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Report of Findings on the Use of Aerosols and Other Chemicals in the San Francisco Auto Repair Industry

Background

In recent years there has been an ongoing effort to make the automotive repair industry more "green". Much of this has been undertaken voluntarily by individual auto repair shops seeking to protect employees from chemical hazards as well as shops looking to promote themselves as green in the hope of attracting environmentally-conscious consumers. In 2001, the California Department of Toxic Substance Control published a series of fact sheets, promoting environmentally friendly practices for automotive repair. Much of the success of toxics reduction in the industry thus far can be attributed to efforts by the DTSC to create research-based educational materials on safer practices.

Our group coordinated with the San Francisco Clean and Green Program which is part of the SF Department of Public Health. The Clean and Green Program is a subsection of the City's Hazardous Materials Unified Program Agency (HMUPA). HMUPA is responsible for permitting and inspecting all businesses in San Francisco which are using hazardous materials and/or producing hazardous waste. Through the inspection process, concern developed among Clean and Green Program employees regarding the health and environmental implications of the many aerosol products in use in the auto repair industry. Despite the promotion of aqueous parts cleaners by the DTSC, use of solvent-based aerosol parts cleaners remains widespread—even at

environmentally-conscious repair shops. Much of the motivation for this survey was to determine the reason for this. And though California has reduced VOC allowances and banned many chlorinated compounds in automotive aerosols since 2005, products now being used frequently contain Prop. 65 listed carcinogens or other chemicals of concern.

Methods

We conducted a sample survey of the aerosols (and some non-aerosols) currently being sold by two San Francisco retailers at three sites, and those being used at four local auto repair shops. Most shops had been certified as Clean and Green businesses at the time of the survey. Shops were therefore glad to participate. Inventories were created for each of the separate sites and compiled into a master database of aerosol products, as well as a limited number of non-aerosols. The ingredients in each product were identified through the product's Material Safety Data Sheet. An MSDS is required for all potentially hazardous products sold in the U.S. Each must describe the chemical composition of the product, the hazards associated with the product and, if applicable, proper handling, spill response or personal protective equipment required. Since Prop. 65 status is not always included on the MSDS, each chemical was compared to California's current list of Prop. 65 chemicals. It was noted in the database if an ingredient was or was not found on the list.

Aerosols were divided into separate categories based on their use—for example: Brake Cleaners, Engine Degreasers – External, Engine Cleaners – Internal (Carb and Choke Cleaners). Using chemical profiles posted on scorecard.org, each chemical

component of each product was ranked as being more or less hazardous relative to the other chemicals in the system which was used. Products were then compared to others in the same category based on their chemical composition. Additional research was conducted on aerosols which were being marketed by manufacturers as being eco-friendly.

Product Comparison

Scorecard.org is a non-profit pollution information site. The website provides detailed profiles for over 11,200 chemicals. For most of the chemicals commonly found in consumer products, Scorecard provides hazard ranking from a variety of university studies and ranking systems. Hazard rankings are divided into 3 categories: Human Health Rankings, Ecological Health Rankings and Integrated Environmental Rankings. For the purpose of this study, the system used for nearly all chemicals was one developed by the Indiana Clean Manufacturing Technology and Safe Materials Institute (CMTI) at Purdue University and known as the Indiana Relative Chemical Hazard Ranking System. This hazard evaluation system was used because it had information on the largest number of chemicals.

In order to create a means by which a product could be compared to others in the same category, a numerical value for each product was created based on the relative hazard of each chemical component. The approximate, average percentage of each active ingredient contained in a product was entered into the spreadsheet from the information contained in the MSDS. Chemicals which are rated as being the least hazardous by the

IRCH and fell into the 0-25th percentile of the Integrated Environmental Rankings were given a value of 1. The 25^{th}-50^{th} percentile were given a value of 2 and numbers were assigned up to the value of 4, given to the most hazardous chemicals which ranked in the upper 75^{th}-100^{th} percentile. The assigned numerical value of the chemical was multiplied by its percent composition in the product and the sum of these values was then used as the overall numerical value of the product. The overall value of a product could then be compared to others in the same category and used to place it in a range between those which were more and less hazardous.

