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Don Fugler IEQ Pioneers

This week we welcomed Don Fugler for the second show in our series with the founding fathers and pioneers of today's indoor environmental quality industry. During our first show J. David Miller, PhD mentioned how important Don was during the early research projects that led to solutions for common IEQ problems. This week we reminisced with Don about his contributions to our current understanding of indoor environments and his thoughts on what the future holds.

Don Fugler spent 25 years conducting research projects for Canada Mortgage and Housing Corporation (CMHC), in the areas of residential energy use, ventilation, and indoor air quality. Between 1985 and 2010, he managed over 100 research projects. During that period, he published CMHC research reports; wrote and distributed summaries in Research Highlights and About Your House documents and lectured at conferences and meetings. Since 2011, Don's consulting work has addressed indoor air quality and energy issues for federal departments, NGOs, and individuals. He is active on CSA standards committees (carbon monoxide sensors, residential depressurization) and CGSB (radon). He helped initiate ROCIS (rocis.org) and the Low Cost Monitoring Project through program design and development of the monitoring process participants would follow. He currently concentrates on the house-based factors, such as the entry rate of outdoor pollutants, the distribution of pollutants within the dwelling, the activities within the house that create particles, and the means of reducing the concentrations of particles and other measured pollutants.

Nuggets mined for this week's episode:

In 1973 Don Fugler was a mechanical engineering grad. He took a 10 year detour where he was involved with youth, youth hostels, tree planting, etc. In the early 1980's Don became interested in energy efficiency and sought employment

in solar heating, landing the opportunity to test houses to determine if improving energy efficiency by air sealing would cause IAQ problems. The research took place in 1982-84. Using Drager tubes, blower doors, tracer gases, and manometers, he surveyed and tested 30-40 homes over several seasons for radon, CO, CO₂ and NO₂, etc., establishing baselines and discovering prime factors.

All of the homes had basements and most of the homes had basement furnace rooms which contained the furnace and the chimney. Don worked for Retrospectors, the firm which built blower doors and conducted blower door research.

Colleagues such as Jim White, Sebastian Moffatt, Joe Lstiburek, Bill Rose, J. David Miller and Brendan Reid strongly influenced Don. Don credits Jim White as being a mentor who taught him 3 important considerations about research findings: 1) first get the sign right (i.e. is the effect positive or negative), then find the order of magnitude (big effect or minuscule), 3) and then establish the first significant figure. Don acknowledged Linda Wigington's Affordable Comfort Conferences were very fruitful where he met building science practitioners such as Terry Brennan and Jim Fitzgerald.

Contemporary thinking was that there was nothing complicated about houses. The Canadian Home Insulation Program was supportive of urea formaldehyde foam insulation and learned the hard way that it was an unperfected technology when IAQ problems occurred in houses where it was used. Application issues such as foaming the gap between layers of brick in old housing stock removed the drying plane and sometimes resulted in odor and health issues caused by unexpectedly high formaldehyde emissions. These emerging problems prompted research. The foam insulation was removed from some houses at high cost while Heat Recovery Ventilators were used to dilute pollutants in other houses. New at that time thermographic scanning techniques revealed inconsistencies in foam application.

Mistakes were made after the first energy crisis.

Combustion spillage is the failure of the chimney or vent to evacuate furnace/DHW (Domestic Hot Water)/fireplace emissions due to dysfunctional chimneys or excessively sized exhaust fans in bathrooms, etc. CMHC and other research looked

into whether or not it caused IAQ problems and how to resolve these issues. This research resulted in building code and standards changes. Some of this research was adopted by weatherization groups in the US and then came back up to Canada. As the amount of combustion spillage of woodburning appliances is hard to predict, use of smoke alarms and CO alarms provides adequate protection, according to Canadian codes and standards.

Don studied the roots of drywall failure (discoloration and loss of structural integrity) due to house tightening in Maritime Provinces. He researched how to design walls and where vapor barriers should be located. In northern climates, vapor barriers behind the drywall works. In Florida, that vapor barrier location would cause problems.

Don studied inconsistencies among hygrometers and learned how to calibrate them. Hygrometers may be calibrated using saturated solutions of sodium chloride to create an environment of 75% RH. He had women researchers go door-to-door and offer a free hygrometer if the occupant would allow them to examine the basement for ten minutes. The team inspected 400 homes in the course of several weeks and found that 30%-40% of homes had evidence of previous moisture problems. The team found many poorly maintained drum type humidifiers installed on furnaces.

Don studied asbestos levels in vermiculite attic insulation and whether it would work its way down into homes. Vermiculite from Libby, Montana was known to contain asbestos, although it was controlled to less than 1%, and was considered by the maker not to be a problem. In Indian Housing, where overcrowding was possible and kids sometimes played in attics insulated with vermiculite, mesothelioma cases showed up when the children reached adulthood.

With the advent of the 3M Filtrete filters which fit into existing 1" filter slots and provide superior filtration, Don studied furnace filter efficiency. He found that some filters work and others don't. For furnace filters to reduce airborne particulate, the furnace blower needs to run, preferably continuously. ROCIS.org (Reducing Outdoor Contaminants in Indoor Spaces) advocates use of low-cost, homemade air cleaners (a box fan with a MERV 13 filter taped on). These air cleaners can also be installed in windows to filter incoming outdoor air.

The Hoover vacuum cleaner company has been tracking and publishing dust composition descriptions from collected vacuum cleaner bags for many years. Modern dust has a wider range of plastics and chemical contaminants compared to samples collected 100 years ago.

Vacuum cleaners were tested to determine the efficiency of different types of vacuum cleaners in removing standardized dust from bare and carpeted floors. On bare floors, vacuums could be 98% efficient while even a broom and dustpan picked up 92% of the dust. In the experiments on carpets, ordinary vacuums only removed 40% of the deposited soil. The rest stayed in the carpet.

Settled dusts emissions produce peaks when disturbed. Down feather duvets, which cannot be easily cleaned, have been seen to cast off dust when people roll over in bed, due to the dust deposited on them over time. Dust bunnies form under beds because occupants often spend 7-8 hours daily in bed so their skin flakes, dander, and hairs tend to accumulate there.

Fire retardants from foam mattresses and other plastic are showing up in people's bodies.

Regarding the occupant contribution to poor IAQ in buildings, the Ontario Research Foundation did a comparative study of homes built for highly sensitized people. They found that these new homes had much lower emissions than homes built with conventional materials and methods. However, two months after occupation, there is little difference the chemical contamination in the low emission houses vs. the controls. The consumer products and furniture that occupants introduced swamped the effects of house building materials. Even the best houses can be damaged by ignorant or uncaring occupants.

CMHC had the opportunity to study and experiment on 80 row houses built on a dump and land fill that were contaminated. The houses were deserted and were designated to be torn down. Don found that sub-slab "radon mitigation type" ventilation effectively mitigated the contamination from the contaminated soil.

Pittsburgh, PA is among the America's top 10 cities with worst air quality. Important work being done by ROCIS in 400+ homes in Pittsburgh, PA. ROCIS has learned that occupants need to be engaged and see the difference e.g. what

happens when they cook, clean, vacuum, install air cleaner, etc. Occupants often lose interest when they do not have a monitor to show them what is going on in their houses.

Submicron size particles, which were too small to previously be measured, may be important in future IEQ research.

Z-Man signing off

Trivia:

Name the American who patented a method for counting and sizing microscopic particles suspended in a fluid?

Answer: Wallace C. Coulter

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