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Radiation from Granite: A Definitive Explanation

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by admin.

The "Straight Goods" On The "Radioactive Granite" Issue:

An Interview with Professor William Llope, PhD; Rice University, Houston, TX

Connor Ferster, Universal Slate: Hi Professor Llope, I am a salesman at a Canadian stone import company called Universal Slate Int'l and wanted to provide my interior designer clients with some legitimate 'hard-and-fast' information regarding the potential dangers of radon gas in granite counter-tops.

Professor William Llope: I very much appreciate that you are taking this with an open mind. There are some that claim that this is a "myth" or that this story is simply industrial subterfuge (re: granite vs "synthetic" countertop options). To be clear, I have no affiliation whatsoever with the granite industry, any competitors to granite, granite testing agencies, or any entity like this with some stake in this game. I am completely independent here, and am paying for this research out of my own pocket simply because I find it interesting. Now, the bottom line here is that, on average, the vast majority of granites are safe. This much is clear. But to say that *all* are perfectly safe is a more sweeping comment, and is one that I believe cannot be supported by experimental data.

The issue: Types of radiation

Connor Ferster: I found your name in reference to studies being done at Rice University on radon off-gassing in granite counter-tops in the The New York Times article, "What's Lurking In Your Countertop?" (July 24, 2008). The article stated that you were conducting studies on granite widely used in kitchen counter-tops, presumably on levels of radon gas emitted by such granites. You have also appeared on The Today Show on MSNBC in 2008 as an expert on this subject.

Professor Llope: Actually I'm concentrating on the direct radiation, although the radon emanation and the direct gamma radiation are typically correlated in the hottest stones. The (relatively rare) stones that are very hot in terms of the gamma radiation are typically relatively very hot because they contain elevated amounts of uranium ore or thorium-232. These admixtures of uranium or thorium can result in the emission of radon or thoron gas *and* gamma radiation.

The dangers of radiation

Connor Ferster: It seems that a lot of the press that I have read focusses more on the radon gas emissions and not direct gamma radiation. Would you say that one or the other is more of a concern? Can you give me an idea of the different dangers each one would pose and why?

Professor Llope: You have to distinguish between the radon emanation rate and the direct gamma emission rate; in the hottest stones, both can exist.

The radon is measured in terms of a concentration in air in units of pCi/L (picoCuries/Litre) – a la the 2-4 pCi/L EPA limits. Radon exposure is a risk to the lungs from inhaling radon-laden gas. You take in a breath, and during that breath, radon nuclei decay which shoots alpha particles into the soft tissue of your lungs. Over years, this can result in big damage, and in fact radon exposure is the second leading cause of lung cancer.

This same radon gas flowing around the outside of your body emits the same alpha particles, but these cannot pass through the dead layer of your skin called the epidermis. No damage.

On the other hand, the gamma and beta radiation that some emit in significant quantities are a "whole body dose". Your whole body is getting splashed with radiation. Much of it passes right through you. But some of it interacts inside you and hence deposits energy in cells, which can damage the cells and DNA and potentially lead to mutations (cancer).

This distinction between the health risks from radon and direct radiation is a huge source of confusion in the public.

The important thing to remember is that mitigation for radon involves air exchanges. i.e. open windows or forced ventilation of some kind. That exchanges radon-laden air (from one's basement or, in rare cases, their granite counter tops) with air from outside, which may have less radon in it.

There is no simple mitigation strategy if the counter tops are emitting significant quantities of direct radiation. Those gammas (and betas as well) are shining off the counters and can travel several 10's of feet before ranging out. The only mitigation there is to cover your counters with 6 inches of lead, or to limit the amount of time you spend in the kitchen. Neither are particularly attractive options obviously…

Debunking "the myths"

Connor Ferster: Through my own internet 'research' I've found what seems to be a lot of "pseudo-science" on the topic ('radioactive potatoes', etc.). My assumption from these videos would be that since all of these every day items emit radiation, the actual danger of radiation from granite is over-hyped. Can you comment on this?

Professor Llope: Radioactive potatoes, bananas, brazil nuts, etc are not "psuedoscience". These things do emit radiation in measurable quantities. I have taken "textbook" spectra from bananas for example. The data I get looks exactly like a Potassium-40 source should.

But, one needs a sense of scale. There is a natural background to the radiation that we receive every year, and foods like these *do* contribute to this natural background. We also receive natural background radiation from cosmic rays, from other building materials, from medical and dental x-rays, from radon from the ground in many locations, and so on. All of these sources are "known" and understood to be part of the natural radiation dose that we all receive every day of our lives. These sources are a fact of life on this planet.

This natural background level (360 mrem/year) varies by factors of 2-3 depending on one's location and lifestyle. Again, this is also well known. An airline pilot flying from New York to Los Angeles will accumulate an additional ~4 mrem, per trip, of absorbed radiation just from cosmic rays.