Several issues make this method less than exact. MSDS provide a range of percentages for each active ingredient and never a specific number. Therefore, the sum of the average percentages of the ingredients can add up to more than 100%, or less than 100% (even when there are no inert ingredients). Additionally, while there are a large number of chemicals profiled on Scorecard.org, some components of the aerosols were not listed. In these cases, the NFPA health rating, for the product or for the chemical (if it was available), was substituted. Another concern lies with those cases when a specific chemical is unwanted even in very small amounts. This cannot be captured in the overall score. Nevertheless, this ranking scheme can provide a rough means to group products of greater and lesser toxicity.

Findings

The health and environmental hazards presented by aerosols useed in the car repair industry vary widely by the product's intended use. The same is true for the

availability of “environmentally friendly alternatives”. Each product category is described in more detail below.

Brake Cleaners

Aqueous parts washers are portable units which use water and water-based solutions to clean brakes and other parts primarily though mechanical means. The washers can be hooked up to a sink, or other water source, and the wastewater is collected in a container which is part of the unit. Aqueous parts washers have been promoted by the DTSC as the environmentally preferred means to clean brakes and other car parts. All of the auto repair shops visited had purchased units within the past few years. During the survey, several employees had commented that the aqueous parts cleaners did not work as well as the solvent-based chemical cleaners, however, staff felt that the aqueous washers worked well enough in most circumstances and use of the aerosol products could be limited to the more difficult jobs.

Solvent-based Brake Cleaners are among the more problematic aerosols in use in the auto repair industry with regard to human and environmental health. Low-VOC or non-chlorinated formulas which have replaced older products in California have frequently incorporated Prop. 65 carcinogens into the new formulations. Local retailers had significantly more solvent-based aerosol brake cleaners available than were found at the auto repair shops. As well, the aerosols for sale by retailers tended to contain more hazardous ingredients than those found at the shops. This is consistent with the assumption that local retailers primarily sell to residents repairing their own cars who do

not have access to aqueous cleaning units. All brake cleaners found at local retailers contained at least one Prop. 65 listed carcinogen. Toluene was the most common. Other carcinogens found include perchloroethylene (or sometimes called tetrachloroethylene), trichloroethylene, methylene chloride and ethylbenzene. Four aerosol brake cleaners were being used at commercial auto repair shops. One contained perchloroethylene, however two products were found which contained no Prop. 65 listed chemicals. One of those products was Wurth, Low-VOC Brake and Parts Cleaner. This product is composed of acetone, heptane and carbon dioxide. Similarly, Gunk Pro-Series Non-Chlorinated Brake Cleaner contains the same ingredients with the addition of methanol. One shop was using Zep Aerosol Brake Wash which contains heptane, ethanol, methanol, isopropyl alcohol and carbon dioxide. Another Zep product called Brake Flush contained these same ingredients with the addition of acetone and the elimination of methanol. None of these products were found at local retailers.

Internet research turned up three aerosol brake cleaners which are composed entirely of chemicals ranked as being less hazardous than most by the IRCH ranking system. Zep I.D. Clean, which was listed on the manufacturer's website as a degreaser and parts cleaner, contained only D-Limonene as an active ingredient. Two acetone-based products included Gunk Ultra Low VOC Brake Cleaner and Wurth SCAQMD Brake and Parts Cleaner. Carbon Dioxide was listed as the only other ingredient on the MSDS.

<u>Degreasers</u>

A large number of degreasers specifically marketed as being "green" are currently on the market. All degreasers in use at local auto repair shops were D-Limonene-based. Retail shops had no general degreasers for sale, but had a large number of external engine cleaners.

