

**CALIFORNIA PROPOSITION 65  
CHEMICAL EXPOSURE REPORT**

**FOR**

**BRAZILIAN BLOWOUT  
PROFESSIONAL HAIR SMOOTHING  
SOLUTION**

**Prepared for:**

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A handwritten signature in black ink, appearing to read "F. Offermann", written over a horizontal line.

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President**

March 25, 2011  
(IEE File Reference P-3782)

## California Proposition 65 Chemical Exposure Assessment

The California Safe Drinking Water and Toxic Enforcement Act (Proposition 65) requires public “warnings” for all products sold in California that cause exposures that exceed the No Significant Risk Level (NSRL) for carcinogens. The NSRL is the daily intake level calculated to result in one excess case of cancer in an exposed population of 100,000. The NSRL for a chemical listed under Proposition 65 is established by California’s Office of Environmental Health Hazard Assessment (OEHHA). The Proposition 65 NSRL for formaldehyde is a maximum lifetime average daily dose of 40 micrograms per day ( $\mu\text{g}/\text{day}$ ).

The following is the California Proposition 65 chemical exposure assessment report for emissions of formaldehyde from the product, “Brazilian Blowout Professional Smoothing Solution.” The primary objective of this exposure assessment was to determine the lifetime average inhalation dose of formaldehyde to stylists and customers, for the purpose of determining if this product triggers the California Proposition 65 warning requirements. Secondly, this report also examines whether air concentrations of formaldehyde from this product exceed the Acute Reference Exposure Level for formaldehyde inhalation established by OEHHA, which is a measure of the potential for acute irritation (noncancer) from this product.

For this chemical exposure assessment we used both modeled exposures from laboratory measurements of the emissions for formaldehyde, and field measurements of exposures to formaldehyde in actual salon settings.

### Modeled exposures

We utilized the laboratory measurements of the emission rates of formaldehyde as reported in the Berkeley Analytical, February 6, 2011 report to the California Department of Justice, “Measured Formaldehyde Content and Emissions from Brazilian Blowout Hair Smoothing Product.”

We calculated the indoor formaldehyde stylist and customer exposures for a small salon setting with different ventilation rates and with use of different amounts of the Brazilian Blowout Solution product. We used a well-mixed mass balance model to model the indoor formaldehyde concentrations each minute as described in the equation below,<sup>1</sup> using the formaldehyde emission rates from the Berkeley Analytical test chamber measurements and a one-minute time step.

$$C_i(t) = C_i(t-1) + \left( \frac{[E - Q(C_i(t-1) - C_o(t-1))](t - (t-1))}{V} \right)$$

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<sup>1</sup> The method description is contained in Offermann, *et. al*, 3rd International Conference on Indoor Air Quality and Climate, Vol. 1, pp. 257-264, Swedish Council for Building Research, Stockholm.

where:

- $C_i$  = indoor contaminant concentration ( $\mu\text{g}/\text{m}^3$ )
- $C_o$  = outdoor contaminant concentration ( $\mu\text{g}/\text{m}^3$ )
- $E$  = contaminant emission rate ( $\mu\text{g}/\text{min}$ )
- $Q$  = outdoor air ventilation rate ( $\text{m}^3/\text{min}$ )
- $V$  = indoor air volume ( $\text{m}^3$ )
- $t$  = time (min)

For these calculations we assumed that the indoor contaminant emission rates were constant, and that the indoor air contaminants were removed only by ventilation (*i.e.*, no removal by air filtration, surface deposition, chemical reactivity). In order to focus upon the exposures to formaldehyde from just the Brazilian Blowout hair smoothing product, we assumed that the outdoor concentration of formaldehyde was zero and that the only source of formaldehyde in the salon was that emitted by the Brazilian Blowout hair smoothing product.

The model was run to calculate the indoor concentrations for each of the 1,440 minutes of a 24-hour period. The initial concentration for each model run was set to equal the concentration at 1,440 minutes. The following is a description of each of the model input parameters, followed by the results.

