



Episode 676 | September 23, 2022 | 12:00 PM EST

## R. Subramanian, PhD

An International IAQ Perspective & Low Cost Monitor Review

This week we welcomed Dr. R. Submaranian for his international perspective on IAQ and to discuss how to evaluate and use low cost sensors. Dr. R Submaranian is a mechanical engineer who does research in atmospheric chemistry and environmental science. His PhD is in Mechanical Engineering from Carnegie Mellon University in the IAQ Radio hometown of Pittsburgh, PA. Dr. Submaranian is currently working in Qatar and joins us from there today.

**Dr R Subramanian** (“Subu”) is a Senior Scientist at the Environment and Sustainability Center (ESC) of the Qatar Environment & Energy Research Institute (QEERI), where he leads QEERI’s research on sensors for air quality and climate, with applications in outdoor air quality monitoring and forecasting, IAQ management, and measurement of GHG emissions. He is also a research fellow at the Kigali Collaborative Research Centre (Rwanda) and an adjunct faculty member in the Department of Mechanical Engineering at Carnegie Mellon University (Pittsburgh, PA, USA).

His recent accomplishments include leading the development of the Real-time Affordable Multi-Pollutant (RAMP) monitor, co-leading the deployment of a 50 RAMP network in and around Pittsburgh, PA, and establishing the Africa qualité de l’air (AfriqAir) monitoring network in many cities across Sub-Saharan Africa. Currently, he leads the air quality checks program for the FIFA World Cup 2022.

### **Nuggets mined from today’s episode:**

***Is IAQ on the radar in Qatar?*** Yes, in Qatar due to desert climate; virtually 100% of the time is spent indoors. Qatar’s biggest export product is natural gas. Particulate matter is a primary pollutant. Particulate matter is generated by sand, vehicles, mass transit.

***Is the Mideast interested in reducing greenhouse gas emissions (GHG)?*** Yes, Qatar has and follows Environmental Sustainability Guidelines. Flaring is used to burn methane gas emissions; Qatar has reduced flaring 90%. Qatar is working on capturing methane. Green Building Council building certifications are available in Qatar.

***Is IAQ on the radar in Rwanda?*** In Rwanda, the health burden of pollution is split between indoor and outdoor pollution. The population cooks on wood or charcoal stoves. The government and Rwandan scientists are aware of the health risks of airborne particulate matter.

***How did you become interested in monitoring devices?*** Dr. Subramanian began researching air quality field in 2003 while at Carnegie Mellon University. At that time an ozone monitoring device cost \$10K and a small particle monitoring device <2.5PM cost \$20K-\$30K.

In 2013-2014 while again at Carnegie Mellon he was involved in a project to map air quality in and around Pittsburgh, PA. He needed to select between the two available options: mobile IAQ lab or dedicated monitoring sites. The mobile lab was able to monitor one site at a time. Because Pittsburgh has many hills and valleys; he knew that potentially 30-50 monitoring sites would be needed to obtain the needed data. He sought to use low-cost monitors which resulted in development of RAMP system (Realtime, Affordable, Multi-Pollutant) through a combination of industry and academia. SenSevere, LLC was the industry partner. Financial support for this program from the USEPA and the Heinz Endowment. The number of original monitoring sites has been scaled back to 30. He estimates that the RAMP system is in the \$4K range.

***How are airborne particles counted and what if anything effects their accuracy?*** Particles are counted with a light scattering device. High humidity can fool the device into overcounting.

***Do the terms precise and accurate mean the same thing?*** No, accurate refers to calibration. Precise refers to consistency 10 out of 10 sensors all read the same. Precise devices are useful in determining trends.

***Are you familiar with Linda Wigington and ROCIS (Reducing Outdoor Contaminants in Indoor Spaces)?*** Yes, he is familiar with Linda and the great work her organization does: raising awareness, providing training, guidance and contaminant reduction interventions.

***How did sensors get to be low cost?*** Market demand, competition, mass manufacturing, reproducibility and economies of scale have driven down sensor costs. The surge in low-cost sensor development is driven by sensors for HVAC which are precise and low-cost. Many sensors in the cost range between \$12-\$50

***Where are quality low cost sensors made?*** Quality low-cost sensors are made in: China, Switzerland, Germany, US, etc. Low-cost sensor manufacturers include: Honeywell, Bosch, Sensirion, Plantower, etc.

- Core sensor options include: Plantower and Sensirion
- The photo ion sensors in costly GC/Mass Spectrometers samplers cost around \$600.

***Is particulate air pollution geographically consistent?*** No, particulate air pollution can vary widely. It is recommended to calibrate sensors locally. Note: Plantower sensors are calibrated to a city in China not to cities in the US.

***Particle counter sensors may have significant deficiencies.*** Particle counters count small particles (1 micron) more accurately than larger particles (10 micron). High humidity causes sensors to overcount.

***You are leading the air quality checks program for the FIFA World Cup 2022. Is the interest in outdoor air or a combination of indoor and outdoor air?*** Interest in air quality at international sporting event is being driven by China's lack of air quality transparency during the recent Beijing Olympics.

***Is there a universally recognized standard or rating that we should be using?*** No, it's like the Wild West. 3<sup>rd</sup> party product certification is costly and may take 2-3 years. It's likely that the product would be outdated by the time it was certified.

<http://www.aqmd.gov/aq-spec> established the Air Quality Sensor Performance Evaluation Center (AQ-SPEC) program. The AQ-SPEC program aims at performing a thorough characterization of currently available "low-cost" sensors under ambient (field) and controlled (laboratory) conditions.

*Wildfires are a big problem in the US and in other countries. What role do you envision sensors having in post wildfire cleanup?* RAMP won the wildfire challenge. <https://www.epa.gov/sciencematters/wildland-fire-sensors-challenge-winners-provide-real-time-systems-measuring> Having sensors both indoors and outdoors can provide data on building envelope air leakage pathways.

*How often do sensors need to be cleaned and how are sensors cleaned?* Particle counting often last 3-5 years. Can be “air washed” with canned air. Recommends that low-cost sensors be considered disposable.

### Random Comments:

- Likes off the shelf products. When he finds a product he likes he'll buy several to evaluate preciseness.
- Recommends sensors be placed where there is free flowing air: in breathing zone, kitchens, HVAC air returns.
- Opined that the PurpleAir sensor is genius.
- Opined Particles Plus makes good particle counters.
- Opined TSI is the world leader in optical particle counters

### RoundUp

- Knowing is power
- Sensors will continue to improve
- Sensors make it easy for people to track pollution
- Know the limits of the sensor
- Dr. Submaranian shares his knowledge and interest in low-cost sensors on Twitter and is considering writing a book on the subject.

### *Z-Man signing off*

#### **TRIVIA:**

Name the company credited with developing the first portable device for sensing a toxic gas during mining operations?

Answer: Drager - No correct answers during the show