Four degreasers were found for which all ingredients ranked as being less hazardous than most chemicals. On the United Laboratories website, that company is advertising an enzyme-based degreaser called United 612 Fleet-Zyme. No hazardous ingredients for this product are listed on the MSDS. Other products, two of which are water-based degreasers manufactured by CRC, include CRC Hydroforce All Purpose Degreaser and Super Citrus Heavy Duty Degreaser as well as Wurth Super Spray Degreaser.

Engine Cleaners – External

External Engine Cleaners were not widely used at commercial auto repair shops, but a large number of them were on sale at local retailers—suggesting that "weekend mechanics" are the primary market for these products. Staff at one auto repair shop confirmed that they only perform external engine cleaning on rare occasions. Only three External Engine Cleaners were being used in auto repair shops. One of these was Zeprestore, which contains Prop. 65 carcinogens, trichloroethylene and ethyl benzene. Zep Soy Power was being used at one local repair shop. This is a soy-based product being marketed under Zep's "green" line. Eight Engine Cleaners and Degreasers were

found being sold at local retail outlets. Only two contained Prop. 65 carcinogens. One, which was labeled as being low in VOCs, contained ethylbenzene.

Online research found three engine cleaners based on D-Limonene or methyl esthers. Zep O.J., Zep Soy Power and Gunk Citrus Engine Brite Engine Cleaner and Detailer are all citrus or soy oil-based products which contain no Prop. 65 chemicals.

Engine Cleaners – Internal

Various aerosol products were in use at local auto shops for cleaning internal engine parts. These are primarily carburetor and choke cleaners. While aqueous parts cleaners can be used for this purpose, staff said that the advantage of aerosols is that they can be used in tight spots while still on the car. An employee at one repair shop told me that, while they were trying to limit their use of the aerosol parts cleaners, there was no way they could get rid of them entirely. All aerosol carburetor and choke cleaners contained Prop. 65 carcinogens. The carcinogens found include ethyl benzene and most contained toluene. Only one chemical product in use did not contain Prop. 65 carcinogens, but this was not an aerosol product and instead was a dip cleaner. Since there are no aerosol carb or choke cleaners currently on the market which do not contain carcinogenic chemicals, their use should be minimized, aqueous parts cleaners should be used whenever possible and all necessary precautions should be followed to avoid exposure.

Electronics Cleaners

Only a limited number of aerosol battery and electronics cleaners and protectors were in use at San Francisco auto repair shops. Of these, only one contained listed carcinogens. This product was Zep Battery Coat which contained trichloroethylene and ethyl benzene. One shop reported that, though they had battery cleaners in stock, they were hardly ever needed. The opinion of shop staff was that this seemed to be because batteries are now being manufactured in such a way that they rarely have corrosion problems. As a result, battery and electronics cleaners are being used less often.

Online research found three battery and electronics cleaners and protectors which scored as having a lower hazard using the system developed for this survey. However, many of the ingredients contained in these products were not ranked in the IRCH scoring system and the MSDS NFPA health rating had to be substituted. As well, the percentage of active ingredients in these products is low, which produces a lower overall score. Three products which appeared to be worth further investigation include United Laboratories, United 167 TLD15, CRC Lectra Clean II Non-Chlorinated Heavy Duty Degreaser and Wurth Battery Post Cleaner and Protector.

Lubricants, Penetrants

Various lubricants and penetrants were in use at San Francisco repair shops. Of these, several contained Prop. 65 carcinogens, including toluene, trichloroethylene, methylene chloride and tetrachloroethylene. However, many contained none. Retailers had a large number of lubricants for sale however, none of these contained Prop. 65 listed chemicals. The reason for this difference is unknown. Unfortunately a large number of

the chemicals contained in the lubricants did not have chemical profiles on Scorecard.org. For this reason, there was no attempt to compare lubricants currently in use at San Francisco auto shops.

