post-consumer latex paint.
- MP-BR Major Paint Company's Cycle II Brick Red , a flat recycled paint similar in composition to our Type C paints containing a maximum of 12% post-consumer latex paint.
- KM-Sa Kelly Moore Paint Company's Sand , a recycled flat latex paint of proprietary composition containing a minimum of 50% post-consumer latex paint.

- KM-DG Kelly Moore paint Company's Dark Gray , a recycled flat latex paint of proprietary composition containing a minimum of 50% post-consumer latex paint.

The pH of all paints was adjusted with AMP-95 (95% aminomethylpropanol, Angus Chemical Company). The viscosity of most paints was adjusted using a fluidized hydroxyethylcellulose (Aqualon Company's Natrosol FPS) and the latex paint thickeners SCT-275 (Union Carbide Company) and Acrysol TT-935 (Rohm and Haas Company). The post-consumer paint was filtered through a 100 mesh nylon filter prior to conversion into a finished recycled paint. After addition of appropriate ingredients, the mixture was stirred at low speed to achieve a homogeneous mixture, was further mixed for five minutes on a paint shaker, and was then again filtered through a 100 mesh nylon filter.

In carrying out performance tests on these recycled latex paints, the Federal Specification for recycled latex paints (TT-P-2846) was used for making comparisons to a standard. The results of performance testing are presented in Tables 28-37. Recycled paints are designated with the post-consumer collection used , type of paint made, and virgin latex paint used for blending. All paints with designations beginning with "00" are paints formulated by Cal Poly. For example, a paint designated as 002-A, would represent paint type A (100% post-consumer paint) made by Cal Poly from recyclable material from the second collection round (Fall 1992 collection), while a paint designated as 004-B-WC would represent a type B paint made by Cal Poly from post-consumer recyclable paint from the fourth collection round and the virgin paint "Weathercoat".

- **Type A Paints: 100% Unsorted Post-Consumer Content - Viscosity and pH Adjustment.**

Table 28 lists the amounts of thickener and AMP-95 added to 800g of collected post-consumer latex paint to raise the viscosity and pH, respectively, to normal levels. The post-consumer paint was filtered through a 100 mesh nylon filter prior to conversion into a finished recycled paint. After addition of appropriate ingredients, the mixture was stirred at low speed to achieve a homogeneous mixture, was further mixed for five minutes on a paint shaker,

and was then again filtered through a 100 mesh nylon filter. Values for the properties of the Kelly Moore Company and Major Paint Company recycled latex paints, and the 100% virgin commercial paints used for blending, have been added to Tables 28, 31 and 35 for comparison purposes. The Kelly Moore Company recycled paints are known to have a minimum of 50% post-consumer content but may contain a much higher percentage since their formulations are proprietary. The Major Paint Company recycled paints are reported to contain 10-12% post-consumer paint, 38-40% pre-consumer latex paint (secondary waste or wash water), and 50% virgin latex paint. A discussion of the significance of the results presented in the following tables is presented after listing specific properties for each paint type.

Table 28. Type A Paints: 100% Post-Consumer Content - Viscosity and pH Adjustment Compared with Commercially Available Recycled and Virgin Paints.

Paint	Initial Viscosity, KU[a)]	Thickener Added, grams[b)]	Final Viscosity, KU[a)]	Initial pH	AMP-95 Added, grams	Final pH
002-A	65	2.5 N	85	7.6	1.25	8.3
003-A	81	1.0 N	83	7.5	1.25	8.5
004-A	71	2.0 N	84	7.5	1.25	8.9
006-A	69	16.0 S	85	8.0	1.60	9.4
007-A	72	16.0 S	88	7.5	1.60	9.4
009-A	82	0	82	7.8	1.60	8.9
100% WC			102			8.5
100% RA			98			9.5
100%TVE			92			9.0
100% SRS			98			9.5
100% FOB			92			9.5
100% TVI			96			9.8
100% AM			95			10.1
MP-PB			100			8.0
MP-BR			80			7.5
KM-Sa			76			8.9
KM-DG			81			9.1

a) Reference 8.
b) N = Natrosol FPS; S = SCT 275; A = Acrysol TT - 935.

- **Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint - Viscosity and pH Adjustment.**

The finished recycled paints formulated by Cal Poly were made from 50-50 by weight blends of collected post-consumer composites and the virgin latex paints described above. Table 29 lists the amounts of thickener and AMP-95 added to 800g of the blend to raise the viscosity and pH, respectively, to normal levels.

Table 29. Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint - Viscosity and pH Adjustment.

Paint	Initial Viscosity, KU[a)]	Thickener Added, grams[b)]	Final Viscosity, KU[a)]	Initial pH	AMP-95 Added, grams	Final pH
002B-WC	86	0.5 N	88	7.5	1.25	8.6
003B-WC	82	2.0 N	87	7.5	1.25	8.5
004B-WC	82	1.0 N	85	7.5	1.25	8.7
002B-RA	82	2.0 N	86	7.6	1.25	8.5
003B-RA	78	4.0 N	87	7.4	1.25	8.5
004B-RA	83	4.0 N	89	7.5	1.25	8.8
002B-TVE	78	5.0 N	86	7.5	1.25	8.4
003B-TVE	75	5.0 N	85	7.5	1.25	8.4
004B-TVE	81	6.0 N	89	7.5	1.25	8.9
006B-SRS	85	0	85	9.2	0	9.2
007B-FOB	82	8.0 S	90	9.2	0	9.2
009B-TVI	86	0	86	8.0	1.60	9.6
009B-AM	91	0	91	9.2	0	9.2

a) Reference 8.
b) N = Natrosol FPS; S = SCT 275; A = Acrysol TT - 935.

- **Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Latex Paint - Viscosity and pH Adjustment.**

The finished recycled paints formulated by Cal Poly were made from 15-50-35 by weight blends of collected post-consumer composites, the virgin latex paints described above, and secondary latex paint, respectively. The secondary latex paint represents wash water which a paint manufacturer might use in the manufacture of recycled latex paint. In the present study, wash water was obtained by blending virgin paint with 50 weight percent deionized water. Table 30 lists the amounts of thickener and AMP-95 added to 800g of the blend to raise the viscosity and pH, respectively, to normal levels.

Table 30. Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Waste - Viscosity and pH Adjustment.

Paint	Initial Viscosity, KU[a)]	Thickener Added, grams[b)]	Final Viscosity, KU[a)]	Initial pH	AMP-95 Added, grams	Final pH
002C-WC	65	10 N	90	7.4	1.25	8.4
003C-WC	65	10 N	93	7.6	1.25	8.3
004C-WC	65	12 N	84	7.5	1.25	8.5
002C-RA	63	13 N	92	7.5	1.25	8.6
003C-RA	63	13 N	92	7.5	1.25	8.5
004C-RA	64	12 N	96	7.7	1.25	9.2
002C-TVE	65	16 N	90	7.6	1.25	8.5
003C-TVE	63	16 N	89	7.5	1.25	8.5
004C-TVE	64	12 N	86	7.5	1.25	8.4
006C-SRS	68	16 S	83	9.5	0	9.5
007C-FOB	63	16 S	82	9.4	0	9.4
009C-TVI	65	6 A	92	9.4	0	9.4
009C-AM	68	6 A	82	10.0	0	10.0

a) Reference 8.
b) N = Natrosol FPS; S = SCT 275; A = Acrysol TT - 935.

Discussion of Viscosity and pH Adjustment for Paint Types A, B, and C.

Relatively small amounts of AMP-95 are required for raising the **pH** of all paints to that of a normal latex paint which is usually between 8 and 10. In some instances no pH adjustment was required. Relatively small amounts of thickener (hydroxyethylcellulose or the various synthetic thickeners) are adequate to increase the **viscosity** of Type A and Type B paints to values above 85 Krebs Units. Type C paints require more thickener because a relatively large amount

of additional water (17.5 %) is a part of the secondary latex paint used for blending. Most paint specifications call for a viscosity of 85-100 KU's. The Federal Specification, TT-P-2846, calls for a paint viscosity of 80-100 KU.

- **Type A Paints: 100% Post-Consumer Content - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.**

Table 31. Type A Paints: 100% Post-Consumer Content - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints Compared with Commercially Available Recycled and Virgin Latex Paints.

Paint	Scrub Resistance a)	Sag Resistance b)	Contrast Ratio c)	Reflectance	Gloss, 60^0
002-A	675/650	11	1.00	40.97	1.5
003-A	540/400	8	1.00	39.25	1.5
004-A	450/495	10	1.00	44.30	2.3
006-A	330/310	11	1.00	39.6	1.7
007-A	540/420	10	1.00	43.8	1.5
009-A	400/430	11	1.00	39.0	1.2
100% WC	1700/1600	12	0.99	84.0	1.1
100% RA	900+	12	0.98	82.0	1.1
100% SRS	850/800	12	0.98	78.7	1.0
100% FOB	120/120	12	0.97	82.4	1.0
100% TVI	90/95	12	0.90	84.0	1.0
100% AM	600+	12	0.96	89.0	1.1
MP-PB	95	12	0.99	62.0	1.1
MP-BR	135	11	0.99	13.0	1.2
KM-Sa	470	10	0.98	62.0	1.0
KM-DG	405	11	1.0	11.0	1.1

a) Reference 11.
b) Reference 13.
c) Reference 12.

- **Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.**

Table 32. Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.

Paint	Scrub Resistance a)	Sag Resistance b)	Contrast Ratio c)	Reflectance	Gloss, 60^0
002B-WC	850/900	12	1.00	50.6	1.1
003B-WC	1140/1040	12	1.00	46.3	1.1
004B-WC	750/925	12	1.00	54.0	1.3
002B-RA	1145/1150	12	1.00	50.2	0.9
003B-RA	1020/1140	12	1.00	48.6	0.9
004B-RA	1500/1300	12	1.00	52.1	1.2
002B-TVE	850/860	12	1.00	49.1	1.9
003B-TVE	980/990	12	1.00	47.4	1.9
004B-TVE	660/660	12	1.00	51.2	1.3
006B-SRS	650/680	12	1.00	50.9	1.2
007B-FOB	540/450	12	1.00	53.5	1.2
009B-TVI	140/170	11	0.97	65.6	1.1
009B-AM	600+	12	0.98	63.3	1.0

a) Reference 11.
b) Reference 13.
c) Reference 12.

- **Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Waste- Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.**

Table 33. Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Waste- Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.

Paint	Scrub Resistance a)	Sag Resistance b)	Contrast Ratio c)	Reflectance	Gloss, 60 Deg.
002C-WC	850/860	11	0.99	65.58	1.1
003C-WC	800/900	12	0.99	64.42	1.9
004C-WC	850/900	12	0.99	66.33	1.2
002C-RA	990/1050	12	0.98	62.28	1.0
003C-RA	900/900	12	0.98	61.46	1.0
004C-RA	850/900	12	0.98	63.66	1.1
002C-TVE	630/625	7	0.97	60.41	2.0
003C-TVE	750/780	7	0.97	59.20	1.9
004C-TVE	900/800	6	0.97	61.91	2.1
006C-SRS	290/360	9	0.98	62.8	1.0
007C-FOB	190/220	9	0.98	66.8	1.1
009B-TVI	35/40	8	0.93	71.9	1.0
009B-AM	650/700	11	0.96	72.2	1.1

a) Reference 11.
b) Reference 13.
c) Reference 12.

- **Type D Paints: 80% Collected Post-Consumer Latex Paint Blended with 20% Virgin Latex (Union Carbide Ucar 376) - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.**

Table 34. Type D Paints: 80% Collected Post-Consumer Latex Paint Blended with 20% Virgin Latex (Union Carbide Ucar 376) - Scrub Resistance, Sag, Contrast Ratio, and Gloss of Recycled Paints.

Paint	Scrub Resistance a)	Sag Resistance b)	Contrast Ratio c)	Reflectance	Gloss, 60^0
002D	2050	12	1.0	42.06	9.7
003D	2290	12	0.99	39.43	9.6
004D	2150	12	1.0	45.77	11.0

a) Reference 11.
b) Reference 13.
c) Reference 12.

Discussion of Scrub Resistance, Sag, Contrast Ratio, and Gloss of Type A, B, C, and D Recycled Paints

The **scrub resistance**, which is an indication of the resistance of a paint film to repeated washing or scrubbing, for all of the recycled paint types prepared in this study is excellent. The Federal Specification TT-P-2846 gives a minimum value of 300 scrubs for a grade A recycled paint (40% minimum volume solids) and 150 scrubs for a grade B recycled paint (30% minimum volume solids). The Federal specifications indicate that both grade A and grade B paints are for use on interior and exterior wallboard, concrete, stucco, masonry, and wood but do not indicate why different grades are specified. Some new (virgin) latex interior paints have scrub resistances which are below the proposed federal specification of 150 while most are equivalent to that observed for the recycled latex paints prepared in this study.

Sag resistance is a measure of a paint's tendency to run on a vertical surface and is related to viscosity. It is desirable for a paint not to run (sag) on a vertical surface yet run just enough before drying to prevent the formation of brush or roller marks (called leveling). Thus paints are formulated to have different viscosities at different shear rates, i.e., the movement of a paint brush produces shear and temporarily reduces paint viscosity. A sag value of 12 (anti-sag index) indicates no sag while lower values indicate a tendency to sag. The interpretation of sag-index ratings is empirical and strongly subjective but in general, a value of 12 indicates excellent sag resistance, a value of 8 would be

considered good, a value of 6 as fair and a value of 4 as poor. Type A paints show only a slight tendency to sag. Type B paints are almost all excellent and show little sagging. Type C paints made from True Value's virgin paint (least expensive paint) exhibit only fair sag resistance.

The **opacity** or **hiding power** (ability of a paint to cover or obliterate a surface) is excellent for all of the recycled paints that have been made. Hiding power may also be expressed as a **contrast ratio** at a specified reflectance. There is a relationship between percent solids and hiding power. Specifically, if percent solids is low, thinner paint films are obtained when the paint dries. These thinner paint films consequently could give lower hiding than thicker paint films. Since hiding is also related to the amount of titanium dioxide in the paint, thickness of paint films alone should not be used as the only criterion for hiding. A paint manufacturer is able to produce paints which give very good hiding even for thin paint films by adjusting titanium dioxide levels.

The hiding power measurement was made at a spreading rate of 535 square feet per gallon (3 mil wet film thickness). The Federal Specification (TT-P-2846) for recycled paints recommends a spreading rate of 400 square feet per gallon (4 mil wet film thickness) and suggests the following minimum contrast ratios at various reflectances:

Reflectance	Contrast Ratio
>80	0.92 min.
76-79	0.93 min.
72-75	0.94 min.
68-71	0.95 min.
61-67	0.96 min.
< 60	0.98 min.

All of the recycled paints meet the contrast ratio specification at a spreading rate which is even higher than that in the Federal Specification (i.e., the recycled paint can be applied to a larger surface area and still give acceptable hiding). The Type C paints, because of higher water content, show a tendency to give slightly lower hiding. It should be note that **reflectance** values are a measure of the "whiteness" of a paint. A low value of reflectance does not mean that the paint is inferior in any way but simply gives an indication of where on the white-black spectrum the paint is represented. Thus, a reflectance value greater than 80 means that the paint is very white while a value of 10 or below would indicate the paint to be very dark gray or close to being black.

The 60^0 **gloss** values for the Type A, B, and C recycled paints are generally between 1 and 2 and meet the gloss specification for flat paints. Federal Specification TT-P-2846 gives a maximum value of 10 (using an 85^0 gloss meter) for flat paints. For a Class 2 (eggshell or low gloss) recycled latex paint a gloss specification of 15-25 (60^0) is given. Three recycled paints (002D, 003D, and 004D) were prepared by blending the latex Ucar 376 (binder) with collected paints to demonstrate that gloss can be increased. At 20% Ucar 376, the 60^0 gloss was increased from 2 to approximately 10. Incorporation of more binder would increase gloss even further.

- **Type A Paints: 100% Post-Consumer Content - Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance.**

Table 35. Type A Paints: 100% Post-Consumer Content - Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance Compared with Commercially Available Recycled and Virgin Latex Paints.