Formaldehyde Emission Rates. The Berkeley Analytical, February 6, 2011 report contains measurements of the formaldehyde mass-specific emission rates for a sample of the liquid product as measured at room temperature in a 67-liter stainless steel ventilated test chamber. The formaldehyde emission rates were measured over three consecutive one hour periods (*i.e.*, 0-1 hour, 1-2 hours, and 2-3 hours). The emission rates were 1,020  $\mu\text{g}/\text{gram-hour}$  for the first hour and increased during the second and third hours to 1,280 and 1,670 respectively. We elected to use the emission rate for the first hour (1,020  $\mu\text{g}/\text{g-h}$ ), which represents a conservatively low emission rate, since the Berkeley Analytical report shows that the emission rates actually increase over time. In addition, since the Brazilian Blowout treatment, involves applying the Smoothing Solution to the customer's hair and then heating the product with a blow dryer followed by a flat-iron (as described in the "Original Brazilian Blowout Salon Training Video" at <http://www.youtube.com/watch?v=r9KhydvXks8>), the emission rates can be expected to be substantially higher than the room temperature emission rate we have selected.

We also converted the mass-specific emission rate of 1,020  $\mu\text{g}/\text{g-h}$ , to an absolute emission rate ( $\mu\text{g}/\text{h}$ ), by multiplying the mass-specific emission rate by the mass of product recommended in the "Original Brazilian Blowout Salon Training Video." This training video recommends 1 capful for short hair, 2 capfuls for medium hair, and 3 capfuls for long hair. Berkeley Analytical reports that the average mass of product in one capful is 12.6 grams.

We also set the length of time that formaldehyde is emitted during a treatment to 90 minutes, in accordance with the "Original Brazilian Blowout Salon Training Video," which states that a typical treatment with this product, including application, blow drying, and flat ironing, takes approximately 90 minutes.

We assumed that there was one treatment in the salon each day, beginning at 10:00 AM and concluding at 11:30 AM. This is also a conservatively low estimate, in that it underestimates emissions in any salons performing more than one treatment per day.

Salon Characteristics. For this model we used a salon with a 240 square feet (ft<sup>2</sup>) floor area and a ceiling height of 8 feet. We also selected three different outdoor air ventilation rates for use in the model. For a low ventilation rate scenario, typical of a salon without a mechanical ventilation system and with only openable windows, we used an outdoor air ventilation rate of 0.13 cubic feet per minute (cfm)/ft<sup>2</sup>. For a medium ventilation rate scenario, typical of a salon with a mechanical ventilation system operated in accordance with the 2001 California Building Code (CBC) required minimum ventilation rates, we used a rate of 0.38 cfm/ft<sup>2</sup>. For a high ventilation rate scenario, typical of a salon with a mechanical ventilation system operated in accordance with the 2007 CBC required minimum ventilation rates, we used a rate of 0.60 cfm/ft<sup>2</sup>.

Stylist and Customer Exposures. We assumed the stylist is exposed to one application per day, 5 days per week, 50 weeks per year, for 40 years per working lifetime. We assumed that the stylist is exposed to the air in the salon for 8 hours each workday (*i.e.*, 9 AM to 5 PM). We assumed the customer is exposed to one application every two months for 40 years per lifetime. We assumed that the customer is exposed to the air in the salon for 110 minutes for each treatment (*e.g.*, 9:50 AM to 11:40 AM, which includes 10 minutes before and 10 minutes after the 90 minute treatment). For calculating the lifetime average daily dose we assumed that 100% of the formaldehyde inhaled is absorbed by the respiratory system. This is a reasonable assumption because the high water-solubility of formaldehyde makes it readily absorbable by the human respiratory system.

### **Modeled Results and Proposition 65 NSRL**

The results of the modeling of the concentrations of formaldehyde in the air of the salon are summarized in Table 1 for the three different ventilation rates and for the three different product amounts. The time-averaged concentrations of formaldehyde are reported separately for the stylist and the customer exposures to the single application of the product. The stylist exposure represents an 8-hour time averaged exposure during each work day, while the customer exposure represents a 110-minute time averaged exposure during each appointment.

The 8-hour time averaged concentrations of formaldehyde in the air the stylist is breathing ranged from a minimum of 0.008 ppm for a one capful application (*i.e.* short hair) with the high ventilation rate scenario, to a maximum of 0.108 ppm for a three capful application (*i.e.* long hair) with the low ventilation rate scenario.

The 110-minute time averaged exposures in the air the customer is breathing ranged from a minimum of 0.033 ppm for the one capful application (*i.e.*, short hair) with the high ventilation rate scenario to a maximum of 0.269 ppm for the three capful application (*i.e.*, long hair) with the low ventilation rate scenario.

