



Cosmetic, Toiletry, and Fragrance Association

August 27, 2004

Dorothy Shimer
Research Division
Air Resources Board
P.O. Box 2815
Sacramento, California 95812
AB1173@listserv.arb.ca.gov

Re: **Draft Report to the California Legislature: Indoor Air Pollution in California (Assembly Bill 1173, Keeley 2002)**

Dear Ms. Shimer:

On behalf of The Cosmetic, Toiletry, and Fragrance Association (CTFA), we are submitting written comments to respond to the Draft Indoor Air Report to the Legislature. The Draft Report contains a number of incorrect assumptions and inaccuracies regarding personal care products which we believe need to be corrected for the reasons specified herein. In addition, in Appendix A and B we review flaws in both the methodology and analysis of studies relied upon in the ARB Draft Report.

CTFA is the national trade association representing the personal care products industry. Founded in 1894, CTFA has almost 600 members who are responsible for the vast majority of cosmetics, toiletries and fragrances sold in California and throughout the United States. Approximately one half of our members are active members that manufacture and distribute these products while the remaining members are suppliers of goods and services to the manufacturers and distributors.

I. Indoor Air and Personal Care Products

CTFA agrees with the finding in the Draft Report that personal care products are a small contributor to indoor air emissions and therefore, properly listed as a lower priority for consideration (listed as number five of seven sources). The chief flaw in the Draft Report is that it fails to establish any causal link that the presence of a VOC causes an adverse health effect. Specifically, in

its analysis of personal care products, the Draft Report cites a study that found the presence of a VOC ingredient indoors, but presents no evidence showing that indoor air is negatively affected. (**See** discussion of specific studies, below.)

One recommendation in the Draft Report on mitigating indoor air emissions is to go directly to the source. Personal care products are named as a source of VOCs in the Report. In discussing consumer products as sources of indoor air emissions, the Report states that zero to low-emitting VOCs in all consumer products is the state's goal.

In the 15 years that CTFA has worked with the Air Resources Board to reduce VOCs in ambient or outdoor air, it is apparent that zero and ultra-low VOC products are not "commercially and technologically feasible" in most cases. Nevertheless, VOCs in these products have been reduced substantially in that time through reformulation of several product categories. Since personal care products are a small contributor to indoor air emissions, due, in large part, to these reformulations resulting in decreased VOCs in both outdoor and indoor air, these products should not be a focus of efforts to improve indoor air.

II. Sources and Emissions of VOCs – Section 2.3.2.2

A. California Has Thoroughly Reviewed the Indoor Air Impact of Toluene and Formaldehyde

The Draft Report states that "[t]oluene is emitted from a number of consumer products in California." A study by Akland and Whitaker (2000) that is cited by ARB states that toluene is in "personal care products, such as in fingernail polishes." Draft Report at 55. The Draft Report also states that "a nail finish" and "make-up" exceeded the Proposition 65 no significant risk levels (NSRLs) for formaldehyde. (ARB Draft Report at 55 and 57. **See also** references to formaldehyde in Table ES-3 at 17; Table 6.1 at 124).

CTFA has done a thorough review of the Akland *et al.* study and found its methodology to be seriously flawed. It does **not** support the authors [and ARB Draft Report's] statement that the "nail finish" and "make up" analyzed exceed Proposition 65's risk levels for formaldehyde. (**See** Appendix A for critique of Akland and Whitaker study.)

In addition, the Draft Report fails to cite a more scientifically rigorous study of the indoor impact of formaldehyde and toluene in nail products relied upon by the California Office of the Attorney General under Proposition 65 to resolve issues of when a Proposition 65 warning would be required for exposure to toluene and formaldehyde in nail products. The study concluded that:

* "Nail polish containing toluene and formaldehyde sold for consumer use does not require a Proposition 65 warning, either for toluene or formaldehyde."

*"Consumers in salons where nail polish contains toluene and formaldehyde do not need to be given [Proposition 65] warnings."

