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Letter to the Editor

Does filter media type really affect BRS?

Dear Editor,

Buchanan et al., (2008) correlated outdoor ozone concentrations with perceived building related symptoms (BRS) in the BASE study and provided useful results from this valuable database. In most cases, their findings corroborate those in other studies. However, we wish to raise concerns about one of the central findings in the study: the correlation between high outdoor ozone with the simultaneous use of polyester-synthetic filters and higher incidents of perceived problems of higher and lower respiratory symptoms, cough, eye irritation, fatigue, and headache. The paper states 'these findings suggest possible health consequences from chemical interactions between outdoor ozone and polyester-synthetic filters in buildings.' We propose that these consequences actually arise from the ozone reactions with contaminants that are collected on the filter and not with the filter media itself, and further that the methods that the authors used to assess the efficiency of the filters affects this correlation.

One measure of the presence of chemical reactions with filter materials and dirt on filters are ozone removal rates. Zhao et al. (2007), studied ozone removal by HVAC filters and found in their tests of clean filters that two of the synthetic filters did not remove any ozone, three from a different manufacturer removed an average of 8% of the ozone and three fiberglass filters removed 3% of the ozone. These values were much lower than those for used filters. Similar tests for ozone reactions with new filters were reported in Hyttinen et al. (2006) who found that a polyester filter did not remove ozone, a fiberglass filter removed 6% of the ozone, and another fiberglass filter removed 19% of the entering ozone. Beko et al. (2007) analyzed ozone reactions with new fiberglass media used to make a bag filter and found that it removed 25–45% of the ozone. Clearly, chemical reactions with media in air filters vary considerably by manufacturer, which makes sense given the diversity of materials used in filter media of the same type (i.e. fiberglass or polyester-synthetic), and different uses of binders, tackifiers, and resins. There is little reason to assume that all filters of a given type would react in the same way. It also shows that fiberglass filters can, in fact, produce more byproducts than synthetic filters.

So why did the authors find a high correlation between the use of polyester-synthetic filters and increased perception of BRS? We believe the answer to this question could be in their determination of filter efficiency. The BASE data has limited information about the filters used in the buildings. Efficiencies were reported as average dust spot efficiencies and determined from manufacturer specifications. Buchanan et al. (2008) created a two-part variable for the overall filtration efficiency that described filters as have a minimum efficiency reporting value (MERV) of either ≤ 7 for less efficient filters or > 7 for more efficient filters. The major limitation of this approach is that ASHRAE Standard 52.2 was not published until 1999 and the data in the BASE study was collected between 1994 and 1998. Therefore, some type of conversion from average dust spot efficiencies to MERVs had to have been performed to make the data fit this variable. Such a conversion is very approximate as dust spot efficiencies and MERV numbers are derived by two different test protocols (ASHRAE, 2007). One is derived from the analysis of a target dust spot and the other is determined from efficiencies at multiple particle sizes. For example, many pleated panel filters have an average dust spot efficiency of 20–30% and a MERV of 6–8 and therefore could be categorized as either high or low-efficiency in Buchanan et al. (2008).

In addition to this imprecision, there is reason to suspect a bias in the results as well. Filters of MERV 6 and above are almost always a denser media and filters that are MERV 1–4 have sufficiently low efficiencies that they are tested with a dust arrestance test rather than an efficiency test (ASHRAE, 2007). Although, filtration market data is hard to find, it is likely for manufacturing cost reasons that most of these 'throw-away' MERV 1-4 filters sold during 1994–1998 were fiberglass. They capture far fewer particles that could react with ozone. Most of the mid- and high-efficiency pleated filters sold during this period were constructed using cotton–polyester media. Consequently, it is possible that the correlation that was found between filter media and BRS could be explained by differences in filter efficiencies rather than differences in filter materials. Furthermore, two filters of the same arrestance, and even of the same MERV, could have a very different total amount and size distribution of particles on them after use. Size distributions can also be correlated with particle composition, which further suggests that the differences in ozone reactions may be explained by differences in the dust on the filter rather than the filter media.

Given the likely scenario that the amount and chemical composition of the dust on the filter rather than the filtration media actually caused the reported correlation, the solution to the problem of increased BRS on high ozone days may not be a change in general filter media type, but rather a change in filter replacement cycles or a consideration of filter media that remove ozone or suppress ozone reactions.

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