The results of the calculations of the lifetime average daily dose of formaldehyde in a hair salon for a single application of Brazilian Blowout hair smoothing product are summarized in Table 2 for the three different ventilation rates and for the three different product amounts. The lifetime averaged daily doses are reported separately for the stylist and the customer exposures. The stylist lifetime averaged daily dose represents exposure to the 8-hour time averaged concentrations in Table 1 for five days per week, 50 weeks per year, for 40 years per working lifetime. The customer lifetime averaged daily dose represents exposure to the 110-minute time averaged concentrations in Table 1 for four days per year (*i.e.*, once every three months) for 40 years per salon-treatment lifetime.

The lifetime average daily doses for the stylist ranged from a minimum of 26 µg/day for a one capful application (*i.e.*, short hair) with the high ventilation rate scenario to a maximum of 347 µg/day for a three capful application (*i.e.*, long hair) with the low ventilation rate scenario.

The lifetime average daily doses for the customer ranged from a minimum of 0.6 µg/day for a one capful application (*i.e.*, short hair) with the high ventilation rate scenario to a maximum of 4.8 µg/day for a three capful application (*i.e.*, long hair) with the low ventilation rate scenario.

The Proposition 65 NSRL for formaldehyde is a maximum lifetime average daily dose of 40 µg. Thus, the NSRL for formaldehyde is exceeded for the stylist in eight of the nine exposure scenarios, *i.e.*, in all except for the one capful application (short hair) with the high ventilation rate scenario. The NSRL for formaldehyde is not exceeded for the customer in any of the nine exposure scenarios.

We note that the above modeled formaldehyde concentrations and subsequently calculated lifetime average daily doses are likely to be significantly underestimated as a result of the use of a conservatively low formaldehyde emission rate, which was based on a one hour room temperature emission rate test by Berkeley Analytical, rather than an emission rate reflecting the application of high heat (flat-ironing, blow-drying) to the Brazilian Blowout Solution.

### **Modeled results and acute irritation standard**

The modeled concentrations represent substantially elevated indoor air concentrations of formaldehyde. OEHHA has established a non-cancer irritant guideline for inhalation (Acute Reference Exposure Level, or “aREL”) of 0.045 ppm for a one hour exposure to formaldehyde.<sup>2</sup> Concentrations above this level, for a one hour period or longer, pose risks of respiratory and eye irritation to sensitive individuals.<sup>3</sup> The one-hour average concentrations of formaldehyde exceeded the aREL of 0.045 ppm in eight of the nine

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<sup>2</sup> OEHHA’s Reference Exposure Levels for formaldehyde and other toxic chemicals are listed at: <http://oehha.ca.gov/air/allrels.html>

<sup>3</sup> OEHHA sets “Reference Exposure Levels” for certain toxic chemicals pursuant to the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588 of 1987), which requires facilities to report the types and quantities of certain substances routinely released into the air. The primary purpose of the "Hot Spots" Act is to identify toxics-emitting facilities that create localized health risks, to notify nearby residents of

exposure scenarios, *i.e.*, all except for the one capful application (*i.e.*, short hair) with the high ventilation rate scenario. The number of hours that the one hour aREL was exceeded are summarized in Table 3 and ranged from 1.1 hours for the one capful application (*i.e.*, short hair) with the medium ventilation rate scenario, to 3.9 hours for the three capful application (*i.e.* long hair) with the low ventilation rate scenario. Thus, other salon customers or workers that are not involved with the treatment are at risk of respiratory and eye irritation in salons where this product is used.

## Field Results

The report by Oregon's Occupational Health and Safety Administration (Oregon OSHA) on, "Keratin-Based Hair Smoothing Products and the Presence of Formaldehyde," (October 29, 2010)<sup>4</sup> contains measurements of formaldehyde in seven case studies of hair salons. In these studies, the investigators measured the formaldehyde concentrations in the breathing zones of stylists while they performed a hair treatment using the Brazilian Blowout hair smoothing product. For these tests, only one treatment was performed in the salon that day.

The report contains the 8-hour time-averaged concentrations for each of the stylists performing the treatments. We note that the personal air samples for the stylists (*i.e.*, samples taken from the air they were breathing) were collected during the total time of the treatment, which lasted between 32 minutes and 114 minutes. To calculate the 8-hour time average concentrations, the investigators combined the measured exposure with an assumed zero exposure for the time outside of the actual treatment time. As the stylists will continue to be exposed to formaldehyde for some time following the treatment, these calculated 8-hour time averaged exposures will underestimate the true exposures.

