State of California
AIR RESOURCES BOARD

Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters

RESEARCH PROPOSAL

Resolution 14-10

May 22, 2014

Agenda Item No.: 14-4-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2771-278, entitled "Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters," has been submitted by Lawrence Berkeley National Laboratory; and

WHEREAS, the Research Division staff has reviewed Proposal Number 2771-278 and finds that in accordance with Health and Safety Code Section 39701, research is needed to quantify the impact of fiberglass filters on formaldehyde exposures in California, and determine the benefits of the use of synthetic particle filters to reduce human exposures to formaldehyde. Results from this project will help inform decision-makers about whether synthetic particle filters are a part of the solution to reduce indoor formaldehyde exposures. Research Division staff recommends this proposal for approval;

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee recommends for funding:

> Proposal Number 2771-278 entitled "Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters," submitted by Lawrence Berkeley National Laboratory, for a total amount not to exceed $350,000.

NOW, THEREFORE BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendations of the Research Screening Committee and Research Division staff and approves the following:

Proposal Number 2771-278 entitled "Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters," submitted by Lawrence Berkeley National Laboratory, for a total amount not to exceed $350,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $350,000.

I hereby certify that the above is a true and correct copy of Resolution 14-10 as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters"

Background

Formaldehyde has been classified as a known human carcinogen by the International Agency for Research on Cancer and designated as a toxic air contaminant in California by the Air Resources Board (ARB) with no safe level of exposure. Based on recent research by Lawrence Berkeley National Laboratory (LBNL), fiberglass particle filters in central heating and air systems may be the second largest source of indoor formaldehyde levels, after composite wood products. The formaldehyde apparently is attributable to urea-formaldehyde resins used in fiberglass filters. In limited laboratory and field studies, fiberglass particle filters produced indoor concentrations that exceeded the Office of Environmental Health Hazard Assessment's (OEHHA) non-cancer 8-hour and Chronic Reference Exposure Levels (RELs) for formaldehyde (both set at 9 $\mu g/m^3$). LBNL found that emissions of formaldehyde from some fiberglass filters increased with increasing relative humidity. The LBNL study suggests that changing filter type from fiberglass filters to synthetic filters could reduce indoor concentrations by about 4-5 $\mu g/m^3$ in homes. This reduction would result in a level that is approximately 50 percent lower than OEHHA's non-cancer 8-hour and Chronic RELs for formaldehyde.

However, these preliminary results were based on just a few measurements of emissions from filters used primarily in commercial buildings under limited test conditions. Further study is needed to quantify the contribution of residential fiberglass and synthetic filters to indoor concentrations of formaldehyde under a variety of conditions found in California homes and evaluate the benefits of synthetic filters.

Objective

The objective of this project is to quantify the emissions of formaldehyde from fiberglass particle filters relative to synthetic particle filters, and estimate their contributions to indoor concentrations for California homes. The specific objectives are to measure formaldehyde emission rates from fiberglass particle filters and synthetic particle filters across a range of humidity levels, temperatures and air velocities typical of California homes, and estimate the impacts of fiberglass particle filters and synthetic particle filters on indoor formaldehyde levels under typical scenarios in California homes.

Methods

The investigators will identify fiberglass particle filters and synthetic particle filters marketed or designed for use in residential central heating and air conditioning systems in California, and test at least four types of fiberglass filters that are likely to emit formaldehyde and four types of synthetic filters that, based on prior data, are not expected to have significant emissions. The investigators will modify the experimental chamber and ancillary equipment that LBNL used to test formaldehyde emissions from

particle filters for commercial buildings in a previous study for the purpose of this project.

Formaldehyde emission rates of fiberglass and synthetic particle filters will be determined in bench-scale and full-scale tests. Bench-scale tests will determine formaldehyde emission rates of filter media under different conditions. A 4-inch diameter filter sample cut from each filter will be placed in an air-tight holder connected with the experimental chamber. Formaldehyde concentrations upstream and downstream of the filters will be measured. Each filter will be tested across a range of real world conditions observed in California homes, including at least three humidity levels, two temperatures, and three air velocities passing through filters. In addition, a few used filters will be tested to determine if formaldehyde emissions increase with filter loading. In total, the investigators will conduct 36 bench-scale tests.

Formaldehyde emission rates of complete filters will be measured in full-scale tests in order to determine if filter frames emit substantial amounts of formaldehyde. Ductwork will be used to connect the experimental chamber to a filter holder which can host a complete filter. Formaldehyde concentrations upstream and downstream of the filters will be measured. In total, the investigators will conduct 4 full-scale tests.

Using the measured formaldehyde emission rates and modeling parameters appropriate for California homes, the contributions of fiberglass particle filters to indoor formaldehyde levels under typical scenarios will be estimated using a mass balance model. The contributions of fiberglass filters and synthetic filters under similar conditions will be compared to quantify the exposure reduction that would likely be achieved by switching to synthetic filters.

Expected Results
The results from this project will consist of formaldehyde emission rates of fiberglass filters and synthetic filters across a range of conditions in typical California homes, the contributions of these filters to indoor formaldehyde concentrations in typical California homes, and potential health risks of exposures to formaldehyde from these filters.

Significance to the Board
The results will help quantify the impact of fiberglass filters on formaldehyde exposures in California, and determine the benefits of the use of synthetic particle filters to reduce human exposures to formaldehyde. This project will help inform decision-makers about whether synthetic particle filters are a part of the solution to reduce indoor formaldehyde exposures.

Contractor:
Lawrence Berkeley National Laboratory

Contract Period:
30 months

Principal Investigator (PI):
Hugo Destaillats, Ph.D.

Contract Amount:
$350,000

Basis for Indirect Cost Rate:
The State and Lawrence Berkeley National Laboratory have agreed to a 51 percent indirect cost rate.

Past Experience with this Principal Investigator:
ARB staff is currently managing a contract with Dr. Hugo Destaillats, which evaluates pollutant emissions from portable air cleaners. Dr. Destaillats and his team of researchers showed broad knowledge and extensive experience in the field of source characterization, analytical chemistry, and indoor air quality assessment. He is very responsive and cooperative in terms of meeting ARB's research needs.

Prior Research Division Funding to Lawrence Berkeley National Laboratory:

Year	2013	2012	2011
Funding	$ 0	$ 2,530,873	$ 754,264

BUDGET SUMMARY

Contractor: Lawrence Berkeley National Laboratory

"Characterizing Formaldehyde Emissions from Home Central Heating and Air Conditioning Filters"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 154,051	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 2,236	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 18,198	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 57,595[1]	
Total Direct Costs			$ 232,080
INDIRECT COSTS			
1.	Overhead	$ 117,920	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 117,920
TOTAL PROJECT COSTS			**$ 350,000**

[1] Miscellaneous include:
1. Organization and Associate Lab Directorate burden ($27,113): a direct cost applied to total salaries plus fringe benefits.
2. Department burden ($10,291): a direct cost applied to total salaries plus fringe benefits, comprising general departmental costs including, but not limited to, laboratory and office space recharges, telephone charges, faxes, electronic backups, photocopying, and department-level administrative support, and other miscellaneous recharges, corresponding to facilities and laboratory services.
3. Stipends and honoraria ($20,000): a stipend of $2,000/month will be paid for 10 months for a student hired to help on carrying out the experimental work.
4. Electricity ($191): estimated at a monthly rate of $19-$20/month.