Paint	Density[a] (lbs/gal)	Solids[b] (weight %)	Grind[c] (Hegman)	Flexibility[d] (1/4 inch mandrel)	Alkali Resistance[e]
002-A	10.38	45.35	4+	Pass	Negative
003-A	10.25	45.07	3+	Pass	Negative
004-A	10.40	46.93	4+	Pass	Negative
006-A	10.31	45.16	3	Pass	Negative
007-A	10.43	43.92	3	Pass	Negative
009-A	10.61	47.49	4	Pass	Negative
100% WC	12.06	53.80	5	Pass	Negative
100% RA					
100%TVE					
100% SRS	11.19	48.68	5	Pass	Negative
100% FOB	11.43	48.41	5+	Pass	Negative
100% TVI	10.82	44.76	4+	Pass	Negative
100% AM	11.67	56.01	4+	Pass	Negative
MP-PB	10.09	36.25	2.5	Pass	Negative
MP-BR	9.42	32.36	4.5	Pass	Negative
KM-Sa	10.64	49.75	5	Pass	Negative
KM-DG	9.54	49.64	5	Pass	Negative

a) Reference 7.
b) Reference 9.
c) Reference 10.
d) Federal Test Method 6221, FED-STD-141.
e) Reference 14.

- **Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint. Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance.**

Table 36. Type B Paints: 50% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint - Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance.

Paint	Density[a] (lbs/gal)	Solids[b] (weight %)	Grind[c] (Hegman)	Flexibility[d] (1/4 inch mandrel)	Alkali Resistance[e]
002B-WC	11.12	54.34	3	Pass	Negative
003B-WC	10.95	54.18	3	Pass	Negative
004B-WC	11.12	55.15	4	Pass	Negative
002B-RA	10.77	50.91	3+	Pass	Negative
003B-RA	10.65	50.84	3+	Pass	Negative
004B-RA	10.77	51.84	4+	Pass	Negative
002B-TV	10.13	41.88	3	Pass	Softens
003B-TV	10.13	41.82	3	Pass	Negative
004B-TV	10.15	42.85	4	Pass	Softens
006B-SRS	10.72	46.97	3.5	Pass	Negative
007B-FOB	10.87	46.26	3.5	Pass	Negative
009B-TVI	10.77	46.14	3	Pass	Negative
009B-AM	10.74	51.88	3.5	Pass	Negative

a) Reference 7.
b) Reference 9.
c) Reference 10.
d) Federal Test Method 6221, FED-STD-141.
e) Reference 14.

- **Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Waste. Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance.**

Table 37. Type C Paints: 15% Collected Post-Consumer Latex Paint Blended with 50% Virgin Latex Paint and 35% Secondary Waste - Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance.

Paint	Density[a] (lbs/gal)	Solids[b] (weight %)	Grind[c] (Hegman)	Flexibility[d] (1/4 inch mandrel)	Alkali Resistance[e]
002C-WC	10.70	49.43	2	Pass	Negative
003C-WC	10.71	49.39	2+	Pass	Negative
004C-WC	10.68	49.72	3-	Pass	Negative
002C-RA	10.44	45.01	3-	Pass	Negative
003C-RA	10.42	44.99	3-	Pass	Negative
004C-RA	10.52	45.32	3+	Pass	Negative
002C-TV	9.64	33.21	2+	Pass	Softens
003C-TV	9.60	33.19	3-	Pass	Negative
004C-TV	9.73	33.54	3-	Pass	Negative
006C-SRS	10.65	39.31	3.0	Pass	Negative
007C-FOB	10.80	39.00	3.5	Pass	Negative
009B-TVI	10.28	37.56	4	Pass	Negative
009B-AM	10.24	45.12	4	Pass	Negative

a) Reference 7.
b) Reference 9.
c) Reference 10.
d) Federal Test Method 6221, FED-STD-141.
e) Reference 14.

Discussion of Density, Solids Content, Fineness of Grind, Flexibility and Chemical Resistance of Type A, B, and C Latex Paints.

The **densities** of most of the recycled paints formulated by Cal Poly appear to represent normal values for latex paint. The Type C paints made from True Value's exterior latex appear to have somewhat low values which are the result of added secondary paint and the minimal paint characteristics of the virgin material.

Federal Specification TT-P-2846 for recycled latex paint gives a **volume percent solids** minimum of 40% for their Grade A paints, a 30% minimum for their Grade B paints, and no minimum for graffiti abatement paints. Solids were measured as **weight per cent solids** and are therefore approximately 5% to 10% higher than the corresponding volume percent solids. Most of the recycled paints would therefore meet the Grade B specification while the Type

C paints would meet only the graffiti abatement specification. Some paint manufacturers have stated that the specification of 40% minimum volume solids for Grade A paints would be difficult to meet even for many virgin latex paints.

The Federal Specification gives a minimum fineness of **grind** value of 3 (values numerically lower than 3 would not meet the specification). While most grind values for the recycled paints prepared by us are borderline, this specification should not present a problem since proper paint filtration can normally correct this characteristic.

The recycled paints were applied on steel panels at a wet film thickness of 0.001 inch, were air-dried for 18 hours, and then further dried at 105^0C for 3 hours. After cooling, the painted panels were bent over a 1/4 inch mandrel and examined under a magnification of 7 diameters. None of the cured paints showed loss of adhesion or cracking and therefore meet the Federal Specification for **flexibility**.

All of the cured recycled paints were tested with 0.1 normal sodium phosphate solution using the open spot test method and a one hour time interval. This test is a means of subjecting the paint film to a highly alkaline environment and measures **alkali resistance** which is related to the consumer environment where soap solutions represent the alkaline environment. Most paint films were not affected by this treatment. Three of the paint films containing True Value exterior latex paint showed softening.

COLLECTION AND SORTING GUIDELINES

A concern that has been expressed and discussed at several PRTF meetings relates to the color of finished recycled paint. It was generally agreed that white recycled paint can only be obtained if collected paint is color sorted at the collection site. Also, certain other colors of paint containing a high post consumer content can only be obtained and reproduced if color sorting is carried out at the collection site or recycled paint manufacturing location. The Major Paint Company "Cycle II" line of recycled latex paints is available in various colors and contains approximately 10 to 12% post-consumer latex paint, 38 to 40% secondary latex paint, and 50% virgin material. This composition was chosen by the Major Paint Company to make it possible to manufacture specific reproducible colors and to provide the company a means of disposing of secondary paint or wash water. Accordingly, a study was undertaken by Cal Poly to establish the level of post-consumer paint content at which reproducible colors could be achieved using unsorted collected post-consumer latex paint/virgin paint mixtures.

A paint company normally makes virgin paints called tint bases. Typically a company may have a light, medium, dark and masstone tint base. A light tint base usually is a white paint containing approximately 2 pounds of titanium dioxide per gallon of tint base. Titanium dioxide makes the paint white and since it also has an exceptionally high ability to scatter light, it gives good hiding of the surface being painted. Other white pigments such as calcium carbonate, talc, or silica are added to paint as extender pigments to give "flatness" and other characteristics to the paint but since these don't scatter light very well, their hide properties are not as good as that of titanium dioxide. For example, a crayon mark on a wall would be covered up or "hidden" with a single coat of paint containing titanium dioxide, but would still show through with one containing only calcium carbonate. A medium tint base has less titanium dioxide, a dark tint base has minimal titanium dioxide and a mass tone has no titanium dioxide and is colorless or "whiteless".

If a tint base has lots of titanium dioxide, it hides the surface well but is very difficult to change to a dark or intense color by adding colorants. This type of tint base is used for making paints which include the pastels and eggshell colors. When a colorant is added to a tint base, the typical amount should not exceed about 5%. If more is added, the quality of the paint is compromised.

With a light tint base, therefore, a dark color such as brown or black can not be made by adding only 5% colorant. For darker colors, the tint base must contain less titanium dioxide or no titanium dioxide. Since one of the principal functions of titanium dioxide is to hide the surface, for dark colored paints the colorant itself must do the hiding.

For an unsorted, collected recyclable paint one can think of it as a mixture of all four of the above tint bases containing colorants at a level of approximately 0 to 5%. It would probably contain at least 1 pound per gallon of titanium dioxide and therefore it is not possible to make dark colors out of it by adding just 5% of dark colorant. Since the unsorted collected paint already contains colorants it is also not possible to make lighter colors by adding additional colorant. If the collected paint is mixed with 50% of a virgin tint base the situation improves somewhat but it is still virtually impossible to match certain colors at the 50% post-consumer content level. The data below will illustrate this.

When making particular colors from a collected recyclable paint, the recyclable paint or recyclable paint/virgin paint combination becomes the tint base. Its color is measured with a color computer and this color is then stored in the computer data base. The computer is then given a specific desired color (i.e. a color chip) and is asked to give the amounts and kinds of individual colorants which must be added to the recyclable tint base to give a color match. In addition to the amount and kind of colorant to be added to give the best possible match, the computer provides a match quality measured as DE1, DE2, and DE3. DE1 is the match quality under daylight lighting conditions, DE2 is the match quality under incandescent lighting conditions, and DE3 is the match quality under fluorescent lighting conditions. A DE value of 0 indicates a perfect match. A DE value of 0.2 indicates the match is not exact and can be detected by some human eyes. A DE value of 0.5 indicates a match quality in which the difference can be detected by most human eyes. DE values greater than 0.5 indicates that the best possible match is a poor match which is readily seen by the human eye.

Composite samples from the 2nd, 3rd, 4th, and 5th collection rounds of recyclable latex paint were mixed at a level of 50 % by weight with a Sherwin-Williams Paint Company white exterior vinyl-acrylic flat latex paint containing approximately 2 pounds per gallon of titanium dioxide These samples were then further diluted with the same virgin paint to give paints containing 25% and

12%, respectively of the collected post-consumer paints. These samples and the 100% Sherwin-Williams paint were analyzed with an ACS color computer and were made the tint bases for preparation of colored paints. Seven light-colored recycled paints of various colors as represented by color chips of Major Paint Company's "Cycle II" line of recycled paints were then analyzed using the same color computer. The computer was then used to provide the level of colorants needed to convert the tint bases to the same colors as the Cycle II color chips, i.e., make a color match (Table 38).

1) Light-Colored Paints Prepared from Unsorted Collected Latex Paint.

Table 38. Per Cent Colorant Needed to Produce a Color Match for Tint Bases Containing Unsorted Post Consumer Latex Paint

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Ocean Green	Shmn Wlms	0.00	0.32	0.76	2.5
	50% 002	1.78	1.76	1.51	1.4
	50% 003	2.30	2.19	1.97	0.9
	50% 004	0.20	0.99	0.18	1.8
	50% 005	3.38	3.15	3.09	2.0
	25% 002	0.01	0.85	0.42	1.6
	25% 003	0.01	0.92	0.35	1.0
	25% 004	0.01	0.91	0.42	1.9
	25% 005	0.01	0.92	0.29	1.7
	12% 002	0.00	0.57	0.70	2.7
	12% 003	0.01	0.50	0.46	1.1
	12% 004	0.01	0.81	0.51	2.8
	12% 005	0.01	0.79	0.46	2.7
Sea Mist	Shmn Wlms	0.01	0.57	0.77	1.4
	50% 002	2.73	2.60	2.41	0.8
	50% 003	3.26	3.07	2.88	0.5
	50% 004	1.15	1.30	0.92	0.9
	50% 005	4.39	4.13	4.06	1.0
	25% 002	0.01	0.92	0.36	0.9
	25% 003	0.00	0.36	0.82	0.5
	25% 004	0.01	0.78	0.45	1.3
	25% 005	0.00	0.36	0.49	0.9
	12% 002	0.01	0.44	0.51	1.6
	12% 003	0.01	0.21	0.41	0.7
	12% 004	0.01	0.37	0.55	2.0
	12% 005	0.01	0.58	0.44	1.8
Cowhide Tan	Shmn Wlms	0.03	0.18	0.28	2.4
	50% 002	1.13	1.84	1.07	0.8
	50% 003	1.83	2.51	1.66	0.5
	50% 004	1.01	1.81	0.92	1.4
	50% 005	2.88	3.44	2.74	1.1
	25% 002	0.01	0.10	0.34	1.3
	25% 003	0.03	0.22	0.27	0.7
	25% 004	0.00	0.13	0.34	1.7
	25% 005	0.01	0.13	0.31	1.8
	12% 002	0.03	0.22	0.26	2.4
	12% 003	0.02	0.18	0.27	1.0
	12% 004	0.03	0.23	0.27	2.9
	12% 005	0.02	0.15	0.31	2.8

Table 38 (continued).

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Laguna Sand	Shmn Wlms	0.00	0.31	0.30	2.0
	50% 002	4.08	4.51	3.97	1.1
	50% 003	4.68	5.20	4.51	0.6
	50% 004	3.56	4.31	3.44	1.2
	50% 005	5.87	6.31	5.78	1.5
	25% 002	0.01	1.07	0.37	0.9
	25% 003	0.16	1.69	0.77	0.4
	25% 004	0.01	1.35	0.53	1.2
	25% 005	0.96	1.87	1.01	0.9
	12% 002	0.00	0.17	0.38	1.7
	12% 003	0.00	0.20	0.30	0.7
	12% 004	0.00	0.22	0.36	2.2
	12% 005	0.00	0.19	0.37	2.1
Palomino Beige	Shmn Wlms	0.00	0.19	0.38	1.0
	50% 002	6.89	7.18	6.85	0.6
	50% 003	7.48	7.84	7.36	0.3
	50% 004	6.31	6.88	6.19	0.5
	50% 005	8.71	9.01	8.68	0.6
	25% 002	2.42	2.88	2.30	0.3
	25% 003	2.84	3.39	2.67	0.2
	25% 004	2.37	3.19	2.25	0.4
	25% 005	3.70	4.11	3.59	0.4
	12% 002	0.00	0.21	0.36	0.7
	12% 003	0.15	1.19	0.28	0.2
	12% 004	0.00	0.39	0.43	0.9
	12% 005	0.32	1.28	0.39	0.5
Harbor Blue	Shmn Wlms	0.01	0.33	0.43	1.5
	50% 002	0.01	0.53	0.42	2.9
	50% 003	0.54	0.99	0.39	0.3
	50% 004	0.00	0.31	0.39	0.9
	50% 005	1.06	1.48	0.97	0.5
	25% 002	0.01	0.21	0.54	0.9
	25% 003	0.01	0.23	0.50	0.5
	25% 004	0.01	0.28	0.47	1.2
	25% 005	0.00	0.21	0.53	1.0
	12% 002	0.01	0.26	0.47	1.5
	12% 003	0.00	0.17	0.41	0.6
	12% 004	0.01	0.32	0.44	1.8
	12% 005	0.01	0.22	0.46	1.8

Discussion

The color ocean green can be prepared from unsorted collected paint at the 25% post-consumer content level with DE1 values (daylight illuminant)

below 0.5. At this level, the illumination with incandescent lighting or fluorescent lighting would give perceptible color differences since DE2 and DE3 values are above 0.5 for most paints. DE values at the 12% content are somewhat better. Amount of colorant needed is reasonably low.

Sea mist can be prepared from unsorted collected paint at the 25% post-consumer content level with DE1 values (daylight illuminant) below 0.5. At this level, the illumination with incandescent lighting or fluorescent lighting would give perceptible color differences since some DE2 and DE3 values are near or greater than 0.5 for most paints making this paint color undesirable as an interior paint. DE values at the 12% content are somewhat better. Amount of colorant needed is low.

Cowhide tan can be prepared from unsorted collected paint at both the 25% and 12% post-consumer content level with all DE values below 0.5. Color sorting at the collection site would make it possible to prepare this color at the 50% post-consumer content level. The amount of additional colorant needed is at a reasonable level.

Laguna sand could be prepared best at the 12% post-consumer content level using unsorted collected paint. This color would probably be best prepared from sorted collected paints if a higher amount of post-consumer content is desired. Amount of colorant needed is reasonably low.

Palomino beige can be prepared only at the 12% post-consumer content level using unsorted collected paint. Even at this level, some collections gave somewhat high DE values. This color would probably be best prepared from sorted collected paints. Amount of colorant needed is reasonably low.

Harbor blue can be prepared from all unsorted collected paint at the 25% post-consumer content level with all DE1 values (daylight illuminant) near 0 . DE2 and DE3 are also reasonably low. For some of the collections, color matching would be possible at the 50% post-consumer

2) Light-Colored Paints Prepared from Unsorted Collected Paint Containing Additional Titanium Dioxide.