* "While formaldehyde levels in the salons exceeded the concentration at which a warning would be required, the levels did not exceed amounts commonly found in numerous indoor air environments in which nail polish was not present and the relative concentrations of formaldehyde in the ambient salon air, the breathing zone of the customers, and the breathing zone of the technicians were not significantly different. Accordingly, the formaldehyde exposures cannot be attributed to the nail polish products and the manufacturers have no duty to warn technicians for formaldehyde."

Source: California Attorney General's Office Letter, April 17, 2000 at 2-3 (discussing results of a study "conducted under a protocol agreed to by the Attorney General's Office," overseen by Dr. Jed Waldman, Chief of the Indoor Air Quality Section of the Department of Health Services.)

B. Other Chemicals Cited as "Sources and Emissions of VOCs"

A particularly unclear part of the ARB Draft Report relating to personal care products is their inclusion in a discussion of a study of "cleaning products" and "their impact on personal exposure in indoor environments." Zhu *et al.* study, Draft Report at 57. After discussing cleaning products, the same paragraph states the following:

For example:

- * Finger nail polish remover contained toluene, BE and ethyl acetate.
- * Permanent hair color contained BE, alcohols, and propylene glycol.

It is not explained by ARB why finger nail polish remover and permanent hair color are mentioned in relation to the Zhu cleaning product study. Also, the "propylene glycol" listed as a hair color ingredient is incorrectly called a VOC. Under the ARB's current consumer product rule for ambient air, propylene glycol does not meet the criteria to be classified as a VOC.

C. Fragrance Ingredients are Safe and Present at Very Low Levels in Indoor Air

The ARB discusses a 1995 study by Cooper *et al.* that identified "ethanol, α -pinene, camphene, β -pinene, diethylene glycol monoethyl ether, benzaldehyde and others as components of fragrance in two colognes, a perfume, a soap and an air freshener." Draft Report at 57-58.

ARB states that “toxicological data indicate the compounds [found in the Cooper study] may be irritants, mutagenic, teratogenic, or carcinogenic; however, these health effects generally occur at much greater levels than would be expected from the use of the products.” Draft Report at 57-58.

CTFA agrees with ARB that the ingredients listed, assuming they are used in some scented products, do not pose a risk to consumers when used indoors at these minute levels. CTFA has specific comments about the assumptions and methodology in the study ARB cites regarding fragrance ingredients. (See Appendix B, analysis of Cooper *et al.* study regarding the toxicity analysis used, use of skin and eye irritancy tests rather than inhalation tests, flaws in air testing, etc.)

D. Impact of Human Occupancy and Activity on Indoor VOCs

Section 2.3.2.2 also discusses a 1996 study (Shields *et al.*) of indoor VOC concentrations in 70 commercial buildings. The ARB Draft Report states that the authors “identified six compounds associated with occupant density” and listed a few compounds that *may* be used in personal care products. The study, however, only speculates about the source of the six compounds. Draft Report at 58.

For example, the study makes the inconclusive statement that the n-dodecane through n-hexadecane “found at low levels indoors comes **probably** from cosmetics, hand lotions, and shaving creams.” (emphasis added) The Draft Report also states that the study detected two other ingredients commonly known as D-4 and D-5 “which are associated with underarm deodorants and antiperspirants.” Again, the source of the low levels of these compounds is sheer conjecture by the authors and their impact on the air in the buildings is inconclusive.

Finally, the compounds identified in the Shields study as originating from personal care products were detected at extraordinarily low levels. Further, these compounds are not identified as Toxic Air Contaminants (TACs) in California, do not appear on the Proposition 65 list, and have not been identified by either OSHA¹ or by the ACGIH² for establishing an exposure level in the workplace. The reason that such minute levels of those compounds were found in the commercial buildings likely is the ventilation systems in those buildings are

¹ OSHA is Occupational Safety and Health Administration, a U.S. government agency that has responsibility for assuring the safety and health of America’s workers by setting and enforcing standards, including setting “permissible exposure levels”(PEL), the levels of exposure established as the highest level of exposure to a chemical that an employee may be exposed to without incurring the risk of adverse health effects.