The calculated 8-hour time-averaged exposures for the stylists ranged from 0.006 ppm to 0.331 ppm, with an average for the seven case studies of 0.079 ppm. Using the same assumptions for the lifetime average daily dose that we used for the previous modeled salon scenarios (*i.e.*, exposure 5 days per week, 50 weeks per year, for 40 years), the average 8-hour time averaged exposures of 0.079 ppm translates into a lifetime average daily dose of 254 µg/day.

According to the Oregon OSHA report, the manufacturer of Brazilian Blowout Solution commissioned an independent study of the exposure of stylists to formaldehyde in a salon setting during a hair treatment conducted on October 9, 2010. Personal air samples were collected for two stylists over an 8-hour time period, during which multiple Brazilian Blowout hair smoothing treatments were conducted. The number of treatments conducted by each stylist and the characteristics of the salon (*i.e.*, size and ventilation rate) were not reported.

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significant risks, and to reduce such risks to acceptable levels (*See generally*: [www.arb.ca.gov/ab2588/ab2588.htm](http://www.arb.ca.gov/ab2588/ab2588.htm) for program overview.) Although the focus of AB 2588 is outdoor exposures of the general population to contaminated air, the "Reference Exposure Levels" have additional regulatory and nonregulatory applications, such as indicating the acute health effects of exposure to specific concentrations of air toxics in any indoor or outdoor setting.

<sup>4</sup> This report is available at:

[www.ohsu.edu/xd/research/centers-institutes/croet/emerging-issues-and-alerts.cfm](http://www.ohsu.edu/xd/research/centers-institutes/croet/emerging-issues-and-alerts.cfm)

The measured 8-hour time-weighted concentrations for the two stylists ranged from 0.064 ppm to 0.073 ppm. Using the same assumptions for the lifetime average daily dose that we used for the previous modeled salon-worker scenarios (*i.e.*, exposure 5 days per week, 50 weeks per year, for 40 years), the average 8-hour time averaged exposures of 0.064 ppm and 0.073 ppm translate into a lifetime average daily doses of 205 µg/day and 235 µg/day, respectively. These exposures considerably exceed the Proposition 65 NSRL of 40 µg/day, and thus trigger Proposition 65 warning requirements.

## **Conclusions**

The modeled salon exposures to formaldehyde from use of Brazilian Blowout Solution, and the field study measurements conducted by both the Oregon OSHA and the manufacturers of Brazilian Blowout Solution, indicate that stylists that regularly use this product will have lifetime average daily doses of formaldehyde that far exceed the maximum 40 µg/day NSRL established under Proposition 65.

In addition, customers or workers that are not directly involved in applying or receiving a hair treatment with Brazilian Blowout Solution are at risk of acute respiratory and eye irritation in salons where this product is used, based on exceedence of the Acute Reference Exposure Level under eight out of nine exposure scenarios.

Table 1. Projected formaldehyde concentrations in a hair salon for a single application of Brazilian Blowout hair smoothing product utilizing three different product amounts and with low, medium, and high ventilation rates.

Formaldehyde Concentrations (ppm) in a Hair Salon <sup>a</sup> from a Single Product Application <sup>b</sup>				
Outdoor Air <sup>c</sup> Ventilation Rate (cfm/ft <sup>2</sup> )	Exposure <sup>d</sup> Averaging Period	Short Hair 1 Capful (12.6 grams)	Medium Hair 2 Capfuls (25.2 grams)	Long Hair 3 Capfuls (37.8 grams)
0.13 Low	Stylist 8 hours	0.036	0.072	0.108
	Customer 110 minutes	0.090	0.180	0.269
0.38 Medium	Stylist 8 hours	0.013	0.026	0.038
	Customer 110 minutes	0.048	0.096	0.145
0.60 High	Stylist 8 hours	0.008	0.016	0.024
	Customer 110 minutes	0.033	0.065	0.098

a.) Salon: 240 ft<sup>2</sup> floor area and 8 ft ceiling  
b.) Single product application from 10:00 AM to 11:30 AM during an 8 hour workday (i.e. 9 AM – 5 PM)  
c.) Outdoor air ventilation rate scenarios: low = (0.13 cfm/ft<sup>2</sup>), no mechanical ventilation, openable windows only; medium = (0.38 cfm/ft<sup>2</sup>), mechanical ventilation according to 2001 CBC required rates; , high = (0.60 cfm/ft<sup>2</sup>), mechanical ventilation according to 2007 CBC required rates.  
d.) Stylist exposure - 8 hours (i.e., 9 AM – 5 PM); Customer exposure – 110 minutes (e.g., 9:50 AM – 11:40 AM)

Source: Indoor Environmental Engineering, March 2011.