CRC lists a large number of lubricants in their catalog of "Environmentally Preferred Products." A search of lubricants on the United Laboratories website turns up several in their "green" product line and Wurth has a number available in their saBesto line, which is marketed as being more ecologically friendly. None of these products were individually evaluated for this survey.

Case Studies

Auto Repair Shop #1 services vehicles for the City of San Francisco. There are a large number of work areas for repair and maintenance on a range of vehicle types from city-owned cars to fire trucks. The manager of the facility told me that their primary suppliers are City Auto Supply, ChemSearch and Zep. The survey was conducted during staff lunch hour and there were no employees around at the time. An inventory was done of products stored in the primary chemical storage area as well as several of the work areas. Two Permatex Anti Seize Lubricants were in use in aerosol and non-aerosol forms, as well as an aerosol dry-spray lubricant. Three internal engine cleaners were in use, including a non-aerosol diesel injector cleaner, an aerosol carburetor cleaner and a carb and choke cleaner. Two degreasers were in use and both were D-Limonene-based. Since there were no employees present at the time of the survey, none could be questioned about the use of these products.

Auto Repair Shop #2 is a commercial auto repair shop operating on the eastern edge of the Mission District. They were certified as a Clean and Green business about 4 years ago. One employee told me that many of the aerosol products which I found in their chemical storage area were old and not being used any more. One of their primary motivations for purchasing safer and more environmentally friendly products is their own occupational safety. As one employee explained, they "don't want to have to breathe that stuff." Their primary suppliers are Wurth and Zep, and they mainly deal with account representatives for those companies. For many of their "green product" substitutions, they themselves had researched which products were available and approached the company representatives about switching to their use. Shop staff had commented that representatives were not actively promoting their green product lines, but they were able to give them information on which auto repair shops were using these products and their satisfaction levels with their performance.

Various lubricants and penetrants were being stored onsite, however, most of these were no longer used or used very infrequently. Of the various lubricants and penetrants, Lubrisil was the only one which contained a Prop. 65-listed chemical, namely trichloroethylene. However, this product was one which was now disused. Several general degreasers and cleaners were in use. As with the other aerosols, shop employees said that most of these were not being used or used only rarely. The shop did not normally perform external engine cleaning, however, at times there was a need for degreasers or external engine cleaners for engine parts or general cleaning. Floor

cleaning was one of the most common uses. Zep 65, Multi-Purpose Cleaner was being used for cleaning the interior of the car. While old product was still in stock, the products currently in use were either soy-based or D-Limonene based. A soy-based external engine cleaner was being used. The product was Zep Soy Power which is part of Zep's green product line. The staff at the shop said that they had initially had some problems with the performance level of this product, however—presumably after some product reformulation—the performance level had improved and they were now satisfied with it. The staff said that they had also found that often hot water worked for external engine cleaning to the degree that they needed it. Two aerosol electronics cleaners and protectants were being stored onsite: Zep Battery Coat and Battery Care. Shop staff had said that these products were rarely if ever used at this point—the primary reason for this being that they simply aren't needed anymore. Staff commented that newer batteries do not have the same problems with corrosion that they had seen in the past. The employee speculated that this was due to better seals or better protections incorporated into the manufacturing process.

The shop had aqueous parts and brake cleaners in use. They also had several aerosols stored onsite for the same purpose. One employee said that most of the aerosol cleaners onsite were no longer used and the ones that were in current use were only needed when they had a particularly tough job. The shop bought aqueous parts cleaners about 3 or 4 years ago and one employee said that he didn't think they worked as well as the chemical products. One advantage held by the aerosol cleaners is that they can used to reach tight places while the parts are still on the car. For this reason, aqueous parts

cleaners could not entirely replace aerosols. All carburetor and choke cleaners found in use contain Prop. 65 chemicals. Toluene and ethylbenzene are common ingredients in these products and both these chemicals were contained in both of the products found at this shop. A non-aerosol product, Berryman Chem-Dip Carburator and Parts Cleaner was also in use as a dip cleaner. The staff said that the aerosols were not in frequent use. An old brake cleaner containing perchloroethylene was being stored onsite, but was not being used. The product currently being used for brake cleaning was Wurth Low VOC Brake and Parts Cleaner. This product was being applied using cartridges which were refilled from a large drum. Acetone and heptane are the active ingredients in this product.