² ACGIH is the American Conference of Governmental Industrial Hygienists, a professional organization which issues Threshold Level Values for Chemical Substances in the Work Environment, that represent airborne concentrations under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.

working properly and filtering indoor air. The Report fails to analyze what impact, if any, might be expected on indoor air from the chemicals and their low concentrations as reported by Shields.

II. Section 2.3.7.2 – Sources of Mercury in Indoor Air

The Draft Report incorrectly states that “skin bleaching creams” are a source of “mercury in the Residential Environment.” (See Table 2.11 at 71.) The U.S. Food and Drug Administration (FDA) specifically banned the use of mercury in skin bleaching agents since 1973. FDA regulations state:

Because of the known hazards of mercury, its questionable efficacy as a skin-bleaching agent, and the availability of effective and less toxic nonmercurial preservatives, there is no justification for the use of mercury in skin-bleaching preparations or its use as a preservative in cosmetics, with the exception of eye-area cosmetics for which no other effective and safe nonmercurial preservative is available...because mercury compounds are exceptionally effective in preventing *Pseudomonas* contamination of cosmetics and *Pseudomonas* infection of the eye can cause serious injury, including blindness.

21 Code of Federal Regulations Section 700.13(c) and (d) (2004).

Accordingly, under the Federal Food, Drug, and Cosmetic Act and FDA rules, if a skin bleaching product with mercury were to appear, such a product could be considered adulterated under Section 601(a) of the Federal Food, Drug, and Cosmetic Act. Also, California Department of Health Services would have similar authority against skin bleaching products with mercury under the State’s Sherman Food, Drug and Cosmetic Law. In summary, we do not believe it is accurate to identify these products as a source of mercury in the indoor air environment.

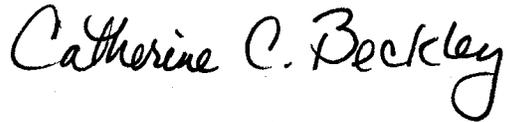
Conclusion

CTFA agrees that the ARB Draft Report is correct in finding that personal care products are a minor contribution to indoor air VOC emissions. The fact that so many personal care products have been reformulated to reduce the amount of VOCs for ambient air improvement has had the additional benefit of reducing VOCs in indoor air. CTFA, however, strongly believes that the studies cited by ARB do not support the Draft Report’s findings related to personal care products.

The Draft Report mentions the presence of VOCs and other compounds that ARB believes are in personal care products. In many cases, the assumption is made that personal care products are the source of VOCs and other compounds without clear evidence to support that assumption. In any case,

whatever the source, the conclusion cannot then be drawn that there is an adverse indoor air impact simply because a compound is present in indoor air without further evaluation than is presented in this Report.

Respectfully submitted,

A handwritten signature in black ink that reads "Catherine C. Beckley". The signature is written in a cursive style with a large, prominent "C" at the beginning.

Catherine C. Beckley
Associate General Counsel

Attached: Appendix A and Appendix B

Appendix A – Analysis of Akland and Whitaker Study (2000)

G. Akland and D. A. Whitaker, “Characterizing the Sources of Human Exposure to Proposition 65 Substances,” Final Report from Research Triangle Institute, Prepared for the California Public Health Foundation, March 2000

The Draft Report states that the Akland & Whitaker study of product emission rates found six products that exceeded the California Proposition 65 law’s no significant risk levels for formaldehyde including a “nail finish” and “make-up.” Analysis of this study reveals flaws both with the test conditions and the analysis of the data. The report has not been peer reviewed, it does not provide sufficient information to allow the study to be thoroughly evaluated or duplicated, and it makes incorrect assumptions that do not reflect the use levels of personal care products.

The measured levels of VOCs reported by Akland & Whitaker seem to have been significantly influenced by careful selection of the amount of product in the chamber, airflow, temperature, and relative humidity that inflate the reported VOC emissions. In some cases the VOCs detected may be products of chemical degradation due to test conditions. Therefore, these data do not represent actual use conditions.