Because recycled latex paints containing 50% unsorted post-consumer paint are essentially too dark for tinting to lighter colors, we examined the effect of adding more titanium dioxide to a tint base consisting of 50% Sherman Williams white paint and 50% unsorted post-consumer paint to see if the resulting tint base would become light enough to be tintable to light colors. We tried 5% and 10%, respectively, of additional titanium dioxide paste (white colorant paste). The results are presented in Table 39 and show that the match values (DE's) were not improved significantly for all colors examined. The color Blue Moon is acceptable at 5% added titanium dioxide and Ocean Green may be acceptable at 10% added titanium dioxide.

Table 39. Light Colors/50% Recyclable Content/Additional Titanium Dioxide

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Sea Mist	50% 005	4.39	4.13	4.06	1.0
	plus 5% TiO2	3.00	2.80	2.75	0.8
	plus 10% TiO2	1.85	1.74	1.66	0.7
Palomino Beige	50% 005	8.71	9.01	8.68	0.6
	plus 5% TiO2	7.38	7.76	7.33	0.3
	plus 10% TiO2	6.34	6.74	6.26	0.3
Blue Moon	50% 005	1.32	1.65	1.32	1.1
	plus 5% TiO2	0.28	0.86	0.48	0.7
	plus 10% TiO2	0.00	0.34	0.08	1.0
Ocean Green	50% 005	3.38	3.15	3.09	2.0
	plus 5% TiO2	2.06	1.91	1.89	1.1
	plus 10% TiO2	0.96	0.91	0.85	1.3

3) Dark-Colored Paints Made from Unsorted Collected Paints

Table 40 presents tinting data for making dark colored paints. In making a dark virgin paint a light tint base (i.e., 2 pounds per gallon of titanium dioxide) would not be used. Even though good color match values are possible, the amount of colorant required is excessive in all cases. In looking at the values of the paints containing recyclable material, it should be kept in mind that the virgin blending paint used was a light tint base. When a masstone tint base (paint without titanium dioxide) was used for making the same color, the results in tables 40-42 were obtained.

Composite samples from the 2nd, 3rd, 4th, and 5th collection rounds of recyclable latex paint were mixed at a level of 50 % by weight with a San Luis

Paint Company "Weathercoat" masstone tint base (exterior latex containing no titanium dioxide).These samples were then further diluted with the same tint base to give paints containing 25% and 12%, respectively of the collected post-consumer paints. These samples and the 100% Weathercoat masstone were analyzed with an ACS color computer and were made the tint bases for preparation of dark-colored paints. The three dark colors chosen for study were "toast brown", "brick red", and "seal black" and are represented by color chips of Major Paint Company's "Cycle II" line of recycled paints. The computer was used to provide the level of colorants needed to convert the tint bases to the same colors as the Cycle II color chips, i.e. make a color match. The results presented in Tables 41-43 represent attempts to make these dark color matches.

Table 40. Dark-Colored Paints Using a Titanium Dioxide Containing Tint Base.

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Brick Red	Shmn Wlms	0.31	0.31	0.53	23
	50% 002	0.03	0.61	0.84	15
	50% 003	0.54	0.30	0.55	14
	50% 004	0.00	0.68	0.65	8
	50% 005	0.57	0.30	0.20	13
Seal Black	Shmn Wlms	0.05	0.10	0.08	82
	50% 002	0.06	0.17	0.09	74
	50% 003	0.05	0.03	0.03	50
	50% 004	0.03	0.12	0.13	66
	50% 005	0.07	0.10	0.05	46
Toast Brown	Shmn Wlms	0.01	0.08	0.13	32
	50% 002	0.01	0.13	0.27	14
	50% 003	0.03	0.09	0.16	15
	50% 004	0.01	0.08	0.21	7
	50% 005	0.02	0.10	0.20	14

Table 41. Per Cent Colorant to be Added to Tint Bases Containing Various Amounts of Unsorted Post-Consumer Latex Paint and Corresponding DE Values for the Color Toast Brown.

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Toast Brown	Masstone	0.00	0.18	0.16	0.7
	50% 002	0.01	0.13	0.23	7.8
	50% 003	0.03	0.09	0.10	7.1
	50% 004	0.01	0.11	0.23	6.8
	50% 005	0.03	0.11	0.21	5.8
	25% 002	0.00	0.23	0.11	5.2
	25% 003	0.00	0.19	0.16	4.6
	25% 004	0.00	0.20	0.10	8.2
	25% 005	0.00	0.24	0.09	6.3
	12% 002	0.00	0.23	0.11	4.9
	12% 003	0.00	0.21	0.10	5.3
	12% 004	0.00	0.22	0.11	7.3
	12% 005	0.00	0.08	0.21	6.8

Discussion: The color toast brown can be prepared from unsorted collected paint at the 50% post-consumer content level with all DE values below 0.5. The amount of colorant needed to achieve the indicated DE values is somewhat high and could probably be reduced since DE values are well below 0.5.

Table 42. Per Cent Colorant to be Added to Tint Bases Containing Various Amounts of Unsorted Post-Consumer Latex Paint and Corresponding DE Values for the Color Brick Red.

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Brick Red	Masstone	0.02	0.36	0.52	0.4
	50% 002	0.01	0.13	0.68	14.6
	50% 003	0.03	0.09	0.10	7.1
	50% 004	0.00	0.64	0.65	7.3
	50% 005	0.00	0.64	0.65	6.2
	25% 002	0.00	0.15	0.62	6.8
	25% 003	0.00	0.15	0.64	8.0
	25% 004	0.01	0.45	0.61	4.5
	25% 005	0.00	0.14	0.63	8.4
	12% 002	0.02	0.54	0.60	2.6
	12% 003	0.00	0.16	0.63	7.1
	12% 004	0.01	0.49	0.60	4.0
	12% 005	0.00	0.14	0.63	7.6

Discussion: The color brick red can be prepared from unsorted collected paint at the 50% post-consumer content level with DE1 values (daylight illuminant) below 0.5. At this level, the illumination with fluorescent lighting would give perceptible color differences since most DE2 and DE3 values are near or greater than 0.5 for most paints, making this paint color undesirable as an interior paint. Colorant levels are somewhat high.

Table 43. Per Cent Colorant to be Added to Tint Bases Containing Various Amounts of Unsorted Post-Consumer Latex Paint and Corresponding DE Values for the Color Seal Black.

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Seal Black	Masstone	0.09	0.08	0.07	5.7
	50% 002	0.01	0.13	0.05	46.7
	50% 003	0.04	0.06	0.03	34.3
	50% 004	0.00	0.12	0.12	58.8
	50% 005	0.00	0.11	0.13	55.0
	25% 002	0.03	0.15	0.05	42.0
	25% 003	0.06	0.11	0.08	45.2
	25% 004	0.06	0.10	0.09	52.4
	25% 005	0.06	0.12	0.08	46.4
	12% 002	0.03	0.15	0.04	40.0
	12% 003	0.03	0.14	0.05	42.8
	12% 004	0.06	0.11	0.09	49.4
	12% 005	0.06	0.13	0.08	44.1

Discussion: The color seal black cannot be prepared from unsorted collected recyclable latex paint at low DE values. Colorant levels are excessive in all cases. It may be possible to prepare this color only with fairly high DE values at lower colorant loading.

4) Light-Colored Paints Prepared from Sorted (White) Collected Paint of the Winter 1994 Collection.

During the Winter 1994 collection round (sixth collection), those sites now sorting by color were asked to send in their sorted white paints. Of the seven sites that Cal Poly is receiving paint from, San Francisco, Marin County, and Sacramento County are sorting their white and off-white paints from other colors. Cal Poly received off-white paints from Marin County and from San Diego County. These were tinted as described for the light colors described in Table 38. The results are presented in Table 44.

Table 44. Light -Colored Paints Prepared from Off-White Paints of the Winter 1994 Collection.

Desired Color	Tint Base	DE 1	DE2	DE3	% Colorant
Cowhide Tan	100% Marin	0.04	0.23	0.23	2.0
	100% San Diego	0.03	0.24	0.21	1.5
Sea Mist	100% Marin	0.01	0.70	0.43	1.2
	100% San Diego	0.01	0.64	0.46	0.8
Ocean Green	100% Marin	0.03	0.44	0.69	2.4
	100% San Diego	0.00	0.35	0.73	1.5
Harbor Blue	100% Marin	0.00	0.18	0.51	1.9
	100% San Diego	0.01	0.35	0.40	0.9
Blue Moon	100% Marin	0.00	0.25	0.34	2.4
	100% San Diego	0.00	0.22	0.35	1.5
Palomino Beige	100% Marin	0.00	0.28	0.23	0.5
	100% San Diego	0.00	0.21	0.27	0.4
Laguna Sand	100% Marin	0.00	0.31	0.28	1.9
	100% San Diego	0.00	0.28	0.28	1.3

Discussion: All of the light-colored paints can be prepared from sorted white paints at the 100% post-consumer content. DE values are below 0.5 in almost all cases and the amount of colorant added is low. Sorted white paints could also be used for making the so called "antique" whites.

Various collection and sorting protocols in use by different collection programs were presented to the PRTF. These individual protocols are summarized in Appendix F.

Gina Purin of the Marin County Office of Waste Management and Pam Jackson of the Hazardous Material Management Division, San Diego County, have consolidated these protocols into a single document. Their findings resulted in the following general conclusions and are written as a general recommendation on what aspects relating to sorting and bulking of paint to consider:

Sorting and Bulking Protocols

Depending of the end-use of the paint (e.g., what you intend to do with the paint or how you intend to use it after you have collected it), you may want to:

- simply consolidate colors and make it available to residents (or a select audience) as an anti-graffiti paint or what have you
- separate out various colors, keep them in their original containers, and offer them to residents as a re-use effort or materials exchange
- give the paint to a paint manufacturer and request that it be sent back to you for distribution within the community or for "in-house" use
- give the paint to a paint manufacturer for recycling and request that it not be returned to you
- any variations of the above

For reuse efforts, it is recommended that some sort of testing protocols be implemented to ensure that the latex paint does not contain hazardous constituents in excess of regulatory limits. (See section on Testing.)

No matter what you do, there are a few protocols that you will follow:

* Separate out latex paint from oil-base paint. Initially, this will be done according to labels. If the label indicates "water clean-up", the paint can be considered latex.

* Paint that does not have a label will initially be set aside. Later, a visual inspection of the can's contents can be conducted to determine if the paint is

latex. If there is any doubt the paint is latex, the paint should **NOT** be sent for reprocessing or reuse. Do not intentionally smell any paints as a method of evaluation.

* After the paint has been sorted according to latex vs. solvent-based, the solvent-based should be set aside for placement in a supplemental fuels program. Each of the cans of latex paint can then be inspected to ensure that the contents matches the label (i.e., that the paint is really latex). This is done through visual examination of the paint after the lid is removed.

What to Look For:

* If the paint has a clear watery layer on top, and a distinctive solvent smell is absent, the paint is probably latex as indicated on the label. Paint can be tested for water solubility by adding a small amount of water to a sample of the paint.

* Make sure the paint isn't dried, lumpy, moldy or rusty. If it is, don't give it away for reuse and don't send it for reprocessing. The same holds true for paint that has dirt in it or looks like it's been mixed with something.

* Make sure the paint does not say "Contains Lead" if the paint is to be given away for reuse efforts. Lead-based paint should be sent for hazardous waste disposal. Small amounts of lead-based paints can be consolidated for reprocessing by a paint manufacturer. If the paint is dried out, it can be disposed of as a non-hazardous waste product.

* Depending on what you intend to do with your paint, you may want to consolidate it. If you plan on sending it to a paint manufacturer, you will need to talk with the manufacturer first and decide on what you can and can't consolidate. Some manufactures may allow ALL types of latex products to be consolidated while others may insist that only latex flat, semi-gloss, gloss or primers be consolidated to enable them to make a reprocessed paint.

Doing Color Sorts:

* If you use a paint manufacturer and want to take the paint back, you will need to work with the manufacturer in determining the types of colors that must be sorted based on the colors of paint you want back. If you don't want the paint back, the paint manufacturer will tell you how to sort the paint that best suits his/her needs. Prices you will pay to a paint manufacturer will vary depending on the quality of the recycled paint you want back and the colors.

* Whether or not you use a paint manufacturer, you will probably want to do at least a minimal color sort if you consolidate paint. It is easiest to do two colors. "White" can include any latex paint that has the word "white" on the label. "Mixed colors" refers to any other color of latex paint . Other programs use one or more of a combination of color sorts as indicated below. It should be noted that the batches of off-white, red, green, gray, and rose paints generated by consolidating the colors given below, may change from one batch to another as the amounts of various colors placed in the drums will differ from one drum to another. If color consistency is required from one batch to another, a paint manufacturer will need to be consulted and you will need to work this out prior to sorting and shipping paint to the manufacturer.

Off-white - Includes whites and off-whites.
Green - Includes yellow, blue and green with the exception of olive green.
Gray - Includes black and gray.
Red - Includes red, pink, brick and peach.
Beige - Includes all other colors which do not fit into the previous categories.

Some programs simply separate colors according to light (white and off-white), dark (black, brown and gray), and medium (all other colors).

Testing of Paint for Hazardous Constituents

No specific testing is required for sorting or bulking the paint. If, however , paint is offered for use as an interior paint (either through a recycle/reprocess program or a reuse effort), it should not contain mercury in excess of 200 ppm. The paint should also meet other requirements that are set for a similar type of virgin paint.

For paint that is given away as part of a reuse effort, EPA recommends no interior paint be given away if levels of mercury exceed 200 ppm. Programs not testing their paint, should consider marking it "For Exterior Use Only". However, they should be aware that interior paint , used for exterior purposes, will generally not last as long or retain its color as long, as a paint designed for exterior use.

If paint exceeds 200 ppm mercury, EPA requests that each can bear a warning on it and that it be marked for exterior use only. In addition to mercury, programs may also want to test for lead in paints offered for interior use. The CPSC maximum for lead content in dried paint films is 600 ppm. Programs may also test for grams/liter of VOC as required by their local air quality management program.

MATERIAL SAFETY DATA SHEETS

Mr. Rod G. Repke, a member of the Paint Recycling Task Force and an Industrial Hygienist with the Department of Industrial Relations, California Division of Occupational Safety and Health, examined the issue of Material Safety Data Sheets (MSDS) related to the handling of recycled latex paint and issued an opinion in a letter to the California Integrated Waste Management Board dated April 19, 1995 (Appendix D). His opinion on hazard communication (HAZCOM) issues include the following points:

- The HAZCOM standard excludes hazardous waste from all HAZCOM requirements including MSDS and labeling requirements. Household and small quantity generated hazardous waste dropped off at a household waste recycling center would therefore not have to be accompanied by an MSDS.
- Waste paint becomes a commodity after consignment for shipment to a paint manufacturer and if it contains hazardous substances in excess of 1% (0.1% if carcinogenic) it must be accompanied by an MSDS. Physical hazards such as flammability must also be considered.
- Since no hazardous ingredients in excess of 1% by weight were found in the 61 samples analyzed by the Cal Poly study, and if this trend holds true, an MSDS may not be necessary.

- If hazardous substances are found to be present in excess of allowable amounts, a generic MSDS for recyclable latex paint may be an acceptable alternative.

Based on the results of the Cal Poly study, Paul Fresina and Tom Watkins of the San Francisco Sanitary Fill Company have prepared a rather lengthy generic MSDS which is in use by them for recyclable latex paint (Appendix D). This same MSDS could be used by other HHW collection facilities should they choose to do so. Since recyclable and recycled latex paint contains about 50% water, it is a non-flammable material and thus meets this physical hazard requirement. All of the paint manufacturers who produce recycled latex paint have prepared MSDS's which accompany their products. MSDS's provided by the Rasmussen Paint Company, Major Paint Company, and Kelly Moore Paint Company for recycled latex paint are included in Appendix D.

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May 20, 1993

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GREEN SEAL

STANDARD GS-11

ENVIRONMENTAL STANDARD

FOR PAINTS

FIRST EDITION

May 20, 1993

GREEN SEAL

Green Seal is a non-profit organization devoted to environmental standard setting, product certification, and public education. Green Seal helps identify environmentally preferable products in order to encourage and enable consumers to purchase such products with reduced impacts on the earth. Through its standard setting, certification and education programs, Green Seal:

- identifies products that are designed and manufactured in an environmentally preferable manner;
- offers scientific analysis to help consumers make educated purchasing decisions regarding environmental impacts;
- ensures consumers that any product bearing the Green Seal Certification Mark has earned the right to use it; and
- encourages manufacturers to develop new products that are significantly less damaging to the environment than their predecessors.