Auto Repair Shop #3 is located on the eastern end of town. They were actively using aqueous parts and brake cleaners and had only a very small number of aerosols or other chemicals in use. There were only six in total—which was a far lower number than the shops that had been previously surveyed. The shop was using one chemical brake cleaner but did not rely on it extensively. In total, this shop was using one external engine cleaner, one carburetor cleaner, one lubricant and one general cleaner for non-conductive surfaces. One employee asked about the use of Zepreserve, which is advertised as a rust preventative. The product contains trichloroethylene and during the last DPH inspection its use was discussed with the inspector. Aside from this, there was only one additional Prop. 65 listed chemical. This was tetrachloroethylene which is contained in Gunk Liquid Wrench White Lithium Grease. The employees at this shop said that they generally relied on the aqueous parts cleaners. When I had asked them if

they were satisfied with their effectiveness, I was told that they don't clean as well as the chemical cleaners, but that "they work well enough."

Auto Shop #4 is located on the northern side of the Mission District. They are a Clean and Green site and currently going though the process of becoming a SF Green business. The shop was using a large number of aerosols, however, they were also making use of their aqueous brake washers on a regular basis. This site was using two different carb. and choke cleaners, one of which contained toluene and the other contained ethyl benzene. I asked about the aerosol brake cleaner which was being used at this site. This product contained no carcinogens and it seemed promising as a less-hazardous chemical brake cleaner. However, when I asked them what they were using it for—since they were using the aqueous brake cleaners to clean the brakes—it turned out that the staff was primarily using this product for external engine cleaning. They felt that it worked very well for that purpose. I took the opportunity to let them know that there a large number of external engine cleaners currently on the market which are less hazardous than any of the chemical brake cleaners available. I recommended that they limit the use of this product for cleaning brakes when need be, and purchase a "greener" product for engine cleaning, since there are many.

Conclusions

The number of safer and environmentally friendly aerosol products currently on the market varies widely by the product's intended use. There are a large number of degreasers which are based on environmentally benign chemicals such as soy or D-

limonene, whereas we were unable to find any carburetor or choke cleaners which could truly be considered non-hazardous or environmentally-friendly. Several of the larger manufacturers, such as Zep and CRC have started "green" product lines. A few other manufacturers are promoting individual "green" products on their websites, but have not yet assembled them into an entire line of environmentally friendly chemicals. Some products which may be promoted as being environmentally friendly are considered such because they comply with California's ban on chlorinated compounds or VOCs. However, these products frequently contain toluene or other Prop. 65 chemicals. This is frequently the case with brake, carburetor and choke cleaners. While the use of aqueous brake and parts washers has enabled minimal use of solvent-based aerosols, automotive workers felt these products could not be eliminated entirely, since the performance of aqueous cleaners is inadequate for tough jobs. In fact, laws banning VOCs and chlorinated compounds may have increased the number of Prop. 65 chemicals being used in the industry, as many of the products re-formulated for sale in California contain toluene, trichloroethylene or other listed carcinogens. While managers and staff at the sites visited were strongly motivated to use products which are safer for themselves and the environment, they generally lack the technical expertise that they feel is needed to make informed decisions about chemical use. One employee remarked: "just tell us what to get and we'll get it."