We are concerned about the criteria for choosing products to be tested. The products were selected, among other criteria, to “be expected to have large indoor loading or high personal exposure level.” (page 1-3) The makeup and fingernail products tested are applied in small amounts and dry very quickly so that high indoor loading or high personal exposure level is not likely.

We are concerned about possible effects of extreme test conditions on the results. Several examples summarized in Table 3-5, page 3-20, indicate possible contamination or degradation of the products tested. The detection in cosmetic products of xylene (pages 3-5, 3-7), benzene (page 3-9), or styrene (pages 3-8, 3-9) is unlikely because these chemicals are not used in cosmetic products. They are more likely trace contaminants from an unknown source or possibly produced from thermal degradation of other chemical components.

We are concerned about the effects of high temperatures on the products during the testing process. At temperatures exceeding 50° C, VOC decomposition or other chemical reaction can alter the composition of the products into new and different compounds, which can then be detected. At greater than 200° C, thermal decomposition of organic materials may produce VOCs not ordinarily emitted by the products. Thermally desorbing the VOC-exposed cartridges in the head-space tests is not a reliable recovery method for identification of unknown VOCs because of such chemical changes in the vapor phase. Table 2-1 indicates temperatures up to 250° C. The detection of styrene

(page 3-9) is a very strong indication of VOC decomposition from the heating cycle.

Other evidence of thermal decomposition are shown in the values reported for analysis of known compounds. Recovery rates of 491% for furan and 124% for 2-methoxyethyl acetate are reported and indicate unexpected experimental error. Negative values obtained for butylated hydroxyanisole also indicate problems with the test method, *i.e.*, thermal decomposition.

We are concerned about effects of other test conditions, including relative humidity. Humidity combined with air flow and temperature has a tremendous impact on evaporation into the head space, as stated on page 2-4. The relative humidity is listed in Table 2-4, for the head space tests, as "not applicable." The authors state "the flow rates and relative humidity were adjusted", (page 2-4) which indicates relative humidity was controlled and may have been adjusted to optimize evaporation rates.

We are concerned about potential chemical reactions with acetaldehyde on the DNPH cartridges. The report indicates that the DNPH cartridges produced increased levels of acetaldehyde, which could chemically react to create false identifications of VOC compounds. Readings using these cartridges are suspect.

We have concerns with the accuracy of the data obtained. It appears (page 5-2) that it is very difficult to obtain quantitative data from the test methods used. Without more detailed information on the test method and conditions, it cannot be determined if the study was able to properly quantitate the amount of VOC generated. Many of the reported VOCs appear to be near the detection limit of the test methods, potentially leading to large errors.

Sampling rate is low during the initial phases of the data collection. The irregularly shaped graphs, which sometimes drop below the baseline, are the result of too few data points being collected or reported (pages 4-15, 4-18, 4-20 and others).

Based on the information in the report, quantitative calculations of potential exposure to the products tested cannot be made. The authors report that a "reasonable" amount of product was applied to the glass during the chamber studies (page 2-5). "Reasonable" is not a quantifiable term. It appears that the mass of each product tested was recorded, but these values do not appear in the study report and are not factored into the exposure assessment.

Finally, we have concerns because the Akland & Whitaker study used this data to estimate potential exposure to the tested products at rates far higher than actual consumer usage. The test conditions, *i.e.*, product loads vs. chamber size, were not chosen to replicate real use conditions. The levels reported to be

emitted by two cosmetic products were calculated without regard to the amount of product typically used. It appears that the potential exposures for the cosmetic products were calculated as if the products were being used like paint, wall paper adhesive, or flooring, which are products applied to large areas.

In addition to the unrealistic amounts of product used in the test chamber, it appears that the exposure assessments were based on the assumption that the conditions in the relatively small chamber (52.7 L, *i.e.*, 0.0527 cubic meter) could be extrapolated linearly to estimate exposure in a larger space.

