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ACGIH Bioaerosols Assessment and Control, 2nd edition; It's Here!

Good day and welcome to IAQ Radio+ episode 729 blog. This week we welcomed Tony Havics, Dr. Cheri Marcham, PhD and Jack Springston to talk about the newly released 2nd edition of the ACGIH Bioaerosols Assessment and Control book. The long-awaited update revises the 1999 version that made such a huge impact on the industry.

Tony Havics is an Honors graduate from Georgia Institute of Technology with a Bachelor's Degree in Mechanical Engineering. He is a Certified Industrial Hygienist (CIH), and a registered Professional Engineer (PE) with over 35 years of experience in environmental, health and safety, building science, and materials science consulting. He is a longtime friend of the show.

Dr. Cheri Marcham is an Associate Professor and Program Chair for the Master of Science in Occupational Safety Management degree program at Embry-Riddle Aeronautical University. She is a CIH, CSP, a CHMM, and a Fellow of AIHA. She holds a B.S. in Biology from Arizona State University, and an M.S. and Ph.D. from the University of Oklahoma Health Sciences Center Department of Occupational and Environmental Health.

Jack Springston has over 36 years' experience in industrial hygiene and occupational health. He has been a Certified Industrial Hygienist (CIH) since 1993, and is one of less than 50 active CIHs who also hold a sub-specialty certificate in Indoor Environmental Quality (IEQ). He has also been a Certified Safety Professional since 1999. Jack currently is a technical consultant and subject matter expert for Atlas Technical Consultants in New York City and Long Island.

Nuggets mined from today's episode:

Cheri: ***How did you get started in the industry?*** In 1989 she was working at the University of Oklahoma as their biosafety officer overseeing laboratory and responding to: mold, IAQ and lab exhaust and lab exhaust re-entrainment complaints.

Cheri: ***How did you get wrangled into this project and what obstacles did you encounter?*** The prior book was focused on mold and TB (tuberculosis). The world and our lives changed since then. In 2019, Don Weekes was recruiting volunteers to join the ACGIH Bioaerosols Committee to update the 1999 book due to emerging pathogens such as H1N1, Legionella, and SARS. She was elected chair of the reconvened committee. She served in that role for three years and then handed the reins over to Jack Springston. Don Weekes wrote both the introduction to the new book and the chapter on Writing a Sampling Plan.

Cheri: ***What's new and improved in the book?*** A chapter on respiratory protection and other PPE that was never addressed in the first book. A huge update to the endotoxins chapter. Information on cannabis allergens added by Dr. David Miller. A chapter on recombinant DNA and prions. A bioterrorism chapter. We combined Data Interpretation, Data Analysis, and Data Evaluation chapters into one chapter. The revision also includes information on recombinant DNA, algae, amoeba, mycotoxins, respiratory protection & PPE. A much more comprehensive chapter on Building Assessment written by Ian Cull. And, a much more comprehensive chapter on Developing a Sampling Plan by Don Weekes.

The common theme you will find throughout the book is that sampling is generally unnecessary (p. 104) and should only be performed if it will answer an unanswered question (a hypothesis). And if you do sample, you have to understand the temporal variability, spatial variability and analytical uncertainty, as well as the limitations of small sample sizes in the data interpretation. Data analysis is just a tool in the toolbox (p.216)

Tony: Everything in the book is referenced to a scholarly peer reviewed source. Chapter 4 has 400+ references. The book contains both classical and CFD (Computational Fluid Dynamics) equations including mixing approaches versus push/pull. Direct work with the flow. The 2nd edition includes working principle of ventilation and filtration, UV lamps, photocatalytic; bipolar devices are downplayed due to the lack of available data on efficacy antimicrobial surfaces, engineering controls, allergen control (e.g. dust mites, cockroach, and rodent) are also included

Jack, my favorite topic is remediation of microbial contamination. You were a big part of that chapter. What is new in remediation? Mold should be remediated with the same methods used for asbestos. An emphasis that antimicrobials are often an unnecessary addition to the environment. Collaboration with David Krause, PhD. Legionella, and the effect of pH on chlorine. Chlorine at pHs of 8 and above only tickle the bacteria and are not lethal to them. Verification and validation of mold and legionella.

