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January 9, 2007

Ms. Peggy L. Jenkins
California Air Resources Board
Research Division, Fifth Floor
1001 I Street, P. O. Box 2815
Sacramento, CA 95814

Re: Comments on Air Cleaner Regulation Draft Concept

Dear Ms. Jenkins:

Thank you for the informative workshop on December 13 and the opportunity to submit written comments. These comments are being submitted on behalf of Ecoquest International, Inc., a manufacturer of indoor air cleaners.

1. Dual use devices.

The workshop included a brief discussion of dual use devices and specifically of whether the ARB intended to allow devices which (a) meet the .05 ppm emission concentration standard for ozone when used as intended in occupied spaces, and (b) could be set for higher emission concentrations under instructions that any higher setting be used only in unoccupied spaces.

Ecoquest manufactures a device with a temporary setting called the "away mode" that can produce higher concentrations. It also produces a device with multiple settings based on room size which, if used in smaller rooms than the indicated setting, could produce higher concentrations.

I believe Richard Bode indicated that no decision had been made on the issue of dual use devices.

We urge the staff to allow such an "away mode" and room-size specific setting with appropriate warning and labeling requirements.

As the staff summary of AB 2276 requirements indicates, that legislation itself speaks in terms of regulating indoor air cleaning devices "used in occupied spaces." Health and Safety Code section 41985.5 adopts a federal ozone emissions limit for occupied spaces (.05 ppm "in the atmosphere of enclosed space intended to be occupied by people for extended periods of time"). The emission concentration standard to be adopted in the regulations is required by section 41986(b)(1) to be equivalent to the federal ozone emission limit.

The discretionary ban that is authorized under Health and Safety Code section 41986(c)(1) would therefore logically be a ban only on devices that exceed the emission concentration limit for occupied spaces, not for unoccupied spaces.

The draft concept recognizes this logic by indicating that larger air cleaning devices "designed and advertised only for commercial or industrial use in unoccupied spaces also would not be regulated."

It would be anomalous at best, and arguably contrary to the carefully crafted statutory grant of regulatory authority, to ban devices that meet the emission concentration standard when used as directed just because they have an alternative setting specifically designed for use in unoccupied spaces.

The effect of such a regulation would be to deprive consumers of a relatively inexpensive product designed to produce some of the widely acknowledged benefits[1] of devices "designed and advertised only for commercial or industrial use in unoccupied spaces," leaving those who could afford the commercial devices the completely legal option of purchasing them separately for use in their homes.

We suggest in the alternative that the staff propose a regulation that includes strict warning and labeling requirements to assure that consumers are fully informed that any settings on a device that could exceed the .05 ppm emissions concentration standard should not be used while the space is occupied.

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[1] The International Ozone Association commented at the workshop about anti-microbial benefits as well as beneficial impacts on mold, mildew and smoke. We also attach a study done at Kansas State University citing ozone's benefits as a disinfectant in combating e coli and other bacteria on food preparation surfaces.

This approach would have several beneficial aspects:

- It would allow tens of thousands of California consumers who have dual-use devices to replace them when they wear out (rather than try to extend their service), but with the benefit of a newly approved set of warnings.

- It would treat consumers of air cleaning devices the same way we treat consumers of all other products that are safe when properly used but potentially dangerous when misused (ranging from automobiles to insecticides to pharmaceuticals).

- It would narrow the market for buying non-conforming devices in other states and bringing them into California

2. <u>Proposed regulation</u>.

We proposed the following warning requirement to deal with the "dual use" air cleaner issues:

"Portable air cleaning devices designed or advertised for use in occupied spaces that do not, when used as directed, meet the concentration standard of .05 ppm shall not be sold in California. Devices that are designed for use in both occupied and unoccupied spaces or that are designed for use in enclosures of multiple sizes and which meet the concentration standard when used as directed in occupied spaces shall contain a clear warning in an instruction manual to be included at time of sale, in the packaging materials and on the device itself, whenever there is reference to any setting that could produce a concentration in excess of .05 ppm, that the device should never be used at that setting when the space is occupied by humans or animals."

3. <u>The "2 inch rule" for ozone monitoring</u>.

We understand the International Ozone Association will comment on this test. We would just add our support to their position with the following:

AB 2276 requires an emission <u>concentration</u> standard, not an emission generation or "tailpipe" standard. Ozone levels dissipate quickly even a few inches from the emissions source. Accordingly the "2 inch rule" in the UL 867 ozone test is not appropriate. It is the equivalent of measuring the temperature of a room by a thermostat next to the heating vent rather than at a location that more accurately measures room temperature.

We look forward to meeting soon with ARB staff to discuss these issues in more depth.