Typical use conditions would most likely result in a cosmetic product load of approximately 0.25 gram of nail polish for each coat of polish on 10 fingernails (information provided by a CTFA member company) or in 0.67 gram of foundation (average daily use, CTFA 2004 Habits and Practices Study). Application at this rate, in a 25 m³ room (roughly 10 feet x 10 feet x 9 feet), would significantly reduce emissions into the ambient air from the values reported. Therefore, the calculations showing that Proposition 65 levels were exceeded are in error.

Analysis of specific case: Nail Finish

The Akland & Whitaker study draws the conclusion that a named brand of "nail finish" exceeds the Proposition 65 "no significant risk level" (NSRL) for formaldehyde (gas). Formaldehyde in the form of gas only is listed under Proposition 65. The NSRL is 40-µg/day.

The study places a portion of product in a small test chamber (52.7-L), measures the formaldehyde levels over a 24-hour period, and then calculates a time-weighted average of the emissions. The data collected for the nail finish product, based on a sampling of 35 L of air from the chamber, were reported as µg of formaldehyde per cubic meter of air sampled.

Hours	Time Elapsed (hours)	Formaldehyde (µg/m ³)
0-1	1	2,681
1-4	3	192
4-8	4	48
8-24	16	44

The study (page 4-2) indicates that the average exposure for one hour during a 24-hour day was calculated from these data:

$$[(2,681 \mu\text{g}/\text{m}^3 \times 1 \text{ hr}) + (192 \mu\text{g}/\text{m}^3 \times 3 \text{ hr}) + (48 \mu\text{g}/\text{m}^3 \times 4 \text{ hr}) + (44 \mu\text{g}/\text{m}^3 \times 16 \text{ hr})] / 24 \text{ hr} = 173\text{-}\mu\text{g}/\text{m}^3$$

This is the "1-Day" concentration, 173-µg/m³ reported in Table 4-3 on page 4-33.

The authors then assumed that, in one day, an exposed person would inhale 20-m³ of air at the same concentration as that of the small chamber. The total 24 hour exposure was then calculated as:

$$173\text{-}\mu\text{g}/\text{m}^3 * 20\text{-m}^3/\text{day} = 3,460\text{-}\mu\text{g}/\text{day}$$

However, the human exposure calculation of the emissions from a sample equivalent to anticipated consumer use is not possible from this data because:

- The size of the emissions chamber was much smaller than the typical space in which these products are normally used.
- The quantity (mass) of material used is not factored into the exposure calculation in the report, making it difficult to assess how the experimental emissions compare to emissions anticipated from actual in use conditions.
- An unknown amount of the test product was poured onto the 0.1 m² glass plate and then spread with a brush, which could have resulted in a much higher emissions rate from a larger surface area covered with a thicker coating of product than is typically used.
- The emissions rate as reported in Table 4-1, page 4-4, *i.e.*, 280 $\mu\text{g}/\text{g}$ in 1 hour for the first half hour and subsequent time points near or below zero cannot meaningfully be compared with the "1-Day" concentration, 173- $\mu\text{g}/\text{m}^3$ reported in Table 4-3 on page 4-33.

For these reasons, any attempt to correct the data would result in an inaccurate approximation. An attempt to recalculate the emissions based on the first point would take these factors into account:

- The actual test chamber was only 52.7-L or 0.0527-m³
- A typical room is 25 m³, roughly 10 ft x 10 ft x 9 ft.

The exposure to a person breathing emissions from the tested sample would be significantly less if it is assumed that the formaldehyde emitted by the sample in a 24 hour period was allowed to diffuse into a larger space. Based on the size of the test chamber, one air exchange rate per hour, and assuming that, to a first approximation, all the available formaldehyde evaporated during the 24 hour test, the product sample would provide a total exposure of 9.12- μg .

$$173\text{-}\mu\text{g}/\text{m}^3 * 0.0527\text{-m}^3 = 9.12\text{-}\mu\text{g}$$

If this sample were then allowed to diffuse into a typical 25 m³ sized room (roughly 10 ft x 10 ft x 9 ft), then the exposure to a person breathing 20 m³ per day would be:

$$(9.12\text{-}\mu\text{g} \div 25 \text{ m}^3) * 20\text{-m}^3/\text{day} = 7.3 \text{ }\mu\text{g}/\text{day}$$

This is far less than the NSRL of 40- $\mu\text{g}/\text{day}$.