THE ENVIRONMENTAL STANDARDS

The intent of Green Seal's standards is to reduce, to the extent technologically and economically feasible, the environmental impacts associated with the manufacture, use, and disposal of products. Set on a category-by-category basis, Environmental Standards focus on opportunities to significantly reduce a product's environmental impact. Each Green Seal Environmental Standard is first issued in proposed form. Industry, trade associations, government agencies, environmental and other public interest organizations, users, and other interested parties are encouraged to comment on the proposal. Standards are then established after careful review and consideration of the comments.

Green Seal offers the opportunity to achieve certification to all products covered by its standards. Manufacturers may submit their products for evaluation by Green Seal. Those which comply with Green Seal's requirements may be authorized to use the Green Seal Certification Mark on products and in product advertising. Manufacturers authorized to use the Green Seal Certification Mark on their product are subject to an ongoing program of testing, inspection, and enforcement. Underwriters Laboratories Inc., the nation's premier product testing and inspection organization, serves as Green Seal's primary testing and factory inspection contractor.

For additional information on Green Seal or any of its programs, contact:

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FOREWORD

A. Certification. This Environmental Standard contains the basic requirements for certain products (as defined in the Scope section below) to be certified by Green Seal and for their manufacturers to receive authorization to use the Green Seal Certification Mark on products and their packaging, and in product advertising. The requirements are based on an assessment of the environmental impacts of product manufacture, use, and disposal and reflect information and advice obtained from industry, trade associations, users, government officials, environmental and other public interest organizations, and others with relevant expertise. These requirements are subject to revision as further experience and investigation may show is necessary or desirable.

B. Compliance with the Standard. Compliance with this Standard is one of the conditions of certification of a product by Green Seal.

C. Compliance with Government Rules. In order to be authorized to use the Green Seal Certification Mark, the manufacturer of the certified product must disclose all governmental allegations or determinations of violation of federal, state, or local environmental laws or regulations with respect to facilities in which the product is manufactured. Certification will be denied any product manufactured in violation of environmental laws or regulations if, in Green Seal's judgment, such violations indicate that the environmental impacts of the product significantly exceed those contemplated in the setting of the standard.

D. Limitations on Purpose of Standard. Green Seal's Standards provide basic criteria to promote environmental quality. Provisions for product safety have not been included in this Standard because government agencies and other national standard-setting organizations establish and enforce safety requirements.

E. Substantially Equivalent Products. Products that are substantially similar to those covered by this standard in terms of function and environmental impact may be evaluated and certified by Green Seal against the intent of the requirements of this standard.

F. Unanticipated Environmental Impacts. A product which complies with this Standard will not necessarily be certified by Green Seal if, when examined and tested, it is found to have other features which significantly increase its impact on the environment. In such a situation, Green Seal will ordinarily amend its standards to account for the unanticipated environmental impacts.

G. Certification Agreement and Green Seal Rules. In order to be authorized to apply the Green Seal Certification Mark to a product or its packaging, or to use the Green Seal Certification Mark in product advertising, the manufacturer of the product must (1) undergo an initial product evaluation to determine that the product complies with Green Seal's requirements, (2) sign a Green Seal Certification Agreement that, among other things, defines how and where the Green Seal may be used, (3) pay fees to cover the costs of testing and monitoring, (4) agree to an ongoing program of factory inspections and product testing, and (5) comply with the requirements found in the most recent version of "Rules Governing the Use of the Green Seal Certification Mark."

H. Disclaimer of Liability. Green Seal, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. Green Seal shall not incur any obligations or liability for damages, including consequential damages, arising out of or in connection with the interpretation of, reliance upon, or any other use of this Standard.

I. Care in Testing. Many tests required by Green Seal's Standards involve safety considerations. Adequate safeguards for personnel and property should be employed in conducting such tests.

J. Referenced Standards. Standards referenced in this document may have been superseded by a later edition, and it is intended that the most recent edition of all referenced standards be used in determining compliance of a product with this standard.

K. Labeling Requirements. This standard neither modifies nor supersedes government labeling requirements. Labeling language which varies in form from the requirements of this section may be used with the written approval of Green Seal.

ENVIRONMENTAL STANDARD

1 Scope.

This Standard establishes environmental requirements for paints. The standard does not include stains, clear finishes, or paints sold in aerosol cans.

2 Definitions.

For the purpose of this Standard, the following definitions apply.

2.1 **Paints:** Liquid, liquefiable or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer. These coatings are intended for on-site application to interior or exterior surfaces of residential, commercial, institutional or industrial buildings.[1]

2.2 **Volatile Organic Compounds (VOCs):** Compounds as defined by U. S. Environmental Protection Agency (EPA) in 40 CFR § 51.100 (s), (s) (1).

2.3 **Aromatic Compounds:** Hydrocarbon compounds containing one or more 6-carbon benzene rings in the molecular structure.

3 Product-Specific Performance Requirements.

3.1 **Interior Topcoats.** Products intended for interior opaque topcoat use shall meet the following requirements.

3.1.1 **Scrubbability (Abrasion Resistance).** The product shall demonstrate at least 100 cycles (200 separate strokes) before failure, as determined by American Society for Testing and Materials (ASTM) D2486-89, *Standard Test Method for Scrub Resistance of Interior Latex Flat Wall Paints*.

3.1.2 **Hiding Power (Opacity).** The product shall demonstrate a minimum 0.95 contrast ratio at 400 square feet per gallon as determined by ASTM D2805-88, *Standard Test Method for Hiding Power of Paints by Reflectometry*. Compliance will be determined by testing a white paint having a minimum 80% reflectance.

---

1 ASTM D16-91, *Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products*. Stains and clear finishes, which are included in the ASTM definition, are not covered by this standard.

3.1.3 Washability (Stain Removal). The product shall demonstrate the following minimum requirements for stain removal as determined by ASTM 4828-91 Mechanical Method, *Standard Test Method for Practical Washability of Organic Coatings.*

Flat[2]	5 minimum rating
Non-Flat	7 minimum rating

3.2 Exterior Topcoats. Products intended for exterior opaque topcoat use shall meet the following requirements.

3.2.1 Hiding Power (Opacity). The product shall demonstrate a minimum 0.95 contrast ratio at 400 square feet per gallon as determined by ASTM D2805-88, *Standard Test Method for Hiding Power of Paints by Reflectometry*. Compliance will be determined by testing a white paint having a minimum 80% reflectance.

4 Product-Specific Environmental Requirements.

4.1 Chemical Component Limitations.

4.1.1 VOCs. The VOC concentrations of the product shall not exceed those listed below as determined by U. S. Environmental Protection Agency (EPA) Reference Test Method 24 (Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coatings), Code of Federal Regulations Title 40, Part 60, Appendix A.

The calculation of VOC shall exclude water and tinting color added at the point of sale.

Interior Coatings:

Coating Type	VOC weight in grams/liter of product minus water
Non-flat[3]	150
Flat	50

Exterior Coatings:

Coating Type	VOC weight in grams/liter of product minus water
Non-flat[4]	200
Flat	100

2 If the manufacturer has not characterized the paint as to gloss, the specular gloss level at 60° will be determined. Flat paints are those which register less than 5 and non-flat paints are those which register a 5 or greater. The gloss reading will be determined by ASTM D523-89, *Standard Test Method for Specular Gloss.*

3 See note # 2.

4 See note #2.

4.1.2 Aromatic Compounds. The product must contain no more than 1.0% by weight of the sum total of aromatic compounds. Testing for the concentration of these compounds will be performed if they are determined to be present in the product during a materials audit.

4.2 Chemical Component Restrictions. The manufacturer shall demonstrate that the following chemical compounds are not used as ingredients in the manufacture of the product.

4.2.1 Halomethanes

methylene chloride

4.2.2 Chlorinated ethanes

1,1,1-trichloroethane

4.2.3 Aromatic solvents

benzene
toluene (methylbenzene)
ethylbenzene

4.2.4 Chlorinated ethylenes

vinyl chloride

4.2.5 Polynuclear aromatics

naphthalene

4.2.6 Chlorobenzenes

1,2-dichlorobenzene

4.2.7 Phthalate esters

di (2-ethylhexyl) phthalate
butyl benzyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate

4.2.8 Miscellaneous semi-volatile organics

isophorone

4.2.9 Metals and their compounds

antimony
cadmium
hexavalent chromium
lead
mercury

4.2.10 Preservatives (antifouling agents)

formaldehyde

4.2.11 Ketones

methyl ethyl ketone
methyl isobutyl ketone

4.2.12 Miscellaneous volatile organics

acrolein
acrylonitrile

5 Packaging Requirements.

5.1 Toxics in Packaging.

5.1.1 The manufacturer shall demonstrate that paint cans and their components are not fabricated with lead.

Appendix: Labeling Requirements for Certification by Green Seal

Unless otherwise approved in writing by Green Seal, the following labeling requirements shall apply:

1 The Green Seal Certification Mark must appear on the packaging.

2 Whenever the certification mark appears on a package or product, the product or package must contain a description of the basis for the certification. The description shall be in a location, style, and typeface that are easily readable by the consumer. The description shall read as follows:

> This product meets Green Seal environmental standards for volatile organic compounds (VOCs) and other ingredients.

3 The packaging shall be accompanied by a brief statement discouraging disposal into drains and encouraging consultation with local authorities for disposal requirements or recycling opportunities.

4 Paints which have been formulated without VOCs shall be designated Class A and may contain a special designation to that effect on the label.

Appendix B Federal Specification TT-P-2846

Metric
TT-P-2846
November 23, 1993

FEDERAL SPECIFICATION

PAINT, LATEX (RECYCLED WITH POST-CONSUMER WASTE)

The General Services Administration has authorized the use of this federal specification for all federal agencies.

1 SCOPE AND CLASSIFICATION. This specification covers latex emulsion paint containing a minimum of 50 percent post-consumer waste in the following Types, Classes and Grades:

Types	Classes	Grades
I - Interior	1 - Flat (Low sheen)	A - 40% minimum volume solids
II - Exterior	2 - Eggshell	B - 30% Minimum volume solids
III - Interior/Exterior	3 - SemiGloss	C - Utility (For graffiti abatement)

2 APPLICABLE DOCUMENTS

2.1 The following documents of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Standards:

FED-STD-141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing

FED-STD-313 - Preparation and Submission of Material Safety Data Sheets (MSDS)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

Code of Federal Regulations:

40CFR Part 247 - Guidelines for Procurement of Products That Contain Recycled Material

(Application for copies should be addressed to: U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328)

American Society for Testing and Materials (ASTM) Standards:

D 523 - Specular gloss
D 562 - Consistency of Paints Using the Stormer Viscometer
D 1210 - Fineness of Dispersion of Pigment-Vehicle Systems
D 1296 - Odor of Volatile Solvents and Diluents
D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes
D 1640 - Drying, Curing, or Film Formation of Organic Coatings at Room Temperature Materials
D 1849 - Package Stability of Paint
D 2243 - Freeze-Thaw Resistance of Water-Borne Coatings
D 2244 - Calculation of Color Differences From Instrumentally Measured Color Coordinates
D 2697 - Volume Nonvolatile Matter in Clear or Pigmented Coatings
D 3273 - Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
D 3274 - Evaluating Degree of Surface Disfigurement of Paint Films by Fungal Growth or Soil and Dirt Accumulation and Adjunct No. 12-43270-00 Pictorial Standards of Coatings Defects
D 3630 - Constituents Classified as Hazardous in Protective Coatings
D 3960 - Volatile Organic Content (VOC) of Paints and Related Coatings

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

Beneficial comments should be addressed to: Director, Engineering and Commodity Management Division, 9FTE-10, 400 15th St., SW, Auburn, WA 98001-6599

DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited. FSC 8010

3 REQUIREMENTS

3.1 **Materials.** The paint shall contain post-consumer waste as defined in 40CFR Part 247 in the quantities specified in table I. Such waste will be latex paint diverted from community waste. The manufacturer shall certify that the paint meets this requirement.

3.1.1 **Prohibited materials.** When tested as specified in table I the paint shall be free from toxic materials under normal conditions of use and shall not contain lead in excess of 0.06 percent by weight of nonvolatile, hexavalent chromates, benzene, halogenated solvents, or mercury in excess of 10 parts per million for Types I and III or 50 parts per million for Type II.

3.2.1 **Condition in container.** When examined as specified in table I, the paint shall show no evidence of putrefaction, hard settled pigment, or corrosion of the container. The paint shall be dispersible to a uniform condition by not more than 5 minutes hand stirring without decanting and remixing.

3.2.2 **Color.** When tested as specified in table I at complete hiding, the Grade A and B paint shall match the color specified within a color tolerance, delta E, of 2.5. The color of the Grade C paint shall be as agreed upon by buyer and seller.

3.2.3 **Accelerated storage.** After storage at 52°C (125°F) for 30 days as specified in table I, a sealed, filled one-liter (one-quart) can of paint shall show no coagulation or hard settled pigment. The paint shall be dispersible to a uniform condition and shall pass the application properties tests specified in 3.2.5.

3.2.4 **Freeze-thaw stability.** When tested as specified in table I for 3 freeze-thaw cycles, the paint shall show no coagulation or flocculation, the consistency shall not change more than 8 KU, and the paint shall pass the brushing properties test in 3.2.5.

3.2.5 **Application properties.** When tested as in 4.3.1, the paint shall brush, roll, and spray easily; and shall dry to a smooth uniform film free from lap marks, excessive brush marks, orange peel, craters or dusting.

3.2.6 **Odor.** When tested as specified in table I, the odor of the paint in the can and during application shall not be irritating. The paint shall have no residual odor after 48 hours air drying.

3.2.7 **Alkali resistance.** When tested as specified in 4.3.3, the paint shall show no blistering or re-emulsification immediately after test. After 24 hours recovery, the film shall show no change in hue or hardness when compared with the untested portion of the paint film.

3.2.8 **Flexibility.** When tested as specified in 4.3.2, the paint film shall not crack or flake.

3.2.9 **Scrub resistance.** The film shall not be worn through to the panel in fewer than 300 cycles for grade A or 150 cycles for grade B when tested as specified in table I.

3.2.10 **Biological growth.** When tested as specified in table I, the paint shall attain a surface disfigurement rating of 8 or greater when evaluated against Adjunct No. 12-432740-00 specified in ASTM D 3274. A certificate of compliance may be accepted from the supplier that a biocide has been used in concentrations which has been tested in similar formulations and has passed this requirement.

3.3 **Quantitative requirements.** The paint shall meet the requirements specified in table I for the type, class and grade specified.

TABLE I. Quantitative requirements and test references

Characteristic	Numeric Limits	Requirement Paragraph	Test Paragraph	Test Method[1]
Requirements for all Grades				
Materials	—	3.1	—	—
Post-consumer waste percent	—			
Grades A and B	50 min			
Grade C	90 min			
Prohibited materials	—	3.1.1	—	D 3630
Condition in container	—	3.2.1	—	3011
Color	—	3.2.2	—	D 2244
Accelerated storage	—	3.2.3	—	D 1849

1 Test methods prefixed with a letter are ASTM methods. Others are FED-STD-141 test methods.

TABLE I. Quantitative requirements and test references (Continued)

Characteristic	Numeric Limits	Requirement Paragraph	Test Paragraph	Test Method[1]
Requirements for all Grades				
Freeze-thaw stability	—	3.2.4	—	D 2243
Application properties	—	3.2.5	4.3.1	2112, 2131, 2141
Odor	—	3.2.6	—	D 1296
Dry through, hr	—	—	—	D 1640
Classes 1 and 2	2 max			
Class 3 —	8 max			
Consistency, KU	80 - 100	—	—	D 562
Volatile organic compound content (less water and exempt solvents) g/L (lb/gal)	200 max (1.67)	—	—	D 3960
Contrast ratio at 9.8 m^2/L (400 ft^2/gal)	—	—	—	4121[2]
Reflectivity 80 and above	0.92 min			
76 - 79	0.93 min			
72 - 75	0.94 min			
68 - 71	0.95 min			
61 - 67	0.96 min			
60 and lower	0.98 min			
Requirements for grades A and B				
Alkali resistance	—	3.2.7	4.3.2	D 1308
Flexibility, inch	1/4	3.2.8	4.3.3	6221
Scrub resistance	—	3.2.9	—	D 2486
Grade A	300 min			
Grade B	150 min			
Biological growth	8 min	3.2.10	—	D 3273, D 3274
Total solids, % volume of paint	—	—	—	D 2697
Grade A	40 min			
Grade B	30 min	—	—	D 1210
Fineness of dispersion				
Class 1	3 min			
Classes 2 and 3	4 min		4.3.4	D 523
Gloss				
85° gloss, Class 1	10 max			
60° gloss, Class 2	15 - 25			
60° gloss, Class 3	30 - 50			

1 Test methods prefixed with a letter are ASTM methods. Others are FED-STD-141 test methods.
2 Procedure B, method B

3.4 **Special marking.** Each container shall be marked with the percentage of post-consumer recycled waste. Each container and shipping container shall be marked:

"DO NOT FREEZE"

3.5 **Material Safety Data Sheet.** A Material Safety Data Sheet shall be prepared in accordance with FED-STD-313.