Respectfully,

Robert W. Naylor

Efficacy of EcoQuest Radiant Catalytic Ionization Cell and Breeze AT Ozone Generators at Reducing Microbial Populations on Stainless Steel Surfaces

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Summary and Implications

This study was conducted to determine the potential use of EcoQuest Radiant Catalytic Ionization Cell for the inactivation of *Escherichia coli*, *Listeria monocytogenes*, *Streptococcus* spp., *Pseudomonas aeruginosa*, *Bacillus* spp., *Staphylococcus aureus*, *Candida albicans*, and *S. chartarum*, on stainless-steel surfaces at diverse contact times in a controlled airflow cabinet. In addition, the EcoQuest Breeze AT Ozone generator was evaluated under the same conditions for the inactivation of *Candida albicans* and *S. chartarum*. Better disinfection technologies for food contact surfaces are needed to control food borne pathogens in processing environments. Ozone technologies have only recently been approved for use on food contact surfaces. This study evaluated the application of gaseous ozone and other oxidative gases on stainless-steel surfaces against the microorganisms listed above. Both technologies reduced populations of all microorganisms tested on stainless-steel surfaces by at least 90% after 24 h exposure. The Radiant Catalytic Ionization Cell was more effective at reducing microbial counts for shorter exposure times than was the Breeze AT Ozone Generator.

INTRODUCTION

The food and beverage industries face a number of issues when it comes to producing a safe, wholesome product. Foodborne pathogens such as *E. coli* 0157:H7, *Listeria moncytogenes,* and *Salmonella* spp. have been a growing concern throughout the years. Processors are also concerned about spoilage microorganisms that shorten shelf life and cost companies millions every year in spoiled product. Industries impacted include the meat, seafood, poultry, produce, baking, canned foods, dairy, and almost all other segments of the market.

The U.S. Department of Agriculture estimates the costs associated with food borne illness to be about $5.5 to $22 billion a year. This doesn't include the billions lost every year due to spoiled product, which must be disposed of or sold as a lesser valued product. Better disinfection and microbiological control measures are needed in almost every area of the food industry.

As a disinfectant, ozone has a tremendous ability to oxidize substances. It's thousands of times faster than chlorine and disinfects water three to four times more effectively. As it oxidizes a substance ozone will literally destroy the substance's molecule. It can oxidize organic substances such as bacteria and mildew, sterilize the air, and destroy odors and toxic fumes. Ozone has been used by industry for many years in numerous applications such as odor control, water purification, and as a disinfectant (Mork, 1993). Recent government approval of ozone for use with foods and food contact surfaces has opened the door to many more exciting possibilities for this technology.

In June 2001, the U.S. Food and Drug Administration approved the use of ozone as a sanitizer for food contact surfaces, as well as for direct application on food products. Prior to that time, chlorine was the most widely used sanitizer in the food industry. Ozone may be a better choice for disinfection of surfaces than chlorine. Chlorine is a halogen-based chemical that is corrosive to stainless steel and other metals used to make food-processing equipment. Chlorine can also be a significant health hazard to workers; when mixed with ammonia or acid cleaners, even in small amounts, a toxic gas can form.

Chlorine is a common disinfect used in meat processing and is effective and safe when used at proper concentrations. However, chlorine is far less effective than ozone and can result in the production of chloroform, carbon tetrachloride, chloromethane, and tri-halomethanes. In contrast, ozone leaves no residual product upon its oxidative reaction.

An important advantage of using ozone in food processing is that the product can be called organic. An organic sanitizer must be registered as a food contact surface sanitizer with the U.S. Environmental Protection Agency (EPA). Ozone has such an EPA registration, and is approved by FDA as a sanitizer for food contact surfaces and for direct application on food products.

Ozone has become more accepted for use in food processing in recent years and is being used in more than just surface applications. A recent U.S. FDA recommendation (2004) stated that "ozone is a substance that can reduce levels of harmful microorganisms, including pathogenic *E. coli* strains and *Cryptosporidium*, in juice. Ozone is approved as a food additive that may be safely used as an antimicrobial agent in the treatment, storage, and processing of certain foods under the conditions of use prescribed in 21 CFR 173.368."

MATERIALS AND METHODS

Preparation of Cultures:

The following bacteria and fungi cultures were used for the study: *Bacillus globigii* (ATCC # 31028, 49822, 49760), *Staphylococcus aureus* (ATCC # 10832D, 25178, 11987), *Candida albicans* (ATCC # 96108, 96114, 96351), *Stachybotrys chartarum* (ATCC # 18843, 26303, 9182), *Pseudomonas aeruginosa* (ATCC# 12121, 23315, 260), *Escherichia coli* (ATCC# 27214, 19110, 67053), *Streptococcus pneumoniae* (ATCC# 27945, 29514, 10782), and *Staphylococcus aureus* - methicillin resistant (ATCC# 33591). Cultures were revived using ATCC recommended instructions.