Additional note: In order to achieve an exposure of 3,460- $\mu\text{g}/\text{day}$ as reported by Akland & Whitaker, at the measured emission rate, exposure to

approximately 474 portions of the product as applied in the test would be necessary:

$$\frac{7.3\text{-}\mu\text{g}}{1 \text{ product portion.}} = \frac{3,460\text{-}\mu\text{g}}{x\text{- product portion}} \rightarrow x = 474 \text{ product portions}$$

Further attempts to bring these data into perspective, requires knowing the amount of material tested. Clearly, the amount used in the study far exceeded the typical use of the product. The sample was applied to a 0.1 m² piece of glass, a considerably larger area than the typical size of 10 human fingernails (10 large 2 x 2.5 cm fingernails, about 50 cm² is twenty times less than the application area used in this study), the results from the study would additionally exceed, by an additional factor of ten, the emissions expected from normal two-application use of the product.

Analysis of specific case: "Make-up" Product

The Akland & Whitaker paper draws a similar incorrect conclusion that a specified make up product also exceeds the Prop 65 NSRL for formaldehyde (gas). The average emission rate for one hour during a 24-hour day was calculated to be 200 µg/m³ from similar data for this make-up product.

Based on the size of the test chamber, one air exchange rate per hour, and assuming that, to a first approximation, all the available formaldehyde evaporated during the 24 hour test, the portion of product applied to a 0.1 m² glass plate would provide a total 24-hour emissions rate of 10.54-µg, or 8.43 µg in a typically sized 25 m³ room, less than the authors calculated and below the NSRL for formaldehyde.

As in the case of the nail polish, this product is usually applied to the human face, an area at least 20 percent smaller in area than 0.1 m², and the emissions should also be corrected to reflect this.

Appendix B – Analysis of Cooper et al. Study Cited in ARB Draft Report

Cooper SD, Raymer JH, Pellizzari ED, and Thomas KW, 1995. The identification of polar organic compounds found in consumer products and their toxicological properties. Journal of Exposure and Environmental Epidemiology 5(1):57.

Fragrances contain ingredients that are not toxic in normal conditions, but could have “health effects...at much greater levels than would be expected from the use of the products.” Draft Report at 57.

A close analysis of the investigators' findings are overly broad and attempt to elucidate the nature of some polar compounds commonly found in fragrance products such as colognes, soaps and air fresheners. The means by which these particular products were chosen is questionable. Apparently “chemical sensitivity groups” were contacted and asked for information about what product types the advocates wanted to be studied. The investigators relied on a group of individuals who report having a disease that is not medically recognized because of the broad and non-specific array of symptoms. The names and number of groups that were contacted by the investigators were not identified.

The text of the Draft Report indicates that a few of the chemicals identified in their samples exhibited toxic effects at relatively low levels. However, in the table listing the nature of these effects, most of the low level effects were noted under the column “other.” These “other” effects were said to include behavioral abnormalities, tissue changes, and death. This is a very broad range of outcomes and, without knowing the exact nature of the effect reported, it is difficult to determine the toxic potential of the compound.

The reported toxic effects of some of the chemicals identified are not pertinent to airborne exposures. A large part of the data showed toxic effects listed under skin and/or eye irritation. It would be assumed that this information was compiled from results using Draize testing which is conducted with actual dermal or ocular exposure to a material. In the majority of cases, the results from the Draize test are not relevant to inhalation of emissions from consumer products such as personal care products.

The investigators acknowledged that a lot of the toxicity seen was attributed to exposures of short duration and were acute in nature. They infer that chronic exposures to low levels of these same chemicals is lacking but needed, without citing any evidence of bioaccumulation.

One of the conclusions put forth in the Cooper paper is that the evidence gathered using particular exposure assumptions would “suggest, but does not prove, that concentrations of fragrance compounds at this low level would not be

expected to produce a toxic effect." This conclusion is based on data obtained using a "worst case scenario," therefore leading one to conclude that the actual concentrations to which a consumer would be exposed would be even safer.