4 QUALITY ASSURANCE PROVISIONS

4.1 **Responsibility for inspection.** Unless otherwise specified in the contract or order, the contractor is responsible for the performance of all inspection requirements specified herein using facilities approved by the Government. The Government reserves the right to perform any of the inspections set forth herein when deemed necessary to assure that the paint conforms to prescribed requirements.

4.2 **Classification of inspections.** Inspections shall be classified as follows:

(a) Quality conformance inspection (see 4.3).
(b) Inspection of preparation for delivery (see 4.2.1).

4.2.1 **Preparation for delivery.** A random sample of filled containers shall be selected in accordance with MIL-STD-105, inspection level S-2, acceptable quality level (AQL) 2.5 percent defective, and examined for com-

4.3 Quality conformance inspection. The paint shall be tested in accordance with the methods specified in Table I and as otherwise specified herein to determine compliance with the requirements of section 3. Unless otherwise specified, all tests shall be conducted at conditions specified in section 9 of FED-STD-141. Failure of any test shall be cause for rejection of the lot from which the sample was taken.

4.3.1 Application properties.

4.3.1.1 Brushing properties. Brush the paint in accordance with method 2141, FED-STD-141 at a spreading rate of 9.8 m^2/L (400 ft^2/Gal) on a primed gypsum wallboard panel prepared in accordance with method 2081, FED-STD-141. Evaluate during brushing and after drying for compliance with 3.2.4.

4.3.1.2 Roller coating properties. Roll the paint in accordance with method 2112, FED-STD-141 at a spreading rate of 9.8 m^2/L (400 ft^2/Gal). Evaluate during rolling and after drying for compliance with 3.2.4.

4.3.1.3 Spraying properties. Spray the paint in accordance with method 2131, FED-STD-141. Evaluate during spraying and after drying for compliance with 3.2.4.

4.3.2 Alkali resistance. Prepare and dry a panel as specified in ASTM D 2486. Test the dried film using 0.1 N trisodium phosphate solution in accordance with paragraph 6.2, ASTM D 1308. Wash the reagent off with distilled water after 4 hours contact time and examine the film immediately and after 24 hours recovery.

4.3.3 Flexibility. Prepare the test panel in accordance with method 2012, FED-STD-141. Supplement the panel cleaning with an additional cleaning with abrasive soap so that the surface shows no water break. Draw down the paint on the clean, dry panel with a film applicator to obtain a dry film thickness of 25 +/- 2 um (0.001 +/- 0.0001 inch). Air dry 18 hours, bake at 105 +/- 2°C (221 +/- 4°F) for 3 hours, and cool 1/2 hour at room temperature. Bend over a 6.35 mm (1/4 inch) diameter cylindrical mandrel and examine under a magnification of 7 diameters in accordance with method 6221, FED-STD-141.

4.3.4 Gloss. Draw down the paint using a film applicator which will produce a wet film thickness of 75 +/- 2 um (0.003 +/- 0.0001 inch) on a plane glass panel. Determine 85° or 60° specular gloss in accordance with ASTM D 523 after 48 hours drying in a dust-free environment.

5 PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking. The paint shall be furnished in quantities specified (see 6.2). The packaging, packing, and marking shall be as specified (see 6.2).

6 NOTES

6.1 Intended use. This emulsion paint is intended is for use on interior or exterior wallboard, concrete, stucco, masonry, and wood. Chalk and loose paint should be removed before painting. New wood should be primed with a suitable primer. Application temperatures should be above 10°C (50°F) to insure proper drying and film formation.

6.2 Ordering data. Purchasers should include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Type, Class, Grade and color required (see 1).
(c) Packaging, packing, and marking required.
(d) Size of container and quantity required.

6.3 Bid evaluation. When specified by the contracting officer, competing offers will be evaluated using the following formula with the lowest evaluated offer being considered as low bid:

Evaluated offer = offer price/AxB where:

A = volume solids percentage divided by 100
B = post consumer waste percentage divided by 10

Example: offer price $10.00 per gallon, 50% volume solids, 50% post-consumer waste

Evaluated offer = $10.00/(50/100)x(50/10) = $4.00 per gallon

TT-P-2846
INTERIM AMENDMENT 1
January 6, 1994

FEDERAL SPECIFICATION
PAINT, LATEX
(RECYCLED WITH POST-CONSUMER WASTE)

This interim amendment was developed by the General Services Administration, Federal Supply Service, based upon currently available technical information.

The General Services Administration has authorized the use of this interim amendment, which forms a part of TT-P-2846 dated November 23, 1993, by all federal agencies.

PAGE 1

Paragraph 2.1 under Federal Standards: add the following.
"FED-STD-595 - Colors Used in Government Procurement."

PAGE 2

Paragraph 3.1 delete and substitute the following.

"**3.1 Materials.** The paint shall contain post-consumer latex paint waste in the quantities specified in table I. The term post-consumer shall be as defined in 40CFR Part 247 and the definitions in section 6.4."

Paragraph 3.1.1 change the following.
delete in line 3 "mercury in excess of 10 parts per million" and replace with
"mercury in excess of 50 parts per million for Types I and III or 100 ppm for Type II."

PAGE 4

Add the following new paragraphs.

"**6.4 Definitions.**

6.4.1 **Postconsumer material.** A material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. "Postconsumer material" is a part of the broader category of "recovered material".

6.4.2 **Recovered materials.** Waste materials and byproducts which have been recovered or diverted from solid waste, but such term does not include those materials and byproducts generated from, and commonly reused within, an original manufacturing process."

PREPARING ACTIVITY
GSA-FSS

Beneficial comments, recommendations, additions, deletions, clarification's, etc. and any data which may improve this document should be sent to: General Services Administration, Engineering and Commodity Management Division (9FTE-10), 400 15th St. SW, Auburn, WA 98001

FSC 8010

DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

TABLE 2
RECOMMENDED SPECIFICATIONS FOR
RECYCLED FLAT INTERIOR LATEX PAINT (SEATTLE, WA)

Characteristic	Acceptable Levels Min	Max
QUANTITATIVE		
Consistency (Krebs Units)	82	110*
Total solids (% by weight)	45	- +
Dry Hard (minutes)	--	60*
85 degree specular gloss	3	10*
Fineness of Grind	1	- +
Lead Content (% by weight)	--	0.06%*
Hiding contrast ratio (rewetted)	93	--*
Hiding contrast ratio (dry)	95	--*
QUALITATIVE		
Condition in container	TO	PASS*
Storage (viscosity) stability (KU)	77	115*
Color	TO BE DETERMINED +	- *
Flexibility (inch)	1/4	PASS*
Working Properties	TO	PASS*
Appearance of dried paint	TO	1/16*
Anchorage (inch)	--	- *
Scrub resistance (cycles)	400	10%+
Washability	--	20%*
Washability at 85 degrees	--	- *
Reflectance (%),	95	- +
Freeze-thaw resistance (KU)	--	PASS*
Water resistance	TO	- +
Alkali resistance	--	PASS*
Resistance to biological growth	TO	PASS*
Resistance to reflectance var.	TO	PASS*
Recoating	TO	PASS*
Odor		
OTHERS #		
pH	8	10#
Application bubbling	--	NONE#
Sag (mils)	10	- #

* Per TT-P-29

\+ Deviation from TT-P-29

\# Addition to TT-P-29

Source: Morley & Associates (Seattle, WA)

State of California

Memorandum

Date: 19 April 1995

To : H. Fernando Berton, Sr. Waste Mgt Specialist
Household Hazardous Waste Program Manager
California Integrated Waste Management Board
8800 Cal Center Drive, Sacramento, CA 95826

Through : John Howard, Chief
Division of Occupational Safety and Health

From : **Department of Industrial Relations**
Division of Occupational Safety and Health
Rod G. Repke, Industrial Hygienist RGR
Member: Paint Recycling Task Force
455 Golden Gate Avenue, Room 5227
San Francisco, CA 94102

Subject : Latex Paint Recycling (1): Hazard communication (HAZCOM) issues: 8 CCR 5194.

I formally became a member of the Task Force on 19 September 1994. Although I haven't attended all of the meetings, I have attended enough to get a feel for the HAZCOM issues involved at household waste recycling centers of the type characterized in Health & Safety Code[H&S], subsection 25218.1(k).

1. Material Safety Data Sheets (MSDS's) are required for the safety of downstream workers who may use a given product. The HAZCOM standard, however, excludes hazardous waste [which presumably includes household hazardous waste as defined in H&S 25218.1(e)] from all HAZCOM requirements including MSDS and labeling requirements. Household hazardous waste dropped off at a household waste recycling center would therefore not have to be accompanied by an MSDS (See Figure 1., item A.).

2. Once the recycled paint has been received at the recycling center, upon being consigned for shipment to a paint manufacturer as paint feedstock it ceases to be waste and becomes a commodity destined for downstream use. "Use" in HAZCOM means "To package, handle, react, or transfer" [5194(c): Definitions]. The paint feedstock is obviously going to be "used" by downstream employees and therefore, if it contains any hazardous substances as defined in §5194 at or in excess of 1% (0.1% if carcinogenic) [§5194(d)(5) and (g)(2)(A)], it must be accompanied by an MSDS (See Figure 1., item B.). Physical hazards such as flammability must also be considered [§5194(g)(2)(C)]. Herein lies the main HAZCOM problem with recycled waste.

3. To routinely analyze batches of recycled paint at H&S 25218.1(k)-type household recycling centers prior to shipment to paint manufacturers would probably be prohibitively expensive and possibly kill the recycling program. The Division supports the recycling concept, however, our first concern must be to fulfill our worker protection mandate.

4. I have been working with Prof. Max Wills at Cal-Poly University in San Luis Obispo in an attempt to resolve this difficulty. Prof. Wills's analyses of recyclable latex based paint received at household recycling centers have so far failed to indicate the presence of hazardous substances in significant quantities (1%, 0.1%). If this trend holds true, an MSDS may not be necessary because no hazardous substances are present in the recyclable paint feedstock. The recycling center would, however, need to attest to that fact.

5. If hazardous substances *are* found to be present in excess of the allowable amounts, a *generic*

MSDS for recyclable latex paint may be an acceptable alternative. The Division contends that any MSDS must be specific to the batch of substance for which it has been developed and that generic MSDS's are acceptable only as training devices. An exception, however, exists in §5194(g)(4) which states: "Where complex mixtures have similar hazards and contents . . . the manufacturer, importer, or employer may prepare one [MSDS] sheet to apply to all of these similar mixtures."

6. Justification for this would necessarily be based on research data such as that being developed by Prof. Wills. In order to maintain this justification, periodic analyses of batches of recyclable paint may still be necessary.

7. If further analyses show the significant presence of any hazardous substances, the Task Force must decide who will be responsible for developing an appropriate MSDS and labeling for the recyclable paint feedstock product. I discussed the issue briefly with Prof. Wills on 5 April 1995 at Cal-Poly and subsequently provided some HAZCOM guidance documents for his consideration including the Director's List, the HAZCOM standard, and the Division's model MSDS form.

RGR/rgr
cc: Nancy Carroll, Task Force Chair
Frank Ciofalo, Ph.D., Deputy Chief
Mike Mason, Chief Counsel
Max Wills, Ph.D., Prof. of Chemistry (Cal-Poly, SLO)
R&SD §5194

MATERIAL SAFETY DATA SHEET

essentially similar to form OSHA-174

E-COAT RECYCLE PAINT

5101 RALEY BOULEVARD, SACRAMENTO CA 95838

EMERGENCY PHONE: 800-424-9300 (Chemtrec) INFORMATION PHONE: 916-921-0165

I - PRODUCT IDENTIFICATION

PRODUCT NAME	PRODUCT NUMBER	HMIS CODES: H F R PP
E-COAT RECYCLED LATEX PAINT	1000 series (all colors)	1 0 0 E

II - HAZARDOUS INGREDIENTS

INGREDIENT	CAS REG #	WT PCT	TLV-ACGIH	PEL-OSHA	VAPOR PRESSURE MM HG AT DEG F
ETHYLENE GLYCOL	107-21-1	0-5%	50 ppm	50 ppm	0.1 / 68

NOTE: No chemicals listed by IARC, OSHA or NTP as carcinogenic were used to manufacture this product. It may contain pigments such as titanium dioxide, calcium carbonate, mineral silicates and/or silicon dioxide which are not hazardous in wet paint but may reach hazardous levels in dusts generated from the sanding or grinding of dried paint. These pigments, like most naturally occuring minerals, may contain small amounts of crystalline silica. IARC has determined that there is limited evidence for the carcinogenicity of respirable crystalline silica to humans, with the risk depending on the duration and level of exposure. This product may contaian paint preservatives (such as CAS #26172-55-4, 55406-53-6 and/or 4080-31-3) that have been added to control microorganisms at levels that are not considered hazardous.

III - PHYSICAL PROPERTIES

BOILING POINT: 212 deg F(water) DENSITY: 9-12#/gal VAPOR DENSITY:lighter than air(water vapor)

PERCENT VOLATILE: 55-70% (by volume) EVAPORATION RATE: slower than ether

IV - FIRE AND EXPLOSION HAZARD DATA

FLAMMABILITY CLASSIFICATION: Not regulated

FLASH POINT: None FLAMMABLE LIMITS: n/a EXTINGUISHING MEDIA: n/a

FIRE AND EXPLOSION HAZARDS: Closed containers may explode(due to the build-up of steam pressure) when exposed to extreme heat.

SPECIAL FIREFIGHTING PROCEDURES: None

V - REACTIVITY DATA

STABILITY: Stable CONDITIONS TO AVOID: n/a

INCOMPATIBILITY(MATERIALS TO AVOID): Strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS: May produce hazardous fumes when heated to decomposition as in welding.

PREPARED BY: Julian Schaffer DATE: 10/7/94 WII

VI - HEALTH HAZARD DATA

- SYMPTOMS/EFFECTS OF EXPOSURE AND OVEREXPOSURE -

PRIMARY ROUTES OF ENTRY: Inhalation, Skin and Eye Contact, Ingestion.

ACUTE: Dizziness, headache, nausea, confusion, irritation to upper respiratory tract, skin & eye irritation.

CHRONIC: Prolonged and/or repeated overexposure to high concentrations of respirable (airborne) crystalline silica dusts as may be generated by sanding or grinding of dried paints and other building materials without wearing proper respiratory protection can cause silicosis, a non-cancerous lung disease that can result in substantial impairment of breathing function.

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY EXPOSURE: None known. See your physician for specific medical opinion regarding your condition.

- EMERGENCY AND FIRST AID PROCEDURES -

INHALATION: Remove to fresh air. Restore breathing. Consult physician.

EYE CONTACT: Flush with large volumes of water for 15 minutes. Get medical attention.

SKIN CONTACT: Wipe off with a rag. Wash thoroughly with soap and water.

INGESTION: Consult hospital emergency room or Poison Control Center immediately.

VII - PRECAUTIONS FOR HANDLING & USE

STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED: Ventilate area to prevent build-up of vapors. For small spills, soak up with absorbant. For larger spills, dike area with absorbent material and scoop up liquids.

WASTE DISPOSAL METHOD: Discard in land fill in sealed metal containers away from heat and flame and in accordance with local regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store upright in sealed containers away from heat and flame.