In San Francisco, much of the auto-repair industry is clustered on the eastern edge of the Mission District in an area zoned for mixed light industrial, residential and/or commercial use. Unlike many cities, the built environment of San Francisco was

developed prior to the practice of distinct segregated zoning for residential and industrial uses. Much of the eastern neighborhoods in San Francisco are currently zoned for mixed uses, including Production, Distribution and Repair (PDR). As a result, auto repair shops are frequently located in what are primarily residential neighborhoods. In fact auto repair shops can often be found directly adjacent to commercial businesses, such as restaurants, or apartment buildings. Because they are often mixed in with other land uses, the pollutants and toxics generated by the auto repair industry are of special concern here. Light industries in the Eastern Neighborhoods not only provide essential services, but also a large number of jobs and much needed employment in certain economic sectors. However, given the distribution of these industries within mixed-use areas, businesses in these sectors should have all the more motivation to make their operations as ecologically friendly as possible in order to lessen the environmental burden on employees and neighbors.

Bibliography

Bowen, S. et al. (2009). Alterations in rat fetal morphology following abuse patterns of toluene exposure. Reproductive Toxicology. 27(2), 1661-169

Donald, J. M., Hooper, K., & Hopehayn-Rich, C. (1991). Reproductive and developmental toxicity of toluene: A review. *Environmental Health Perspectives, 94*, 237-244.

Engstrom, K. (1984). Metabolism of inhaled ethylbenzene in rats. Scandianvian Journal of Work, Environment and Health. 10(2), 83-87

Hazard Evaluation System & Information Service. (2001, June). *N-hexane use in vehicle repair*. Oakland, CA: California Department of Health Services.

Jayjock, M. A., & Levin, L. (1984). Health hazards in a small automotive body repair shop. *Annals of Occupational Hygiene, 28*(1), 19-29.

Lavoue, J., Begin, D., & Gerin, M. (2003). Technical, occupational health and environmental aspects of metal degreasing with aqueous cleaners. *Annals of Occupational Hygiene, 47*(6), 441-459.

Liu, Y., Sparer, J., Woskie, S. R., Cullen, M. R., Chung, J. S., Holm, C. T., et al. (2000). Qualitative assessment of isocyanate skin exposure in auto body shops: A pilot study. *American Journal of Industrial Medicine, 37*, 265-274.

Mertens, J. A., (n.d.) *Vapor degreasing with chlorinated solvents*. Midland, Michigan: The Dow Chemical Co.

Miles, R., Clark, L., Ellicks, D., Neale, D., & McKenna, C. (2002, March). Improving the viability of aqueous parts washing for Air Force maintenance operations. *Metal Finishing*, 8-12.

Shoemaker, P. A., Skogstrom, T., Shea, J., & Bethune, L. (2007). The Boston safe shops project—Preliminary findings of a case study in applying the 10 essential services of public health to building environmental health capacity. *Journal of Environmental Health, 70*(1), 22-28.

State of California Environmental Protection Agency. (2008, December 19). *Chemicals known to the State to cause cancer or reproductive toxicity*. Retrieved from http://www.oehha.ca.gov

Toxics Use Reduction Institute. (2006). *Five chemicals alternatives assessment study*. Commonwealth of Massachusetts.

Wildes, S. (2002). Methyl soyate: A new green alternative solvent. *Chemical Health & Safety*, 24-26.

Wilson, M. P., Hammond, S. K., Nicas, M., & Hubbard, A. E. (2007, May). Worker exposure to volatile organic compounds in the vehicle repair industry. *Journal of Occupational and Environmental Hygiene, 4*, 301-310.

Wolf, K., & Morris, M. (2006, November). *Automotive aerosol cleaning products: Low-VOC, low toxicity alternatives*. Cal/EPA's Department of Toxic Substances Control and City of Santa Monica.

Zavadil, J., Wolf, K., & Morris, M. (2004, December). *Alternatives to automotive consumer products that use volatile organic compounds (VOC) and/or chlorinated organic compound solvents.* California Air Resources Board and the California Environmental Protection Agency.