Asbestos Emissions from Hand-held Hair Dryers

WILLIAM H. HALLENBECK
School of Public Health
University of Illinois Medical Center
P.O. Box 6998
Chicago, Illinois 60680

ABSTRACT / The United States Consumer Product Safety Commission (CPSC) is concerned that consumer exposure to asbestos from consumer products may present an unreasonable risk of injury. Recently, CPSC has obtained agreement by industry to cease production and distribution of hair dryers containing asbestos heat insulation. CPSC intends to broaden its investigation by selecting consumer products containing asbestos for “priority attention.” The Commission does not intend to make quantitative estimates of cancer risks posed by exposure to asbestos fibers in making regulatory decisions. This position may lead to a serious waste of resources for the Commission, industry, and society. The Commission should focus its initial attention on those products for which the release of asbestos is significant enough to cause an unreasonable health risk. To make a risk assessment for a particular use of asbestos, CPSC must acquire or request data on asbestos emissions and define “unreasonable risk to health.”

In an attempt to give some meaning to the phrase “risk assessment,” the primary goal of this paper is to present a detailed risk assessment of exposure to asbestos from hand-held hair dryers. Several scenarios of use are presented using various assumptions regarding time of operation, mixing of fibers in a small room, rate of fiber emission, and time of exposure. The worst case analysis of the health risk of exposure to hair dryer emissions is based on several conservative assumptions and shows that the increased number of deaths per year due to respiratory cancer is 4 for the entire United States population. A more representative case analysis shows the increased number of deaths to be on the order of 0.15 per year.

Several studies of asbestos workers have documented that exposure to asbestos increases the risk of mortality due to asbestosis, mesothelioma, and respiratory and gastrointestinal cancer (Levine 1978). The risk of lung cancer is especially high for asbestos workers who smoke cigarettes. Several federal agencies are responsible for the regulation of asbestos levels and uses in the workplace, home, and general environment in the United States. The primary focus of this paper is to examine the recent regulatory activity of the Consumer Product Safety Commission (CPSC) regarding control of asbestos use in consumer products. Risk assessment techniques are presented and issues raised that are of importance to professionals involved in the control of toxic substances.

Since 1977, CPSC has been “concerned that consumer exposure to asbestos from consumer products may present an unreasonable risk of injury and that some consumer products containing asbestos may present a substantial product hazard” (CPSC 1979). CPSC administers two statutes that enable it to regulate asbestos in consumer products. Under the Federal Hazardous Substances Act, CPSC may regulate hazards presented by the use of toxic or hazardous substances in the household. In addition, the Consumer Product Safety Act gives CPSC the responsibility to protect the public from unreasonable risks of injury or death associated with consumer products (CPSC 1979). When a serious threat to public health exists, CPSC can declare a substance to be an “imminent hazard” and ban a substance from commerce pending completion of a rule-making proceeding.

CPSC is particularly concerned about the release of asbestos fibers in the confined space of the household environment, and the agency banned patching compounds and artificial emberizing materials containing asbestos in 1977 (CPSC 1979). In 1979, the Commission was concerned with asbestos emissions from hair dryers. The asbestos was used to insulate the plastic barrel from the hot airstream. The hair dryer industry responded by ceasing to produce and distribute hair dryers containing asbestos and offering repair, replacement, or a refund to consumers (CPSC 1979). CPSC intends to broaden its investigation by selecting consumer products containing asbestos for “priority attention” based on the following criteria:

(1) the number of units of the product estimated to be in use by consumers; (2) the form and location of the asbestos in the product; (3) the frequency, duration, manner and location in the consumer’s environment of product use, including such factors as the expected useful life of the product.
life of the product and the presence of heat and/or moisture and the likelihood of abrasion during use or foreseeable misuse; (4) the likely availability and feasibility of substitutes for asbestos in the product; (5) the relative ease of data collection by the Commission and the reporting burden on industry; and (6) the degree of potential overlap of CPSC reporting requirements with the information gathering efforts of other regulatory agencies, particularly the Environmental Protection Agency (CPSC 1979).