Bacteria, yeast, and mold strains were individually grown in tripticase soy broth (TSB; Difco Laboratories, Sparks, MD) and YM broth (Difco Laboratories), respectively, to mid-exponential phase followed by a wash and re-suspension in 0.1% peptone water. The cultures were combined by specie type to ca. 10^8 CFU/ml.

Preparation of Samples and Ozone Treatment:

The microbial species used to validate the ozone generators were tested as microbial cocktails inoculated onto 6.3 x 1.8 cm on #8 finish stainless-steel coupons (17.64 cm^2 double sided area). Four stainless steel coupons were dipped per microbial inoculum and vortexed 15 sec to optimize microbial dispersion. Using sterile binder clips, stainless steel coupons were suspended on a cooling rack contained inside a laminar flow cabinet for 1 h to dry. The initial microbial populations attached to the stainless steel coupons ranged from 5 to 6 log CFU/cm^2. The inoculated stainless steel coupons were transferred to a controlled airflow test cabinet (Mini- Environmental Enclosure, Terra Universal, Anaheim, CA) at 26°C and 46% relative humidity (ambient conditions), and treated using the EcoQuest Radiant Catalytic Ionization Cell for 0, 2, 6, and 24 h. The EcoQuest Breeze AT Ozone generator was evaluated separately for treatment periods of 0, 2, 6 and 24 h. Ozone levels were monitored throughout the study (Model 500, Aeroqual, New Zealand).

Sampling:

At the end of the ozone contact time the coupons were vortexed for 30 sec in 30 ml of 0.1% peptone water. Samples inoculated with bacterial cultures were serially diluted, plated on tripticase soy agar (TSA; Difco Laboratories), and incubated for 24 h at 35°C. After preparing serial dilutions, samples inoculated with yeast were plated on potato dextrose agar (PDA; Difco Laboratories) and those inoculated with mold cultures were plated on cornmeal plates. Both PDA and cornmeal plates were incubated 30°C for 5 days. Following incubation, data for each microorganism were reported as colony-forming units per square centimeter (CFU/cm^2).

RESULTS AND DISCUSSION

Reductions in microbial populations on #8 finish stainless steel coupons following 0, 2, 6, and 24 h exposure to the EcoQuest Radiant Catalytic Ionization Cell are presented in Figure 1. Exposure to ozone levels of 0.02 ppm for 2 h reduced all microbial populations tested by at least 0.7 log CFU/cm^2. Longer exposure times resulted in greater reductions, with the greatest reductions found after 24 h exposure. After 24 h exposure, mean microbial reductions for each organism were as follows: *S. aureus* (1.85 log CFU/cm^2), *E. coli* (1.81 log CFU/cm^2), *Bacillus* spp. (2.38 log CFU/cm^2), *S. aureus* met^r (2.98 log CFU/cm^2), *Streptococcus* spp. (1.64 log CFU/cm^2), *P. aeruginosa* (2.0 log CFU/cm^2), *L. monocytogenes* (2.75 log CFU/cm^2), *C. albicans* (3.22 log CFU/cm^2), and *S. chartarum* (3.32 log CFU/cm^2).

Reductions in microbial populations following treatment of stainless steel coupons with the EcoQuest Breeze AT Ozone generator are shown in Figure 2. Reductions of at least 0.2 and 0.4 log CFU/cm^2 were observed after 2 and 6 h of ozone exposure, respectively. After 24 h exposure, mean reductions for *C. albicans* and *S. chartarum* were 1.48 and 1.32 log CFU/cm^2, respectively.

The EcoQuest Radiant Catalytic Ionization Cell and EcoQuest Breeze AT Ozone generators reduced microbial populations on stainless steel surfaces within 2 h under ambient conditions, with greater reductions associated with longer exposure times. The Radiant Catalytic Ionization Cell was more effective than the Breeze AT Ozone Generator at reducing microbiological populations at shorter exposure times of 2 and 6 hours. This study demonstrated that ozone gas has the potential to be an effective surface disinfectant for use in food processing applications. Testing is currently ongoing to evaluate non-treated controls. Phase II of the project, scheduled to be completed by the end of this year, will evaluate the effectiveness of the system for eliminating airborne contamination using the same microorganisms and oxidative technologies.

