United States
Environmental Protection
Agency

National Risk Management
Research Laboratory
Cincinnati, OH 45268

Research and Development

EPA/600/SR-01/001 January 2001

EPA

Project Summary

Candles and Incense as Potential Sources of Indoor Air Pollution: Market Analysis and Literature Review

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The report summarizes available information on candles and incense as potential sources of indoor air pollution. It covers market information and a review of the scientific literature. The market information collected focuses on production and sales data, typical uses in the U.S., and data on the sources and quantities of imported products. The estimated total sales of candles in 1999 varied between $968 million and $2.3 billion, while imports were $486 million. The U.S. imports and exports of incense in 1999 were $12.4 and 4.6 million, respectively. The scientific literature review gathered information regarding the emission of various contaminants generated when burning candles and incense, as well as the potential health effects associated with exposure to these contaminants. Burning candles and incense can be sources of particulate matter. Burning candles with lead-core wicks may result in indoor air concentration of lead above EPA-recommended thresholds. Exposure to incense smoke has been linked with several illnesses, and certain brands of incense also contain chemicals suspected of causing skin irritation.

This Project Summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Background and Approach

The potential indoor air impacts of burning candles and incense have drawn increased attention in recent years. There are three particular areas of concern. Candles with lead-core wicks have been found on the market and have been shown to be a source of airborne lead when burned. Metal cores are used to stiffen wicks so they will not fall over and extinguish themselves as the surrounding wax melts. Lead was commonly used as a core material until 1974 when the U.S. candle manufacturing industry voluntarily agreed to discontinue use of lead in wicks. However, candles with lead wicks have been found on the market by an academic as well as a consumer protection group study. Most of the candles found that contained lead wicks were imported.

Secondly, under imperfect combustion conditions, candles emit soot and can cause property damage by blackening walls, ceilings, and carpets. There have been an increasing number of complaints regarding black soot deposition in homes in the last decade. Candles are one source of soot. With candles, sooting occurs as a result of incomplete combustion. Candle composition, wick length, and drafty conditions can all affect candle combustion. The amount of soot produced can vary greatly depending on the type of candle. One type of candle can produce as much as 100 times more soot than another.

Thirdly, incense smoke can be a major source of particulate emissions in indoor

air. The particulates produced when burning incense can deposit in the respiratory tract. These emissions may contain contaminants that can cause a variety of health effects, including mutagenic effects and airborne dermatitis.

EPA is currently testing emissions from candles and incense to generate data. To support this effort, the report collects and presents two types of data: (1) market information, and (2) literature on the potential impacts of burning candles and incense on indoor air quality.

The market information collected focuses on production and sales data, typical uses in the U.S., and data on the sources and quantities of imported products. In addition, the report summarizes the results of a scientific literature review. It reports the findings in the scientific literature regarding the emission rates of the various contaminants generated when burning candles and incense, as well as the potential health effects associated with exposure to these contaminants.

Market Information

Publicly available sources of data, mostly from the U.S. Bureau of the Census, as well as private market studies and trade literature were consulted to produce this summary of economic information regarding the candle and incense markets. Dialog Information Service and Internet searches were performed to identify market and related information. The U.S. Bureau of Census was contacted to obtain import and export data. The National Candle Association was contacted to obtain industry data.

The Census Bureau reports 107 manufacturing establishments; however, industry estimates range from 160 to over 200 manufacturers. Many manufacturers are very small. Candle sales have been growing rapidly in the last 10 years (10 to 15 % per year), fueled by consumer interest in aromatherapy and increased demand for home fragrance products in general. There is a wide range in estimates of candle sales in the U.S. The Census Bureau reports a total value of shipments in 1997 of $968 million; industry estimates put 1999 sales at $1.3 billion just for scented candles, and up to $2.3 billion for all candles. The majority of candle imports are from China. A large portion of imports come from Hong Kong, Mexico, and Canada as well.

There are no public data on incense manufacturers; private data show at least 26 manufacturers. Limited discussions with industry representatives indicate that there are probably many more very small incense manufacturers. The majority of incense imports are from India, China, and Thailand.

Potential Indoor Air Quality Impacts

Scientific literature, consumer interest group reports, and trade and industry studies were consulted for this summary. Resources were identified through Medline, Toxline, a database of on-line journals, the National Candle Association, and extensive web searches. The studies were diverse in origin; many of the incense studies were performed in Asia, where incense is commonly burned.

Candles

According to the literature reviewed, burning candles containing lead-core wicks can result in indoor air concentrations of lead above EPA-recommended thresholds. All three of the scientific studies, found analyzing indoor air concentrations resulting from burning candles with lead-core wicks, indicated that this indoor air threshold was exceeded. Regarding candles with non-lead metal cores, the literature did not indicate that wicks made with zinc and tin emitted these metals at concentrations that would raise health concerns when burned indoors.

In addition to lead, consumers are exposed to concentrations of organic chemicals, such as formaldehyde, acetaldehyde, and acrolein. One study showed worst-case scenario candle emissions containing levels of these three chemicals that exceeded EPA-recommended thresholds. Other studies indicated no health hazards.

Sooting can occur when combustion conditions are impaired when burning candles. Scented candles are more likely to produce soot than unscented candles. Sooting can cause property damage by blackening surfaces. Although soot particles are very small and can potentially penetrate the deepest areas of the lungs, studies regarding potential human health effects associated with soot from candles were not found in the literature search.

Incense

Large quantities of particulate matter are generated when burning incense. Studies that examined the emissions of specific contaminants from incense smoke indicated that benzene and carbon monoxide may be emitted at concentrations that could pose human health risks. Several studies indicated links between exposure to incense smoke and health effects, such as cancer, asthma, and contact dermatitis. Some studies indicated possible mutagenic and genotoxic effects.

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The complete report, entitled "Candles and Incense as Potential Sources of Indoor Air Pollution: Market Analysis and Literature Review," (Order No. PB2001-103 924; Cost: $27.00, subject to change) will be available only from
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5285 Port Royal Road
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Telephone: (703) 605-6000 (world wide)
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