As a general approach, CPSC proposes initially to eliminate all nonessential uses of asbestos in consumer products from which asbestos fibers are released during reasonably foreseeable conditions of use or misuse. This regulatory approach will not preclude possible actions regarding essential uses of asbestos in consumer products from which asbestos fibers are released. The Commission does not intend to make quantitative estimates of cancer risks posed by exposure to asbestos fibers in making regulatory decisions concerning consumer products containing asbestos. This could lead to a serious waste of resources for the Commission, industry, and society. The Commission should focus its initial attention on those products for which the release of asbestos is significant enough to cause an unreasonable risk. To make this risk assessment for a particular product, CPSC must acquire or request data on emissions and define "unreasonable risk to health."

The meaning of the phrase "risk assessment" is still evolving. In an attempt to give some meaning to this elusive phrase, the remainder of this paper is devoted to a risk assessment of exposure to asbestos from hair dryers. This assessment is presented in the spirit of scientific inquiry, and it is hoped that others will be stimulated to apply, extend, and improve upon the methodology.

Methodology and Results

Dilution Ventilation Model Assuming Complete Mixing

The risk assessment presented later is concerned with the incremental risk of respiratory cancer posed by asbestos emissions from hand-held hair dryers. Material balance equations (National Institute for Occupational Safety and Health, henceforth referred to as NIOSH, 1973) are developed below that are applicable to asbestos emissions from hair dryers. It is assumed that there is no asbestos in the ambient air and that asbestos fibers remain suspended in air. Since the exposure-risk relationship employed in the risk assessment is linear, the assumption of a zero background level of airborne asbestos does not introduce a bias in the computation of incremental risk.

Definitions, symbols, and equations.

\[ C \quad \text{Concentration of asbestos at time } t (\text{hr}) \text{ in fibers or } \text{ng/cm}^3 \]
\[ G \quad \text{Rate of generation of asbestos in fibers or } \text{ng/hr} \text{ (see Table 1 for values of } G) \]
\[ V \quad \text{Volume of a small room (13 x 9 x 8) = 936 ft}^3 = 2.65 \times 10^7 \text{ cm}^3 \]
\[ Q \quad \text{Rate of ventilation. Assume tight construction, resulting in an air change rate of 0.5 } \text{V/hr} = 468 \text{ ft}^3/\text{hr} = 1.33 \times 10^7 \text{ cm}^3/\text{hr} \]

[American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 1979]. For a worst case analysis, also assume there is no forced-air ventilation in addition to the infiltration of external air. Complete mixing of asbestos in the room air is assumed.

When a hair dryer is operating:

\[
\frac{(\text{rate of generation of asbestos})}{(\text{rate of removal of asbestos})} = \frac{G}{QCdt}.
\]

The solution for eq. 1 is

\[
\frac{G - QC_2}{G - QC_1} = e^{-\frac{Q}{V}t},
\]

which can be simplified by substituting \( Q = 1.33 \times 10^7 \text{ cm}^3/\text{hr} \), \( V = 2.65 \times 10^7 \text{ cm}^3 \), \( t_1 = 0 \), and \( C_1 = 0 \), and solving for \( C_2 \):

\[
C_2 = \frac{G}{1.33 \times 10^7} (1 - e^{-\frac{t}{2}}).
\]

Four other equations, which will be used later, can be derived from eq. 2 by solving for \( C_2 \) at \( t = 0.25 \text{ hr} \), \( t = 0.5 \text{ hr} \), and \( t = 1.0 \text{ hr} \):

\[
C_{0.25} = \frac{G}{1.33 \times 10^7} (1 - e^{-\frac{0.25}{2}}) = 8.8 \times 10^{-9} \text{ G fiber or } \text{ng/cm}^3
\]