But, what we are talking about here are specific stones that can emit radiation at rates in "hotspots" that are factors of some *hundreds* above this natural background level. I have many stones for which there are large areas that emit radiation at rates that are ~10 times or more above that from the natural background.

Comparing these stones to bananas or potatoes is thus somewhat misleading. There are hugely different

scales in the two cases. Yes, both emit radiation, but to say that both can emit radiation at similar rates is not always true for specific stones. This is not to mention that one does not have *hundreds* of square feet of bananas surrounding them in their kitchens, like they do with their countertops. Again though, I need to stress that it is a relatively small fraction of the decorative stone out there that are very hot like this. The majority are quite quiet and emit radiation at rates that is a small fraction of the natural background. This majority should thus be considered "safe" in general.

Radon gas vs. Direct gamma rays

Connor Ferster: Given what you've told me, I can see how radon gas could be less of a threat to health and safety given the variety of mitigation methods available. I can also see how much more of a concern having direct gamma radiation would be for a consumer.

Professor Llope: I wouldn't really try to say one is more important than another. One at least needs to recognize that radon alone is not the whole story, nor is the radiation alone. I wouldn't want to see a prioritization of the concerns here just yet. At this point what consumers need is the straight facts on what is going on. Both issues "exist" however the relative importance of each depends on a whole lot of other factors and thus it will always be difficult to come up with some general rules that consumers can understand re: predicting whether the radiation or the radon or both is a concern for them.

"The Key Question"

Connor Ferster: Now, getting into the crux of the issue, with some of the hottest granites you have tested, what would you estimate would be the total absorbed radiation in mrem (in a month) if someone were to be touching the hot spot for 1 hour/day? I just want to get an idea of the scale of radiation absorption that could be possible with a hot granite in a residential setting. Would it be below the acceptable additional dosage of 100mrem above and beyond the normal 360mrem from background radiation?

Professor Llope: This *is* the key question! To answer it directly though, I'd be giving away the major result of the paper that I'm working on, and I don't want "to publish in a blog" – I hope you understand. Suffice it to say that there is indeed a non-zero correlation between the readings given by a geiger counter at the surface of the stone and the total absorbed dose of someone standing in a kitchen for a few hours a day… i.e. There is an effect here, and indeed a calculable dose that can be correlated with Geiger counter readings on the surface of the stone.

Proper detection measures

Connor Ferster: I was reading on your FAQ that a geiger counter, while it CAN be used to properly get a measure of the absolute amount of gamma radiation emitted from a sample, cannot be relied on (on its own) for a truly accurate measurement of absolute gamma levels.

Professor Llope: Correct. Geigers are 100% efficient (roughly) for beta particles because they are charged particles, but are only a few percent efficient for gammas. The Uranium ore and Thorium-232 in the hotter stones are primarily gamma emitters.

Connor Ferster: You mention to use a detector with a '2″ or 3″ deep NaI(Th) crystal', instead. What is this kind of detector specifically called?

Professor Llope: It's a detector with a Thallium-doped Sodium Iodide crystal. Basically, it is a 3″ diameter by 3″ depth crystal attached to a light detector called a photomultiplier tube. It is much more dense than a geiger counter so it has a much larger absolute efficiency for measuring gammas. This larger absolute efficiency means that it sees much closer to the total number of radiated particles than does a geiger counter.

Also, as opposed to a geiger counter (which just "counts"), the NaI crystal is "energy-resolved". i.e. I can collect an "energy spectrum" from each of my samples. These spectra have peaks in them that correspond to specific nuclear decays in the stone. I can thus measure directly how much 40-Potassium, Uranium ore, and 232-Thorium are in each stone. The energy resolution of NaI crystals is not spectacular, but it is good enough to determine how much of each of these three major decay series are in the stone.

Additional information sources

Connor Ferster: Whilst I am working in the stone industry, I don't feel like I can *entirely* trust information coming from the Marble Institute of America. I would much rather speak to an independent source. I don't think my customers would really trust me if I was just taking information from the Marble Institute of America, either.

Professor Llope: The more you know, the better prepared you will be to handle a customer's concerns. If you can give them well-informed answers, they will be more likely to do business with you. I can tell you that i have answered several thousand emails on this subject over the last year-plus. I always recommend simply asking the dealer for his/her opinions or their data, if available. If I've been told a dealer got upset by the question, or swept it under the rug as a "myth" or "junk science", I suggest to the consumer that they choose a more-informed dealer.I do not, in general, steer them away from granite. I simply steer them towards dealers that are willing to help consumers pick stones that *both* attractive and quiet. Again, the dangerous stones are relatively rare. The vast majority of trade names should be considered safe, all things considered. Just not *all* stones.
If people would like more information on this topic, then people can visit my FAQ on the issue.

Connor Ferster: Thanks for your time, Professor Llope! Please let us know when your study is published and we will link to it from here.

Professor Llope: The pleasure is mine. Thank you for the interesting discussion. Take care

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