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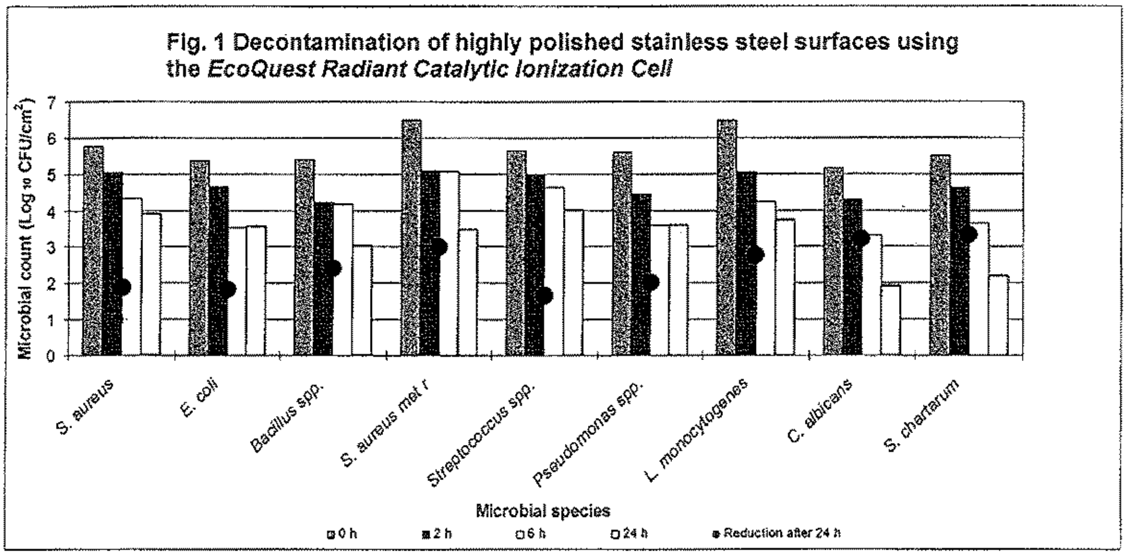
Fig. 1 Decontamination of highly polished stainless steel surfaces using the EcoQuest Radiant Catalytic Ionization Cell
Microbial count (Log10 CFU/cm2)
0
1
2
3
4
5
6
7
S. aureus
E. coli
Bacillus spp.
S. aureus met r
Streptococcus spp.
Pseudomonas spp.
L. monocytogenes
C. albicans
S. chartarum
Microbial species
0 h
2 h
6 h
24 h
Reduction after 24 h

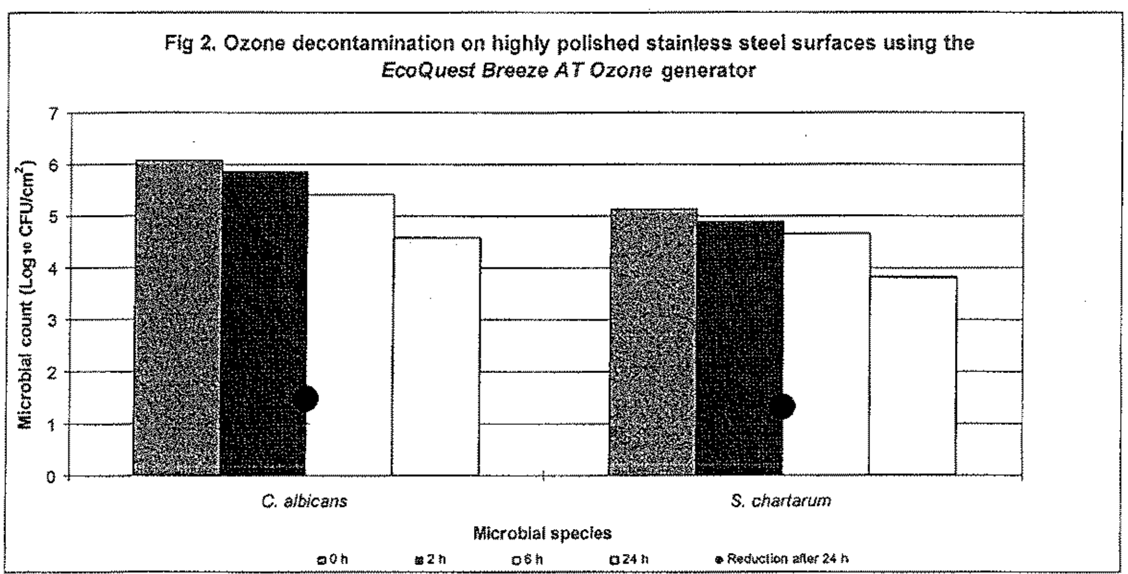
Fig 2. Ozone decontamination on highly polished stainless steel surfaces using the EcoQuest Breeze AT Ozone generator
Microbial count (Log10 CFU/cm2)
0
1
2
3
4
5
6
7
C. albicans
S. chartarum
Microbial species
0 h
2 h
6 h
24 h
Reduction after 24 h