OTHER PRECAUTIONS: Remove and wash contaminated clothing before reuse.

VIII - CONTROL MEASURES

RESPIRATORY PROTECTION: Use a particle mask (NIOSH/MSHA TC-21C) to avoid breathing spray mist or sanding dust if local ventilation is adequate to keep vapor concentrations within acceptable (TLV) limits. If local ventilation is not sufficient, or where exposure limits are exceeded, wear a suitable, properly fitted respirator (NIOSH/MSHA TC-23C or better) for organic vapors with a dust filter as needed.

VENTILATION: Local cross-ventilation or mechanical exhaust sufficient to keep all hazardous vapor concentrations below prescribed limits.

PROTECTIVE GLOVES: Recommended if necessary to prevent extended exposure.

EYE PROTECTION: Glasses with side shields or goggles are recommended to prevent eye contact.

NOTE: THIS INFORMATION IS BELIEVED TO BE COMPLETE AND ACCURATE. IF ANY QUESTIONS ARISE, CONTACT MANUFACTURER LISTED ABOVE. 694-WII

MATERIAL SAFETY DATA SHEET

Manufacturer's Name: Rasmussen Paints
12655 SW Beaverdam Road
Beaverton, OR 97005

Product: Recycled Latex Paint

Product No.: 10, 25

SECTION I – PRODUCT IDENTITY

Date Prepared: 10/30/92

Emergency Telephone Number: 503-644-9137

Preparer's Name: Ed Lind

HMIS Information
Health 1
Flammability 0
Reactivity 0

Chemical Name: Pigmented Water-based Coating

Chemical Formula: N/A Product is a Mixture

DOT Shipping Class: NOI

SECTION II – HAZARDOUS INGREDIENTS

Chemical & Common Name	CAS#	Wt%	OSHA PEL	ACGIH TLV	OTHER
* Ethylene Glycol	107-21-1	1-5	N/A	50ppm	
* Diethylene Glycol	111-77-3	1-5	N/A	N/A	
* Barium Sulfate	7727-43-7	1-5	5mg/m3	5mg/m3	
* Zinc Oxide	1314-13-2	1-5	5mg/m3	5mg/m3	
* Phenyl Mercuric Acetate	62-38-4	<1			Toxicity: LD50 orally in rats: 22mg/kg

* Denotes a reportable chemical under 40 CFR 372, SARA Title III Section 313.

SECTION III – PHYSICAL CHARACTERISTICS

Boiling Range: 212°F
Vapor Pressure: =water
Vapor Density: =water

Specific Gravity: 1.1-1.4
% Volatile(Volume): 45-55
Evaporation Rate(BuOAc = 1): <1

Solubility(Specify solvents):
Completely soluble in water, alcohol, insoluble in most petroleum solvents.

Appearance and Odor:
Various colors; little or no odor.

SECTION IV – FIRE & EXPLOSION DATA

Flash Point: N/A

Flammable Limits: N/A

Extinguishing Media: Non-flammable.

Special Firefighting Procedures:

Cool fire-exposed containers with water.

Unusual Fire & Explosion Hazards:
Material can splatter above 212° F.

Reactivity: Product is stable.

Hazardous Polymerization: Will not occur.

Conditions to avoid: None known.

Materials to avoid: Chlorinated solvents.

Hazardous decomposition products:
None known.

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SECTION V – HEALTH HAZARD DATA

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Route(s) of entry: Eye contact.

ACUTE HEALTH EFFECTS

EYE CONTACT: May cause redness, irritation.

INHALATION: No known adverse effects.

INGESTION: No known adverse effects.

SKIN CONTACT: No known adverse effects.

EMERGENCY FIRST AID PROCEDURES

EYE CONTACT: Flush with water for at least 15 minutes; if irritation persists, get medical attention.

INHALATION: N/A

INGESTION: N/A

SKIN CONTACT: N/A

CHRONIC HEALTH EFFECTS
Not listed as a carcinogen by the NTP, IARC, or OSHA; no long-term adverse effects are known.

Medical conditions aggravated by exposure:
None known.

SECTION VI – SPILL OR LEAK PROCEDURES

Steps to be taken in case material is spilled or released:
Soak up spill with absorbent material. Let dry and dispose of.

Waste disposal method:
Dispose of in accordance with all applicable federal, state, and local regulations.

SECTION VII -- SPECIAL PROTECTION DATA

Respiratory Protection:
None required with normal use.

Ventilation: Local exhaust.

Protective Gloves: Rubber or plastic if contact is likely.

Eye Protection: Goggles or face shield.

Other protective equipment: Plastic apron, if contact is likely. Eyewash statior

SECTION VIII – STORAGE & HANDLING DATA

Precautions to be taken in handling and storage:
Store in original container, keep tightly closed. Do not reuse container for other purposes.

Other precautions:
KEEP OUT OF REACH OF CHILDREN.

The information contained herein is based on the data available to us and is believed to be correct. However, Rasmussen Paints makes no warranty, expressed or implied, regarding the accuracy of these data or the results to be obtained from the use thereof. Rasmussen Paints assumes no responsibility for injury from the use of the product described herein.

This MSDS corforms with OSHA Hazard Communication Standard 1900.1210 and to SARA Title III Section 313 for supplier notification.

MATERIAL SAFETY DATA SHEET

RODUCT NAME: CYCLE-II LATEX S/G TOAST BROWN HMIS CODES: H F R P
RODUCT CODE: 77408 1 0 0 G

SECTION I - MANUFACTURER IDENTIFICATION

ANUFACTURER'S NAME: MAJOR PAINT COMPANY
DDRESS: 4300 West 190th Street, Torrance, CA 90509-2868
MERGENCY PHONE: (213)542-7701 INFORMATION PHONE: (213)542-7701
ATE REVISED : 01-30-92 NAME OF PREPARER : MAJOR PAINT
EASON REVISED : Update warnings.

SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION

HAZARDOUS COMPONENTS	CAS NUMBER	OCCUPATIONAL EXPOSURE LIMITS OSHA PEL	ACGIH TLV	DUPONT TLV	VAPOR PRESSURE mm Hg @ TEMP		WEIGHT PERCENT
IETHYLENE GLYCOL MONOETHYL ETHER	111-90-0	NE	NE	NE	0.1	68F	2
LKYLAMINE (identity withheld as trade secret)		NE	5 PPM C	NE	17.0	68F	
:,2,4-TRIMETHYL-1,3-PENTANEDIOL MONOISOBUTYRATE	25265-77-4	NE	NE	NE	40.6	77F	

Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.
*** This MSDS complies with the OSHA Hazard Communication Standard. ***

: - None established

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

OILING POINT: Basically water. SPECIFIC GRAVITY (H2O=1): 1.1
APOR DENSITY: HEAVIER THAN AIR EVAPORATION RATE: SLOWER THAN ETHER
OLUBILITY IN WATER: Miscible
PPEARANCE AND ODOR: Mild smelling thickened liquid.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

LASH POINT: N/A METHOD USED: N/A
LAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.2% UPPER: 23.5%

XTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

PECIAL FIREFIGHTING PROCEDURES
void confined spaces. Firefighters should be equiped with full protective equipment including a positive pressure IOSH-approved self-contained breathing apparatus.

NUSUAL FIRE AND EXPLOSION HAZARDS
losed containers can build up pressure and may explode when exposed to extreme heat. Water from fog nozzles may be elpful in cooling unruptered containers to prevent pressure build-up.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID

None reasonably foreseeable.

INCOMPATIBILITY (MATERIALS TO AVOID)

None reasonably foreseeable.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

May produce fumes when heated to decomposition. May release carbon monoxide, carbon dioxide, and oxides of nitrogen.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

SECTION VI - HEALTH HAZARD DATA

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause nose and throat irritation. May cause nervous system depression characterized by the following progressive steps: Headache, Dizziness, Nausea, Staggering gait, Confusion, Unconsciousness.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause irritation or burning of the eyes. Repeated or prolonged liquid contact may cause skin irritation with discomfort and dermatitis.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

See inhalation.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

See inhalation. May also result in gastro-intestinal distress.

HEALTH HAZARDS (ACUTE AND CHRONIC)

Reports have associated repeated and prolonged overexposure to solvent with permanent brain and nervous system damage. Material is slightly alkaline and may irritate eyes or skin.

CARCINOGENICITY: NTP? NO IARC MONOGRAPHS? NO OSHA REGULATED? NO

Detectable amounts of a chemical known to the State of California to cause cancer and/or reproductive harm may be present in this product.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Unknown but unlikely.

EMERGENCY AND FIRST AID PROCEDURES

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth.
Eye: In case of eye contact, immediatly flush with plenty of water for at least 15 minutes; call a physician.
Skin: Wash exposed skin with soap and water. If irritation occurs, contact a physician.
Ingestion: For gastro-intestinal distress, call a physician immediately and have names of hazardous ingredients ready. Do not induce vomiting. In all cases, if symptoms persist, consult a physician.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Ventilate area. Remove sources of ignition. Prevent skin contact and avoid breathing of vapor. Confine and remove with inert absorbant. Place in non-leaking containers.

WASTE DISPOSAL METHOD

Do not allow material to contaminate ground water systems. Dispose of absorbed material in accordance with all Federal, State, and local requirements. Do not incinerate in closed containers.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Observe label precautions. Keep away from heat, sparks, and open flame. Close container tightly after each use. Wash thoroughly after handling and before eating or smoking. Do not store above 120 degrees F. Store in dry, well ventilated place.

OTHER PRECAUTIONS

Avoid unnecessary contact.
Do not take internally.
Use with adequate ventilation.
Do not sand, flame cut, braze, or weld dry coating without a NIOSH/MSHA approved respirator or sufficient ventilation.

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION

Do not breath vapors or mists. If the TLV, PEL, or other suggested exposure limits are exceeded then wear a properly fitted vapor/particulate respirator approved by NIOSH/MSHA for use with paints such as a TC-23C during application and until all vapors and spray mists are exhausted. Follow the respirator manufacturer's directions for respirator use.

VENTILATION

Provide sufficient ventilation in volume and pattern to keep contaminants below applicable OSHA requirements or other suggested exposure limits.

PROTECTIVE GLOVES

Use Neoprene gloves or better. Protective creams are not recommended for protection but may be used for ease of cleanup.

EYE PROTECTION

Goggles are preferred to prevent eye irritation. If safety glasses are used include splash guard or side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Apron, coveralls, or work clothes. Eye washes and safety showers may also need to be provided.

WORK/HYGIENIC PRACTICES

As with all chemical products, use care in handling. Do not smoke or eat without first washing your hands.

SECTION IX - DISCLAIMER

DISCLAIMER

The information in this MSDS was obtained from sources which are believed to be reliable. However, the information is provided without any representation or warranty, expressed or implied, regarding its accuracy or correctness. It relates only to the material designated herein and does not relate to use in combination with any other material or process.

MATERIAL SAFETY DATA SHEET

SECTION 1. PRODUCT INFORMATION

Product Origin Consolidated Latex paint from the San Francisco Household Hazardous Waste Collection Facility

Address 501 Tunnel Avenue, San Francisco, CA 94134 (415) 330-1400

Product Name Recycled Latex Paint

SECTION 2. HAZARDOUS INGREDIENTS

Vehicle Hazardous Ingredients

Ingredient	CAS No.	Vapor Pressure (20°C)	Exposure Limit (PPM)
Vinyl Acrylic Polymer	25067-01-0	n/a	n/a
Water	7732-18-5	1.0 atm	n/a
Ammonium Hydroxide	1336-21-6	10 atm	25-TLV
Glycol Ethers:			
Ethylene glycol monobutyl ether	000111-76-2	.6 torr	25-PEL
ethylene glycol monoethyl ether	000106-74-1	4 torr	5-PEL
Ethylene glycol monomethyl ether	000109-86-4	6 torr	5-PEL
Ethylene Glycol	107-21-1	50-PEL	
Diethylene glycol monoethyl ether	111-90-0	.1 atm	n.a.

Vehicle Hazardous Contaminants (0-200 ppm)

2,2,4-trimethyl 1,3-pentane-diol monoisobutyrate	25265-77-4	n.a.	n.a.
Phenyl Mercuric Acetate	62-38-4	n.a.	73-TLV
o-Xylene	95-47-6	7-9 torr	100-PEL
m-Xylene	108-38-3	7-9 torr	100-PEL
p-Xylene	106-42-3	7-9 torr	100-PEL
Toluene	108-88-3	22 torr	100-PEL
1,2,4-Trimethyl benzene	95-63-6	1 torr at 13.6C	25-PEL
Ethyl Benzene	100-41-4	7.1 torr	100-PEL
1,3,5-Trimethyl benzene	108-67-8	1 torr at 9.6C	100-PEL
Di-n-Butyl Phthalate	84-74-2	1 torr at 148C	5-PEL
Butyl Benzyl Phthalate	85-68-7	n.a.	n.a.
Benzoic Acid	65-85-0	1 torr at 96C	n.a.

Pigment Hazardous Ingredients

Ingredient	CAS No.	Vapor Pressure (20°C)	Exposure Limit (PPM)
Calcium Carbonate	471-34-1	none	10 mg/m3-PEL
Zinc (oxide fume)	01314-13-2	none	5-PEL
Titanium Dioxide	131463-67-7	none	10-TLV, 10-PEL
Pigments Hazardous Contaminants (0-100 ppm)			
Barium (oxide)	001304-28-5	none	10 mg/m3-PEL
Beryllium (oxide)	001304-56-9	none	.002 mg/m3-PEL
Cadmium (compounds)	007440-43-9	none	.005-PEL
Cobalt (dust)	007440-48-4	none	.05mg/m3-PEL
Chromium (oxide)	001333-82-0	none	.5 mg/m3-PEL
Copper	007440-50-8	none	1 mg/m3-PEL
Nickel (oxide)	001313-99-1	none	1 mg/m3-PEL
Lead	61790-14-5	none	.15-TLV,.05-PEL

SECTION 3. PHYSICAL DATA

Boiling Point	approximately the same as water
Vapor Density	heavier than air
VOC content	100-200 grams/liter
Solubility in water	miscible
Evaporation rate	slower than butyl acetate
Specific Gravity	1.2 - 1.4 (9.6-11.2 lb/gal)
Odor	mild ammonia smell
Vapor Pressure	approximately .05 torr at 68 degrees F

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point	200 degrees F- none
Lower Explosion Limit (LEL)	23.5%-none
Flammability Classification:	none
Extinguishing Media	Foam, carbon dioxide, Dry Chemical, Water Fog
Unusual Fire and Explosion Hazards	Extreme heat may build up pressure in closed containers and cause them to explode. Water from fog nozzles may be helpful in cooling unruptured containers to prevent pressure build-up. Care should be taken to keep away from open flames, sparks, and high heat.

Special Fire Fighting Procedures	Avoid confined spaces. Firefighters should be equipped with full protective equipment including positive pressure NIOSH-approved self-contained breathing apparatus.

SECTION 5. HEALTH HAZARD DATA

General effects of over-exposure

Inhalation	Temporary dizziness, headache, possible nausea.
Ingestion	Possible gastrointestinal distress.
Skin contact	Possible Primary Irritation.
Eye contact	Possible Primary Irritation.

Emergency and first aid procedures

Inhalation	Remove to fresh air. Treat symptomatically.
Ingestion	Give 2 glasses of milk or water. Do not induce vomiting. Do not force anything into the mouth of an unconscious person.
Skin Contact	Wash affected area with soap and water.
Eye Contact	Flush immediately with water; continue for 15 minutes.

Special Effects: (by specific chemical in its 'pure' form)

VEHICLE MAIN CONSTITUENTS

Ammonium Hydroxide. A human poison by an unspecified route. Poison experimentally by inhalation, ingestion, and possibly other routes. An eye, mucous membrane, and systemic irritant by inhalation. Fumes are an explosion hazard when exposed to heat or flame and emit the toxic fumes of ammonia and nitrogen oxides when exposed to heat. LD50: 350 mg/kg.