Tony: Things changed, there is now more focus on the infectious aspects of viruses and other pathogens. The focus is not just on environmental exposure; occupational and public health exposures are also considered. Due to limitations of space a large number of references have been included for more information. The Assessment Chapter is very practical. Rather than functioning as an overview of issues, the book hits the key points and provides citations and references for those seeking background, foundational and supporting information. Hazard and risk assessment and characterization follows the National Academy of Science paradigm of -hazard identification, dose response, exposure assessment, and risk characterization. This is a good route to follow for the aerosol science of both infectious and non-infectious toxicology. Aerosol science is considered including the matchups: where does it go; how does it transport and what happens when in the lungs? How do aerosols deposit, the differences and endpoints. Contains equations such as the Wells-Riley model. [“...a simple model of the airborne transmission of infectious diseases, developed by William F. Wells and Richard L. Riley for tuberculosis and measles. Wells-Riley can also be applied to other diseases transmitted in the air, such as COVID-19.” Wikipedia] Quanta emission rate, what dose will cause a 63% infection rate in group, or what dose has a 63% chance of infecting an individual? Equations tie mathematically to: fate, time and distance, shielding on control side, susceptibility and other confounding issues of investigation.

Tony: Dr. Kornberg took information from Dr Franz’s bioterrorism book “Medical Aspects of Chemical and Biological Warfare” and made it more readable and understandable. Lisa Brosseau and company took “control banding” approach for selecting respiratory protection according to aerosol exposure used in Canada’s Respiratory Protection Standard. Hierarchy of Controls, bringing in “Matrices Control Banding”. There is a discussion of elastomeric versus filtering face pieces.

Jack: The revision of the prior book was a major struggle. There are people who like to talk and don’t do the writing and people who do the writing. There were people who agreed to write and then backed out. It was a scramble to try and develop and complete a chapter. The committee members were selected for chapter

development and chapter rewrites. From 1-6 authors worked on each chapter. Each chapter was reviewed by the entire committee and then voted upon. After committee approval, the chapter was sent on to the board.

Jack: *Which chapters are most important?* I would caution against saying which chapters are most important, since it really depends on what you are interested in learning about. The chapters by Ian and Don are certainly important and convey a lot of information, both are really geared towards mold/moisture investigations. That's not to say that some of the other chapters are also not mold-centric, seeing as that is still a hot, if not way over hyped, topic, but as Cheri noted, we really tried to not just focus on mold in this edition, particularly since we were going through the pandemic while we were doing the update.

In addition to the huge update to the endotoxins chapter, there was also a substantial update made to the fungal metabolites chapter. The original book had a chapter on just mVOCs, and limited information on other fungal metabolites was provided in certain other chapters. The mVOC chapter was discarded and Dr. David Miller wrote an entirely new chapter that covers not just fungal volatiles, but fungal glucans, low molecular weight secondary metabolites (e.g., mycotoxins), and antigens and allergens as well. He also wrote a chapter on miscellaneous biological allergens and irritants, such as cannabis pollen and dusts and rodent allergens in research laboratories.

Cheri: Too many of us tend to try and answer all the questions with an air sample, that is not the way to start an assessment. If and only if, we decide to sample, what is the sampling plan?

Cheri: *How did the medical community react to the need for respiratory protection?* The medical community was slow to accept airborne viral transmission. In 2015, the Chair of Pediatrics told me that he would never wear a respirator in front of his patients with infectious diseases. And of course, now we know he should have been wearing an N95 respirator.

Tony, the Sample Analysis chapter looks like it has a good bit of new information. PCR is more common today; microorganism classification and identification has changed over the last 25 years. What is important for our audience to understand about these two topics? The basis for determining what to look for are covered in chapters of the book (e.g. the unique specifics of an organism and sample analysis). There has been a shift from culturable analysis to non-culturable analysis, both the spore trap and PCR. Lacking commonalities of spore traps, biomarkers and ERMI cautions outside research settings because there are no good reference values. The intention was not

to replace the AIHA book, rather to supplement it. PCR helps identification, not quantitative common values (lab stuff). Provides different amino assay work: allergens (dust mite, cockroach allergen, etc.) and familiarizes readers with new technology.