The Cooper paper goes on to mention the impacts, both positive and negative, that fragrance can have upon things such as mood and immune function. However, no association between the compounds identified in the study and these events were further discussed.

The Cooper study seems not to adhere to fundamental scientific protocol nor are its conclusions substantiated by the results obtained. For instance, no background measurements were made on the ambient air. A "blank" air test should have been performed before, during, and after each test to determine the background emissions. Nor were the room or sample temperatures noted. Each would have a dramatic effect on evaporation rates. The study does not address important questions. Did some of these detected VOCs exist in the building air? Would these compounds still have been volatile under more reasonable conditions? The study does not indicate whether the residual product was analyzed or whether the original product composition was compared against the residual product. The study fails to indicate whether the standards were compared against the samples obtained from the study. In fact, only vague information was provided about the test apparatus and conditions. Rather than present raw data, only the authors' "interpretations" are given. This makes it impossible to study the quality of the data or gauge the validity of the interpretations.

The test seems to be designed to provide the desired result. For example, the test-sample products were placed in a very small chamber and were bombarded with a steady stream of moist air (with an unreported humidity and temperature), forcing selective (hydrophilic) vaporization to occur. This is not representative of real life conditions and the method skewed the study result. The method itself may have caused the samples to degrade before an identification test was performed. Many factors could have led to sample degradation; including the amount of time spent on the collection cartridges and temperature of the vapor phase during collection, transfer (250°C three times, loading into and desorbing from the column, CG injection port) and testing.

The second paragraph on page 62 of the Cooper study admits that the test did not work and that the peaks from product emissions could not be differentiated from background noise. At such low detection limits, sensitivity is low and small electrical spikes can create artifacts which can lead to false identification. This is a common problem for each of the test methods used when working with dilute samples in the vapor phase. Calibration standards that do exist for these tests methods have low sensitivity in the sample concentration range studied. All are significant problems that hampered the quality of the data

obtained and made accurate, positive identifications of the vapor phase components extremely difficult.

Also, the authors seem to overly rely on computer database searches for identification. Even so, no information was provided concerning the closeness of match to the overall spectra obtained. But instead, the authors focused on a few of the more discernible peaks. This had to be done because they did not find a high correlation with the standard spectra, and there was no other way to make the data fit to a high degree of confidence. At its best the data is general and inconclusive. When discussing their data collection difficulties the authors noted that such situations, "speaks to the difficulty of structural use elucidations of components in complex mixtures." They also make the following complaint about less rigorous approaches to this type of analysis, *i.e.*, not performing all necessary tests. "Too often the steps are omitted to reduce costs," the authors state. The result is that proper identifications cannot be made when this is done. Yet by the authors own admission, in some cases these same tests were omitted from their study and with no explanation. How can the authors expect to make valid structural identifications, when they claim that others who omit these tests cannot expect to do so?

Even the authors admitted to and listed many of the more significant problems with the tests methods they used in the study. The GCMI-FTIR is an instructive example. This method was used to obtain spectra that supposedly verified structural assignments. But, the recorded peaks were buried in equipment noise. The FTIR spectra obtained cannot be expected to provide very much meaningful information and certainly cannot verify chemical structures. In the case as shown, many of the peak assignments did not match the standard, and additional and inconsistent peaks appeared in the spectra. These deficiencies cast serious doubts on the compounds assigned identity or purity. Even the main peak matches were only vague indications, *i.e.*, in the alkyl absorption region they seem to match. But, these are the two most common absorption bands found in IR spectra. In fact, many tens of thousands of common organic substances intensely absorb in this region and with a similar peak shape pattern, so identification of these bands is inconclusive.

The conclusions of the study rely on indications, which were substantiated by other vague and inconclusive indications. The evidence is weak and unconvincing. The collected data does not support the claims that are made. Additionally, we note that the study also appears to be a grant proposal in that it hopes to incite interest in further work without establishing a solid scientific basis for the study's conclusions.