Glycol Ethers. Acute toxic effects of glycol ethers in general are irritation of the eyes, nose and throat; drowsiness; weakness; and shaking. Ingestion can be fatal. Prolonged or repeated exposures may cause headache, drowsiness, weakness, fatigue, staggering, personality changes, and decreased mental ability. Some overexposed workers have suffered encephalaopathy(degenerative brain disease), bone marrow depression and - pancytopenia(reduced levels of all blood cells). Ethylene glycol monoethyl ether(2EE) and Ethylene glycol monomethyl ether(2ME) have the potential to cause adverse reproductive effects in male and female workers. They have been shown to cause embryotoxicity and other reproductive effects in several species of animals exposed by different routes of administration. The exposure of pregnant animals to concentrations of 2ME or 2EE at or below their OSHA permissible exposure limits lead to increased incidences of embryonic death, teratogenesis, or growth retardation. Exposure of male animals resulted in testicular atrophy and sterility. Can be absorbed through the skin. Glycol ethers are flammable or combustible when exposed to heat or flame, and can react vigorously with oxidizing materials. When heated to decomposition they emit acrid smoke and fumes. **Ethylene glycol monobutylether** - LD50: 790 mg/kg , **Ethylene glycol monoethyl ether** - LD50: 3,000 mg/kg, **Ethylene glycol monomethyl ether** - LD50: 3,390 mg/kg.

Ethylene Glycol. Human poison by ingestion (Lethal dose for humans reported to be 100 ml). Moderately toxic to humans by an unspecified route. Moderately toxic experimentally by ingestion, subcutaneous, intravenous and intramuscular routes. Mildly toxic by skin contact. A suspected carcinogen. Human systemic effects by ingestion and inhalation: eye lacrimation, general anesthesia, headache, cough, respiratory stimulation, nausea or vomiting, pulmonary, kidney and liver changes. If ingested it causes initial central nervous system stimulation followed by depression. It can cause lethal kidney damage. Very toxic in particulate form upon inhalation. An experimental teratogen. There is some data supporting the assumption that it is a human mutagen. Ethylene Glycol is combustible when exposed to heat or flame and can react vigorously with strong oxidizing agents. Moderate explosion hazard when exposed to flame. When heated to decomposition it emits acrid smoke and irritating fumes. LD50: 4700 mg/kg.

VEHICLE CONTAMINANTS (0-200 ppm)

2,2,4-Trimethyl 1,3-pentanediol monoisobutyrate. Poison by intravenous route. Moderately toxic by ingestion and intraperitoneal route. It is skin irritant and insect repellent. Combustible when exposed to heat or flame and can react with strong oxidizing agents. When heated to decomposition it emits acrid smoke and irritating fumes. LD50: 2,000 mg/kg

Phenyl Mercuric Acetate. Poison by ingestion, intravenous, intraperitoneal, subcutaneous, and possibly other routes. An experimental teratogen. Other possible reproductive and mutagenic effects. Mercury in general is a protoplasmic poison; after absorption it circulates in the blood and is stored in the liver, kidneys, spleen and bone. In industrial poisoning, the principal effect is upon the central nervous system, the mouth and gums. Symptoms of mercury poisoning are stomatitis, tremors, and psychic disturbances along with excessive salivation and painful chewing. In severe cases there may be gingivitis with loosening of the teeth, and a dark line on the gum margins resembling the "lead line". Psychic disturbances of poisoning include loss of memory, insomnia, lack of confidence, irritability, vague fears and depression. Mercury is readily absorbed by the respiratory tract, skin, and the gastrointestinal tract. Acute toxicity includes violent corrosive effects on skin, and mucous membranes. Nausea, vomiting, abdominal pain, bloody diarrhea, kidney damage, and death can occur within 10 days can occur with an acute exposure to mercury. LD50: 22 mg/kg.

o, m & p-Xylene. Moderately toxic by intraperitoneal route. Mildly toxic by ingestion and inhalation. An experimental teratogen and can cause changes in reproductive functioning. Can be narcotic in high concentrations. A very dangerous fire hazard when exposed to heat or flame and can react with oxidizing agents violently and explosively. When heated to decomposition it emits acrid smoke and irritating fumes. , **o-Xylene:** LD50: 8800 mg/kg, **m-Xylene:** LD50: 8680 mg/kg, **p-Xylene:** LD50: 8600 mg/kg

Toluene. Poison by intraperitoneal route. Moderately toxic by intravenous, subcutaneous and possibly other routes. Mildly toxic by inhalation. An experimental teratogen. Human Systemic effects by inhalation: CNS recording changes, hallucinations or distorted perceptions, motor activity changes, antipsychotic, psychophysiological test changes and bone marrow changes. Experimental reproductive and mutagenic effects. At low concentrations in the air(200-500 ppm) headache, nausea, eye irritation, loss of appetite, a bad taste, lassitude, impairment of coordination and reaction time are reported. With higher concentrations anemia, leukopenia and enlarged liver may be found in rare cases. A very dangerous fire hazard when exposed to heat, flame or oxidizers. Explosive in the form of vapor when exposed to heat or flame. LD50: 5,000 mg/kg

1,2,4 & 1,3,5-Trimethyl benzene. Moderately toxic by ingestion and inhalation. Can cause central nervous system depression, anemia, and bronchitis. Flammable when ex posed to heat, flame or oxidizers. When heated to decomposition it emits acrid smoke and irritating fumes-LD50 - 8,970 mg/kg.

Ethyl Benzene. Moderately toxic by ingestion, inhalation and skin contact. An experimental teratogen and mutagen. Human systemic effects by inhalation: eye, sleep and pulmonary changes. Vapor is an irritant to human eyes and can dizziness, irritation of the nose and throat and constriction in the chest. Guinea pig exposures have caused ataxia, loss of consciousness, tremor of the extremities and finally death through respiratory failure. A very dangerous fire and explosion hazard when exposed to heat or flame and can react vigorously with oxidizing materials. When heated to decomposition it emits acrid smoke and irritating fumes. LD50: 3,500 mg/kg.

Di-N-Butyl phthalate. Moderately toxic by intraperitoneal , intravenous and ingestion pathways. Human systemic effects by ingestion includes: hallucinations, distorted perceptions, nausea or vomiting and kidney, ureter or bladder changes. An experimental mutagen and teratogen. Combustible when exposed to heat or flame, and can react with oxidizing materials-LD50 - 8,000 mg/kg.

Butyl benzyl phthalate. Moderately toxic by ingestion and intraperitoneal routes. An experimental carcinogen. Experimental reproductive effects. Combustible when exposed to heat or flame and can react with oxidizers. When heated to decomposition it emits acrid smoke and irritating fumes - LD50: 2,330 mg/kg.

Benzoic Acid. Poison by subcutaneous route. Moderately toxic buy ingestion and intraperitoneal routes. Human systemic effects by inhalation include: dyspnea and allergic dermatitis. Severe eye irritant. A human skin irritant. Combustible when exposed to heat or flame and can react with oxidizing materials. When heated to decomposition it emits acrid smoke and irritating fumes - LD50: 2,530 mg/kg

PIGMENT MAIN CONSTITUENTS

Calcium Carbonate. A severe eye and skin irritant-LD50 -6,450 mg/kg

Zinc Oxide. Poison by intraperitoneal route. An experimental teratogen and mutagen. Human systemic effects by inhalation of freshly formed fumes: chills, fever, tightness of chest, cough, dyspnea and other pulmonary changes. When heated to decomposition it emits toxic fumes of zinc oxide-LD50 - 6,846 mg/kg.

Titanium Dioxide. An experimental carcinogen, neoplastigen and tumorigen. A human skin irritant. A common air contaminant and nuisance dust- LD50-n.a.

Barium oxide. A poison via subcutaneous route. Symptoms of acute exposure being severe abdominal pain with vomiting, dyspnoea, rapid pulse, paralysis of the arms and legs, eventual cyanosis and death-LD50: 50 mg/kg

Beryllium oxide. Beryllium and its compounds are considered to be human and experimental carcinogens, tumorigens, and neoplastigens. Beryllium compounds can enter the body through inhalation of dusts and fumes, and may act locally on the skin. Inhalation of the dust can cause severe lung damage with symptoms appearing within months. Symptoms include: dermatitis of an ademato us and papulovesicular type, chronic skin ulcers, rhinitis, nasopharyngitis, epistaxis, bronchitis and in severe cases, the development

of an acute pneumonitis, with cough, scanty sputum, low-grade fever, rales, dyspnea and substernal pain. In some severe cases of exposure the pneumonitis can turn into lung fibrosis and eventual death.

Calcium Carbonate. A severe eye and skin irritant-LD50 -6,450 mg/kg

Zinc Oxide. Poison by intraperitoneal route. An experimental teratogen and mutagen. Human systemic effects by inhalation of freshly formed fumes: chills, fever, tightness of chest, cough, dyspnea and other pulmonary changes. When heated to decomposition it emits toxic fumes of zinc oxide-LD50 - 6,846 mg/kg.

Titanium Dioxide. An experimental carcinogen, neoplastigen and tumorigen. A human skin irritant. A common air contaminant and nuisance dust- LD50-n.a.

PIGMENT CONTAMINANTS (0-100 ppm)

Barium oxide. A poison via subcutaneous route. Symptoms of acute exposure being severe abdominal pain with vomiting, dyspnoea, rapid pulse, paralysis of the arms and legs, eventual cyanosis and death-LD50: 50 mg/kg

Beryllium oxide. Beryllium and its compounds are considered to be human and experimental carcinogens, tumorigens, and neoplastigens. Beryllium compounds can enter the body through inhalation of dusts and fumes, and may act locally on the skin. Inhalation of the dust can cause severe lung damage with symptoms appearing within months. Symptoms include: dermatitis of an adematous and papulovesicular type, chronic skin ulcers, rhinitis, nasopharyngitis, epistaxis, bronchitis and in severe cases, the development of an acute pneumonitis, with cough, scanty sputum, low-grade fever, rales, dyspnea and substernal pain. In some severe cases of exposure the pneumonitis can turn into lung fibrosis and eventual death.

Cadmium compounds. Inhalation causes lung cancer in humans. Poison by ingestion, however, the irritating and emetic actions is so violent that little of the cadmium has time to be absorbed and fatal poisoning rarely ensues. Experimental carcinogens and teratogen. Inhalation of fumes or dusts affects the respiratory tract and the kidneys. Brief exposure to high concentrations may result in pulmonary edema and death-LD50: 72 mg/kg

Cobalt compounds. Cobalt has a low toxicity by ingestion. Ingestion of soluble salts produces nausea and vomiting by local irritation. Cobalt is an experimental neoplastigen and tumorigen. It is an experimental carcinogen of the connective tissue and lungs. LD50: 202 mg/kg

Chromium. Poison by ingestion, intraperitoneal and subcutaneous routes. A human carcinogen by inhalation (nasal and lung tumors). An experimental carcinogen and teratogen. Other experimental reproductive effects. Probably and human mutagen as well as a severe eye, skin and mucous membrane irritant-LD50: 80 mg/kg

SECTION 6. REACTIVITY DATA

Stability	Stable
Hazardous Polymerization	Will not occur
Hazardous Decomposition Products	May contain small amounts of ammonia, nitrogen oxides, and carbon monoxide
Incompatibilities	May react slowly with strong oxidizing agents

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES AND PREVENTION:

Steps to be taken in case material is released or spilled
Ventilate area. Remove sources of ignition. Prevent skin contact and avoid breathing of vapor. Confine and remove with inert absorbent. Place in proper DOT container for disposal.

Waste Disposal Method
Do not allow material to contaminate ground water systems. Dispose of absorbed material in accordance with all Federal, State, and Local requirements.

Precautions to be taken in handling and storing
Keep away from heat, sparks, and open flame. Close container tightly after each use. Wash thoroughly after handling and before eating or smoking. Do not store above 120 degrees F. Store in dry well ventilated area.

Other precautions
Avoid unnecessary contact. Do not take internally. Use with adequate ventilation. Do not sand, flame cut, braze, or weld dry coating without a NIOSH/MSHA approved respirator or sufficient ventilation.

SECTION 8. SAFETY CONTROL MEASURES:

Respiratory Protection
Do not breath vapors or mists. If the TLV, PEL, or other exposure limits are exceeded then wear a properly fitted NIOSH/MSHA with appropriate cartridges with paint during application and until all vapors and spray mists are exhausted. Follow the respirator manufacturer's directions for respirator use.

Ventilation
Provide sufficient ventilation in volume and pattern to keep contaminants below applicable OSHA requirements other suggested exposure limits.

Protective gloves
Use Neoprene gloves or better.

Eye protection
Goggles are preferred to prevent eye irritation. If safety glasses are used include splash guard or side shields.

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Eye protection
Goggles are preferred to prevent eye irritation. If safety glasses are used include splash guard or side shields.

Other Protective clothing or equipment
Apron, coveralls, or work clothes. Eye washes and safety showers should be available.

Work/hygienic practices
As with all chemical products, use care in handling. So not smoke or eat without first washing thoroughly.

SECTION 9. SPECIAL PRECAUTIONS

Storage
Do not store above 120 degrees F or below freezing point. Do not take internally. Keep away from children

SECTION 10. CHEMICAL INGREDIENTS BY PERCENT OR PPM

VEHICLE

Vinyl Acrylic Polymer	20-30%
Water	40-60%
Ammonium Hydroxide	0-20%
Glycol Ethers:	
Ethylene glycol monobutyl ether	0-5%
ethylene glycol monoethyl ether	0-5%
Ethylene glycol monomethyl ether	0-5%
Ethylene Glycol	0-15%
Diethylene glycol monoethyl ether	0-5%

Vehicle Contaminants

2,2,4-trimethyl 1,3-pentane-diol monoisobutyrate	0-1000 ppm
Phenyl Mercuric Acetate	0-100 ppm
o-Xylene	0-140 ppm
m-Xylene	0-250 ppm
p-Xylene	0-250 ppm
Toluene	0-50 ppm
1,2,4-Trimethyl benzene	0-170 ppm
Ethyl Benzene	0-120 ppm
1,3,5-Trimethyl benzene	0-100 ppm
Di-n-Butyl Phthalate	0-200 ppm
Butyl Benzyl Phthalate	0-50 ppm
Benzoic Acid	0-200 ppm

PIGMENT

Calcium Carbonate	0-20%
Zinc Oxide	0-5%
Titanium Dioxide	5-20%
Silica	3-8%

Pigment Contaminants

Barium (oxide)	0-200 ppm
Beryllium (oxide)	0-5 ppm
Cadmium (compounds)	0-5 ppm
Cobalt (dust)	0-20 ppm
Chromium (oxide)	0-5 ppm
Copper	0-5 ppm
Nickel (oxide)	0-5 ppm
Lead	0-5 ppm

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: CONSOLIDATED LATEX PAINT
PRODUCT CODE: 8010-01

HMIS CODES: H F R P
1 0 0 A

SECTION I - MANUFACTURER IDENTIFICATION

MANUFACTURER'S NAME: MAJOR PAINT COMPANY
ADDRESS: 4300 West 190th Street, Torrance, CA 90509-2868
EMERGENCY PHONE: 1-800-424-9300 INFORMATION PHONE: (310)542-7701
DATE REVISED : 02-17-94 NAME OF PREPARER :
REASON REVISED : Update warnings.

SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION

HAZARDOUS COMPONENTS	CAS NUMBER	OCCUPATIONAL EXPOSURE LIMITS OSHA PEL	ACGIH TLV	DuPONT TLV	VAPOR PRESSURE mm Hg @ TEMP	WEIGHT PERCENT
DIETHYLENE GLYCOL	111-46-6	NE	NE	100 PPM	N/A	< 5.0%
OCTYLPHENOXYPOLYETHOXY-ETHANOL	9036-19-5	NE	NE	NE	0.0 68F	< 5.0%

*** No toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372 are present. ***
*** This MSDS complies with the OSHA Hazard Communication Standard. ***

NE - None established

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING POINT: Basically water. SPECIFIC GRAVITY (H2O=1): 1.0
VAPOR DENSITY: HEAVIER THAN AIR EVAPORATION RATE: SLOWER THAN ETHER
COATING V.O.C. : 0.33 LB/GL (40 G/L)
MATERIAL V.O.C.: 0.10 LB/GL (12 G/L)
SOLUBILITY IN WATER: Miscible
APPEARANCE AND ODOR: Mild smelling thickened liquid.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 201 F. METHOD USED: N/A
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: N/A UPPER: N/A

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Avoid confined spaces. Firefighters should be equiped with full protective equipment including a positive pressure NIOSH-approved self-contained breathing apparatus.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Closed containers can build up pressure and may explode when exposed to extreme heat. Water from fog nozzles may be helpful in cooling unruptered containers to prevent pressure build-up.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID

None reasonably foreseeable.