Jack, you were part of the Prevention and Control chapter with Dr. Lstiburek. It's nice to see him contributing to this effort. What is different or expanded on in this edition?

Mold is the symptom of a Building Science related moisture problem. Joe Lstiburek, contributed his Building Science perspective to the Prevention & Control Chapter. The original chapter was hard to grasp. The new chapter expanded to include prevention of legionella in public water systems. Legionella cases are rising. It's probable that 90% of legionella disease cases are unreported or misdiagnosed as Covid or something else. New York City passed regulations that only focus on cooling towers. While cooling tower disease related cases are responsible for the largest clusters of disease, cooling tower service firms do their own testing and never find legionella. There is no 3rd party verification. 3rd party verification is needed to protect building owners.

Tony, would practitioners run into issues with Algae, Cyanobacteria and amoeba? Yes, it's possible. These organisms can be beneficial in biodiesel production or algae as food. These organisms can cause health problems (e.g. humidifier fever, eyewash station contamination, slime molds,

- Algae and cyanobacteria (also called blue-green algae) are plant-like organisms that live in water. They can quickly grow out of control, or "bloom." Some of these blooms produce toxins (poisons) that make people and animals sick.
- Amoeba- Cell or unicellular organism that uses pseudopodia for locomotion and feeding.

Cheri, why was info on Recombinant DNA and Prions included? [Recombinant DNA molecules are DNA molecules formed by laboratory methods of genetic recombination that bring together genetic material from multiple sources, creating sequences that would not otherwise be found in the genome. GMO foods are from recombinant DNA processes. Recombinant DNA are also used and found in research and pharmaceutical labs.

Vaccines can be made less hazardous with recombinant DNA. Insulin is made by placing the insulin gene into E. coli and then extracting the insulin and turning it into a medicine. Recombinant DNA is very useful in research. Studying the impact (e.g. health effects, transmissibility, outcomes) of modified genes on animals.

Prions are pathogenic misfolded proteins that cause normal variants of the same protein to misfold and trigger cellular death. Prions cause prion diseases known as transmissible spongiform encephalopathies that are transmissible, fatal neurodegenerative diseases (e.g. Creutzfeldt–Jakob disease) in humans and animals. Prions are not well understood.

Jack: Paraphrasing Dr. Jim Kornberg, who wrote the bioterrorism chapter, “when you hear hoofbeats think horses; don’t forget it could be a zebra.”

ROUNDUP

Cheri:

- 25 years ago, the focus of the Bioaerosols book was mold and TB.
- The biggest change to the book is recognition of the plethora of many more types of biological agents all around us.

Tony:

- A trivia note: this is actually the 3rd edition of the Bioaerosols book, the first book was looseleaf and had a different title.
- The new book is well written and along with the references bringing the information together.
- Information needs to be readable and understandable.
- Proposed endotoxin TLV 90 units per M³
- Need to realize the potential of glove related contamination while sampling for endotoxin
- Need to understand how sampling and analysis are done and work and the assumptions and limitations that come out of it.
- 1 sample or 1 spore, does not a statistic make.
- The growing need for more data.
- Forming the hypothesis is important; how important depends on the circumstances.
- Mold was insurance driven, now mold is public health driven.

Jack:

- Sampling for mycotoxins in the indoor environment are a waste of time and money.
- Concerned over the proliferation of 2-day so-called mold expert certifications.
- Mold isn't difficult to understand or remediate, you need to control the moisture.

Cheri:

- Having 35 authors is hard and akin to herding cats, that's why it took so long to complete the revision.

Jack:

- Sampling is not the way to go in mold remediation.
- An informed visual and olfactory inspection is the key.
- If you don't know how to interpret the samples, why are you taking them.

The opinions expressed by the program participants are solely their opinions and do not reflect the opinions of the AIHA.

Z-Man Signing Off

Trivia question:

Who was the editor of the first edition of the ACGIH Bioaerosols book?

Answer: Dr. Janet Macher