Table 2. Lifetime average daily dose of formaldehyde in a hair salon for a single application of Brazilian Blowout hair smoothing product utilizing three different product amounts and with low, medium, and high ventilation rates.

Formaldehyde Lifetime Average Daily Dose ( $\mu\text{g}/\text{day}$ ) <sup>a</sup> in a Hair Salon <sup>b</sup> from a Single Product Application <sup>c</sup>				
Outdoor Air <sup>d</sup> Ventilation Rate ( $\text{cfm}/\text{ft}^2$ )	Person <sup>e</sup> Exposed	Short Hair 1 Capful (12.6 grams)	Medium Hair 2 Capfuls (25.2 grams)	Long Hair 3 Capfuls (37.8 grams)
0.13 Low	Stylist	<b>116</b>	<b>231</b>	<b>347</b>
	Customer	1.1	2.1	3.2
0.38 Medium	Stylist	<b>41</b>	<b>82</b>	<b>124</b>
	Customer	0.6	1.1	1.7
0.60 High	Stylist	26	<b>52</b>	<b>77</b>
	Customer	0.4	0.8	1.2
Proposition 65 NSRL Maximum Lifetime Average Daily Dose ( $\mu\text{g}/\text{day}$ )		40		
<p>a.) 70 year average lifetime daily dose (<math>\mu\text{g}/\text{day}</math>); doses exceeding the Proposition 65 NSRL of 40 <math>\mu\text{g}/\text{day}</math> are <b>bolded</b>.</p> <p>b.) Salon: 240 <math>\text{ft}^2</math> floor area and 8 ft ceiling</p> <p>c.) Single product application from 10:00 AM to 11:30 AM during an 8 hour workday (i.e. 9 AM – 5 PM)</p> <p>d.) Outdoor air ventilation rate scenarios: low = (0.13 <math>\text{cfm}/\text{ft}^2</math>), no mechanical ventilation, openable windows only; medium = (0.38 <math>\text{cfm}/\text{ft}^2</math>), mechanical ventilation according to 2001 CBC required rates; high = (0.60 <math>\text{cfm}/\text{ft}^2</math>), mechanical ventilation according to 2007 CBC required rates.</p> <p>e.) Stylist exposed to one application each day, 5 days per week, 50 weeks per year, 40 years per lifetime. Customer exposed to one application every 3 months, 40 years per lifetime. Stylist exposure - 8 hours (i.e., 9 AM – 5 PM); Customer exposure – 110 minutes (e.g., 9:50 AM – 11:40 AM)</p> <p>Source: Indoor Environmental Engineering, March 2011.</p>				

Table 3. Projected number of hours that formaldehyde concentrations exceed the OEHHA one hour acute reference exposure level in a hair salon with a single application of Brazilian Blowout hair smoothing product utilizing three different product amounts and with low, medium, and high ventilation rates.

Number of Hours that Formaldehyde Concentrations Exceed the OEHHA One Hour Acute Exposure Level <sup>a</sup> in a Hair Salon <sup>b</sup> from a Single Product Application <sup>c</sup>			
Outdoor Air <sup>d</sup> Ventilation Rate (cfm/ft <sup>2</sup> )	Short Hair 1 Capful (12.6 grams)	Medium Hair 2 Capfuls (25.2 grams)	Long Hair 3 Capfuls (37.8 grams)
0.13 Low	2.5	3.4	3.9
0.38 Medium	1.1	1.9	2.2
0.60 High	0	1.5	1.8

a.) OEHHA Acute Reference Exposure Level of 0.045 ppm for a one hour exposure.  
b.) Salon: 240 ft<sup>2</sup> floor area and 8 ft ceiling  
c.) Single product application from 10:00 AM to 11:30 AM during an 8 hour workday (i.e. 9 AM – 5 PM)  
d.) Outdoor air ventilation rate scenarios: low = (0.13 cfm/ft<sup>2</sup>), no mechanical ventilation, openable windows only; medium = (0.38 cfm/ft<sup>2</sup>), mechanical ventilation according to 2001 CBC required rates; high = (0.60 cfm/ft<sup>2</sup>), mechanical ventilation according to 2007 CBC required rates.

Source: Indoor Environmental Engineering, March 2011.