INCOMPATIBILITY (MATERIALS TO AVOID)

None reasonably foreseeable.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

May produce fumes when heated to decomposition. May release carbon monoxide, carbon dioxide, and oxides of nitrogen.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

SECTION VI - HEALTH HAZARD DATA

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause nose and throat irritation. May cause nervous system depression characterized by the following progressive steps: Headache, Dizziness, Nausea, Staggering gait, Confusion, Unconsciousness.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause irritation or burning of the eyes. Repeated or prolonged liquid contact may cause skin irritation with discomfort and dermatitis.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

See inhalation.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

See inhalation. May also result in gastro-intestinal distress.

HEALTH HAZARDS (ACUTE AND CHRONIC)

Reports have associated repeated and prolonged overexposure to solvent with permanent brain and nervous system damage. Material is slightly alkaline and may irritate eyes or skin.

CARCINOGENICITY: NTP? NO IARC MONOGRAPHS? NO OSHA REGULATED? NO

Detectable amounts of a chemical known to the State of California to cause cancer and/or reproductive harm may be present in this product.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Unknown but unlikely.

EMERGENCY AND FIRST AID PROCEDURES

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth.
Eye: In case of eye contact, immediatly flush with plenty of water for at least 15 minutes; call a physician.
Skin: Wash exposed skin with soap and water. If irritation occurs, contact a physician.
Ingestion: For gastro-intestinal distress, call a physician immediately and have names of hazardous ingredients ready. Do not induce vomiting. In all cases, if symptoms persist, consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Ventilate area. Remove sources of ignition. Prevent skin contact and avoid breathing of vapor. Confine and remove with inert absorbant. Place in non-leaking containers.

WASTE DISPOSAL METHOD

Do not allow material to contaminate ground water systems. Dispose of absorbed material in accordance with all Federal, State, and local requirements. Do not incinerate in closed containers.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Observe label precautions. Keep away from heat, sparks, and open flame. Close container tightly after each use. Wash thoroughly after handling and before eating or smoking. Do not store above 120 degrees F. Store in dry, well ventilated place.

OTHER PRECAUTIONS

Avoid unnecessary contact.
Do not take internally.
Use with adequate ventilation.
Do not sand, flame cut, braze, or weld dry coating without a NIOSH/MSHA approved respirator or sufficient ventilation.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION

Do not breath vapors or mists. If the TLV, PEL, or other suggested exposure limits are exceeded then wear a properly fitted vapor/particulate respirator approved by NIOSH/MSHA for use with paints such as a TC-23C during application and until all vapors and spray mists are exhausted. Follow the respirator manufacturer's directions for respirator use.

VENTILATION

Provide sufficient ventilation in volume and pattern to keep contaminants below applicable OSHA requirements or other suggested exposure limits.

PROTECTIVE GLOVES

Use Neoprene gloves or better. Protective creams are not recommended for protection but may be used for ease of cleanup.

EYE PROTECTION

Goggles are preferred to prevent eye irritation. If safety glasses are used include splash guard or side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Apron, coveralls, or work clothes. Eye washes and safety showers may also need to be provided.

WORK/HYGIENIC PRACTICES

As with all chemical products, use care in handling. Do not smoke or eat without first washing your hands.

========== SECTION IX - DISCLAIMER ==========

DISCLAIMER

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- Personnel from the DTSC (or their designees) will take samples three times a year (Fall, Winter, and Spring). In case two or more sites sort by color, they will draw samples of different colors from each of those sites.
- A five-gallon composite sample of all collected recyclable latex paint from each collection site will be delivered to Cal Poly for preliminary physical testing. At the same time, a separate 16-ounce sample will be taken from the five-gallon composite at the collection site and will be forwarded to a certified laboratory to be tested for hazardous compounds. Cal Poly will transmit portions of its samples of collected recyclable paint to participating paint companies for evaluation as a potential raw material in a usable product.

Preliminary Collection

- The seven participating HHWC programs are not expected to change their existing or evolving latex paint collection protocols for the Cal Poly Project. Each HHWC program will be expected to provide a detailed summary of protocols used by them. These protocols may take into consideration that before bulking, surplus latex paint will be inspected visually at the collection site to eliminate the following:
    1. Paint in containers which are rusted, crushed, leaky or otherwise damaged as well as paint in unlabeled or illegibly labeled containers.
    2. Paint which is no longer liquid (non-pourable) and paint containing lumps, dried particles, and/or other foreign matter.
    3. Mildew or fungus-resistant paint.
    4. Lead primers.
    5. Deep yellow or orange paints.
    6. Paints with bad odors.
    7. Paints which show separation or gelation.

Preparing To Take Sample

- Samples must be taken from full 55-gallon drums, unless only a portion of one drum is filled during the household hazardous waste

collection operation. For example, if 3/4 of one drum is collected, then all of the sample must come from that drum. If 3 and 1/2 drums of paint are collected, then three drums should be sampled. A total of five (5) gallons of sample paint will be taken from each collection site.

- The amount of paint brought to collection sites will vary greatly. Some events result in the collection of over twenty-five 55-gallon drums of latex paint. (This volume would usually accrue at one-day events. Permanent sites will most likely have much less paint at any one time.) For purposes of the PRTF, no more than ten (10) full drums will be sampled at any one site. The amount of paint taken from each drum should be such that a total of 5 gallons of composite paint is obtained from the number of drums sampled. For example, if 10 drums are sampled, then 1/2 gallon would be taken from each drum; if 5 drums are sampled, then 1 gallon would be taken from each drum, and so on.
- Sampling must occur in one continuous sequence and thus should not begin until after the collection site has closed to the public and the paint has been consolidated.
- The 5 gallon sample shall be thoroughly mixed by hand.
- A 16-ounce sample will be extracted from the five-gallon sample and sent to a certified laboratory for testing. The remaining sample will be sent to Cal Poly San Luis Obispo for testing.
- A DTSC or CIWMB official will preside over each of the sampling events for at least the first two rounds of sampling. These officials will take photographs of each drum sampling event and of the composite 16-ounce and five-gallon samples.
- Equipment to be supplied by the PRTF for sampling will include:
    - (1) Coliwasa sampler
    - (1) Ice chest (Large)
    - (1) Ice chest (Small)
    - (2) Gallons Deionized water
    - (2) Frozen blue ice containers
    - (1) Sample collection measuring bucket
    - (1) Cleaning bucket
    - (2) Rinse tubs
    - (2) Scrub brushes

(1) Chalk board/Chalk
(1) Five gallon sample container
(2) 16-Ounce sample container
(Ample) Chain-of-custody forms
(2) Large plastic bags
(1) 35mm camera, film and accessories

Sampling Instrument

- It is imperative that representative samples be obtained from each 55-gallon drum. Since the drums will not be mechanically mixed prior to sampling, a stratified or "top to bottom" sample must be taken to ensure that a representative sample is obtained. A coliwasa provides for stratified sampling and thus will be the sampling instrument used.

Sampling Procedure

- Make sure the coliwasa is clean.
- adjust sampler's locking mechanism to ensure that the stopper provides a tight closure. Open sampler by placing stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
- slowly lower the sampler into the paint at a rate that permits the level of liquid inside and outside the sampler to remain the same. If the level of paint in the sampler tube is lower inside than outside, the sampler rate is too fast and will produce a non representative sample.
- When the sampler hits the bottom of the 55 gallon drum, push sampler tube down to close and lock the stopper by turning the T-handle until it is upright and one end rests on the locking block.
- Withdraw coliwasa from the drum and release sample into sample container.
- Rinse coliwasa in cleaning bucket prior to sampling next drum. The rinse water need not be changed when successive coliwasa cleanings are necessary.

Documentation

- Each sample taken shall be photo documented, showing the number of the sample (1 of 10, 2 of 10, etc.), the date, the time and the sampling location. (A portable chalk board will be used to record this information for the photograph.) The DTSC or CIWMB official will photograph at least the first two sampling events. Other State or local personnel will photograph subsequent rounds of sampling.

Shipping

- The 16-ounce sample being sent to the certified laboratory for analysis must follow specific chain-of-custody procedures. These procedures include:
    1. Sealing the sample container with evidence tape.
    2. Packing the sample in ice.
    3. Sealing the small ice chest with evidence tape.
    4. Filling out chain-of-custody forms.
    5. Sending the sample as soon as possible (within 1 day of sampling).
    6. A duplicate sample will be needed from one site, once a year.
- The five-gallon sample should be tightly sealed and packed with newspaper in a large ice chest.
- Mailing labels for both the Hazardous Materials Laboratory and Cal Poly San Luis Obispo will be provided.

Clean-up

- The coliwasa needs to be thoroughly cleaned at the end of the sampling event, using soap and water. A brush that will allow the inside of the coliwasa to be scrubbed will be provided. Following the soap washing, the coliwasa should be tripled rinsed with tap water. After rinsing, the coliwasa should be air dried overnight (or until completely dried) and stored in a plastic garbage bag.

Appendix F. Collection and Sorting Protocols in Use by Various Agencies

- San Mateo County, California

  1. Set up five shrink-wrapped drums
  2. Place a metal paint strainer on each drum to screen out unwanted materials (chicken wire is suggested).
  3. Place a paint scraper on top of the drum and over the strainer. The drums are retrofit with scrapers that fit inside 1 gallon, 1 quart and 1 pint size containers.
  4. While opening the containers, segregate into five color groups and pour into the five 55-gal drums.

     Drum 1, off-white, which includes white and off-white

     Drum 2, green, which includes yellow, blue, and green (excluding olive green)

     Drum 3, gray, which includes black and gray

     Drum 4, red, which includes red, pink, brick, and peach

     Drum 5, beige, which includes all other colors which do not fit into the first four categories
  5. Send drums to Early American Paint Company for re-processing.

The reprocessed paints are returned to San Mateo County and distributed to the community as off-white, gray, rose, green and beige. No specific protocols were given for the methods used for segregating latex paints from other paint types.

- Alameda County, California

The collection site segregates collected latex paint into two categories: White/Off-White and all other colors. The consolidated paints are sent to Early American Paint Company for reprocessing and are then returned to the county. No specific protocols were given for the methods used for segregating latex paints from other paint types.

- San Luis Obispo County, California

Collected latex paint is transported to San Luis Paint Company as original un-opened containers. Trained personnel segregate latex paints from non-latex paints based on label information and sort them into four color categories. These categories are: 1) Whites, 2) Combined yellow, green, and blue, 3) Dark, and 4) Mid color, defined as too dark to be combined with whites

and too light to be combined with darks. All reds and pinks are combined with the dark category since these tend to give muddy colors if mixed with paints in the other three categories.

- San Francisco, California (Sanitary Fill Company)

1. The San Francisco Household Hazardous Waste Collection Facility uses label information to identify waste latex paint. Specifically, the label must say WATER BASE, LATEX, or CLEAN UP WITH WATER. If the can says OIL BASE, ALKYD, COMBUSTIBLE, FLAMMABLE, CONTAINS MINERAL SPIRITS, the can is placed with oil based materials. If no label is present or if the label is unreadable, a visual examination of the paint surface is made to determine if the paint is a water-based latex paint. Specifically, if the paint has a "watery-clear layer", it is placed with latex paints.

2. If the paint contains dried, solid paint, it is handled as solid waste.

3. If the paint is moldy, lumpy or rusty, it is consolidated in the drum for Standard Brands (Major Paint Company) to be reprocessed as beige paint.

4. Color sorting is carried out to give two categories consisting of white/off-white and all other colors.

Summary: San Francisco sorts into three categories - White/Off-White, Colored, and Moldy/Lumpy/Rusty.

- Contra Costa County, California (Pleasant Hill Bayshore Disposal, Inc.)

Extensive guidelines for segregating latex paints from other paint types have been developed but sorting by color is not carried out. A summary of the key considerations is as follows:

1. Personal protective equipment is required by workers including coveralls, boots, gloves, and safety glasses.

2. Paint identification is by label interpretation based on the terms latex or water based. If the label indicates oil based it is put aside.

3. Cans with large chunks of dried paint are placed in the garbage dumpster. Cans with liquid paint are not put into the dumpster.

- Kern County, California

Only latex/water based paint is accepted on "recycling days". All colors are bulked together. Paints are placed on a paint shaker prior to bulking. Paints

are poured through a large metal screen prior to bulking. Sequoia Paint Company reprocesses the paint and returns it to the county in 5 gallon buckets.

- *San Diego County, California*

1. Safety equipment includes Tyvek or Saranex coveralls, safety glasses or goggles, hard hat and face shield, steel-toed rubber boots, and chemically resistant gloves.

2. Latex paint is sorted by label identifiers including LATEX, WATER BASED, DO NOT LET PRODUCT FREEZE, WATER CLEAN UP. If in doubt, or if a clear label does not exist, the paint is placed with oil based paints.

3. Upon opening, the paint is visually inspected for non-latex appearance. If the paint looks bad (has an oil slick, is dried up, smelly, solidified, moldy) it is placed with oil based paints.

4. Paints are consolidated into 55 gallon drums into the color categories light, medium, and dark. The light category includes white and off-white. The dark category includes blacks, browns, and grays. The medium category includes all other colors.

- Marin County, California

  Sorting carried out based on the categories white/off-white and "all others"

- Sacramento County, California

1. A "screening" team meets participants and briefly examines wastes being brought. A "contingency" sticker is placed on the car if it appears that the wrong types of paint are being brought in. This sticker informs other teams at the collection site to examine the paints in more depth.

2. A "survey" team asks participants about their wastes and may also apply a contingency sticker.

3. A "presort" team examines each waste being brought in depth and places a red sticker on oil based paints which are not accepted.

4. An "unloading" team checks each waste label. Cans with the words OIL BASED, PETROLEUM BASED, CONTAINS LEAD, CLEAN-UP WITH PAINT THINNER OR MINERAL SPIRITS, ACRYLIC ENAMEL, and OIL BASED ENAMEL are not accepted.

5. Acceptable labels include LATEX PAINT, CLEAN WITH SOAP AND WATER, WATER BASED PAINT, etc.

6. All colors are bulked together.

- Seattle, Washington

A latex paint manual was developed. Collected latex paint is sorted into the three categories hazardous waste, disposable latex, and recyclable latex. Trained persons sort collected paint based on label identification and visual and odor characteristics. Color sorting is based on the categories light and dark using a single color chip provided to sorters to make the distinction. Colors lighter than the chip are placed in a recyclable latex drum and paints darker than the color chip are placed in a disposable latex drum. Thus, dark latex paints are not recycled at all. Workers consist of SORTERS, BULKERS, and a TECHNICAL SUPERVISOR. Their responsibilities include the following:

SORTERS

- Throw dried and empty cans in dumpster
- Inspect labels
- Open can lids
- Inspect contents (visual and odor)
- Sort paint into: Hazardous Waste
  Disposable Latex (red drums)
  Recyclable Latex (green drums)
- Notify technical supervisor if questions or problems arise

BULKERS

- Empty sorted cans into appropriate drums
- Throw empty cans into dumpster
- Watch for mis-sorted paint
- Notify technical supervisor when drums are full

Recognition traits for the various kinds of paints are as follows:

1. Solvent paint, lacquer and stain

A. Paint Label: Does not say latex
Says alkyd, lacquer, stain, urethane
Says combustible, flammable, or inflammable
Cleaning instructions say to use paint thinner or mineral spirits

Ingredients list mineral spirits or petroleum distillate
not water or glycols

B. Contents:
Has skin on top of liquid paint
Looks different than latex
Smells like solvent (gasoline)

2. Lead Paint

A. Label
Says "lead"
Indicates it is an exterior wood primer

B. Contents
Orange or yellow
White (primer)

3. High Mercury Content

A. Label
"Mildew resistant" - ingredients list mercury or no active ingredient listed
"Anti-fungal" - ingredients list mercury or no ingredients listed
Phenyl mercuric acetate or PMA
Phenyl mercuric oleate or PMO

4. Sour Latex

A. Contents
Smells rotten

5. Frozen Latex

A. Contents
Looks like cottage cheese or sawdust

5. Recyclable Latex

A. Label
Latex paint
Latex Flat, Latex Semi-Gloss, or Latex Gloss
Latex Primer
Clean up with soap and water
Thin with water