

The following is an Excerpt from the National Research Council's Publication:

**Risk Assessment of Radon in Drinking Water**  
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Commission on Life Sciences  
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[http://books.nap.edu/openbook.php?record\\_id=6287&page=149](http://books.nap.edu/openbook.php?record_id=6287&page=149)

Under the Section: Mitigation Methods for Existing Homes

Although the document focused on radon in water concerns it also addressed methods for reducing radon from soil sources, as a means to also reduce risk. By virtue of the fact that this review was conducted in 1999, it served to assess newer research findings, one of which deals with radon decay product reduction.

**Page 149-151 Excerpt:**

*The third concentration-reduction approach is the use of air-cleaning to reduce radon decay-product concentrations. Unlike their chemically inert parent, the decay products  $^{218}\text{Po}$ ,  $^{214}\text{Pb}$ , and  $^{214}\text{Bi}$  are metals and easily attach to the surfaces of any aerosols that are present (the "attached" mode). Some decay-product atoms, particularly  $^{218}\text{Po}$ , can also remain as ultra fine aerosols (the "unattached" mode, a few nanometers in diameter). Indoor air concentrations of both modes can be reduced by using an air cleaner designed to remove particles.*

*There have been a number of evaluations of air-cleaning systems undertaken in test chambers or actual indoor environments (reviewed in Hopke and others 1990). Some of these systems can effectively remove radon decay products from indoor air. However, the reduction of  $^{218}\text{Po}$  is not as large as that of  $^{214}\text{Pb}$  and  $^{214}\text{Bi}$ . At the same time, the particles are removed from the air. As a result, the unattached fraction of airborne activity increases, especially of  $^{218}\text{Po}$ . Because the unattached fractions of the radon progeny have been considered to be far more effective in depositing their radiation dose to lung tissue, concerns have been raised regarding the efficacy of air-cleaning as a means of mitigating the hazards arising from indoor radon.*

*A major problem in the previous studies was that the systems used to measure radon progeny were not able to determine the full size distribution, especially in the size range below 10 nm. Estimates of the unattached fractions were made*

*with systems that provide a poorly defined size segregation (Ramamurthi and Hopke 1989). In many cases, the size-measurement methods and results were not clearly stated.*

*In 1990–1992, a research program supported initially by the New Jersey Department of Environmental Protection and then also by EPA undertook field studies to investigate the effects of room-air cleaners on radon progeny concentrations and activity-weighted size distributions (Hopke and others 1993; Wasiolek and others 1993; Li and Hopke 1992; 1991b). A unique, semicontinuous graded screen-array sampling system (Ramamurthi and Hopke 1991) was used to measure the radioactivity associated with indoor aerosol particles in the size range of 0.5–500 nm.*

*In an early set of studies, particles were produced by a variety of activities, such as cooking, smoldering of a cigarette, burning a candle, and operating a vacuum cleaner. Aerosol behavior in the absence of an air cleaner was determined for each condition (Li and Hopke 1991a). The experiments were then repeated with a high-efficiency filter system operating (Li and Hopke 1992). It was found that the filtration unit reduced the airborne activity concentrations by removing particles, but the reductions in estimated dose were much smaller than the decrease in PAEC.*

*Other experiments in normally occupied houses have involved the measurement of the effectiveness of the filtration unit and an electrostatic precipitator by comparing the cumulative frequency distributions of measurements made during a week while a particular cleaner was operating and measurements made during a background week in which no cleaner was being used (Li and Hopke 1991b). A similar experimental design was used to study the two cleaners and an ionization system in an occupied home (Hopke and others 1993). The results of the 1992 measurements in Parishville, NY, in which two ionizing units were measured along with two filtration units were described by (Hopke and others 1994). More detailed studies of the NO-RAD ionizer system under the controlled conditions of a room-sized chamber at the Lawrence Berkeley National Laboratory were performed, and there are several other ionizer-based cleaners for which there have not yet been field studies (Hopke 1997; Hopke and others 1995b).*

*From the more recent studies on air cleaners and their effects on exposure to and dose from airborne radon decay products, several important conclusions can be drawn. With the new dosimetric models that more accurately reflect nasal and oral deposition of ultrafine particles, it is extremely unlikely that an air cleaner can reduce exposure and increase dose as suggested by Maher and others (1987), Sextro and others (1986), and Rudnick and others (1983). Thus, there is no reasonable likelihood that the use of an air cleaner will increase the hazards posed by indoor radon.*

*In studies of different types of air-cleaning devices, reductions in exposure have always exceeded reductions in dose. However, cases have been observed in which there has effectively been no reduction in dose. Thus, for many air cleaners, the clean-air delivery rate is insufficient to provide substantial protection from the radon decay-product hazard. The air cleaner might be effective in removing other contaminants—including cigarette smoke, dust, pollen, and spores—and thus provide a considerable benefit to an occupant without lowering the radon-progeny risk substantially and, more important, without raising that risk at all.*

*The experiments with the newest systems suggest that the combination of substantial air movement and ionization could provide sufficient reduction in exposure and dose to be effective in reducing the radon-progeny risk at radon concentrations up to around 400 Bq m<sup>-3</sup>. If it is desirable to reduce the risk to that equivalent to the average dwelling in the United States, then such units would be useful only for lower <sup>222</sup>Rn concentrations. There would also need to be multiple units in a home to provide complete room-to-room reduction.*