Our Past and our Future

By

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Measuring stack emissions has a long history. Our science, technology, needs, assumptions, and politics has dictated the directions we have gone. I will lay out the milestones of our past and look at why we went in our various directions. Then I will attempt to look into the future. The future can and probably will branch in several directions as it has in the past depending upon our future science, technology, needs, assumptions, and politics.

Our History

1717 Henri Pitot - Pitot Tube invented
1723 Stausscheibe - Type "S" Pitot Tube invented
1743 Bernoulli - The beginnings of the Pitot Tube equation as we know it.
1884 Ringelmann Chart – Patented
1884 Power Test Codes - first written
1887 Orsat Analyzer - First Patented
1904 W.B. Gregory -- The pitot tube
1920 WP 50 Isokinetic sampling concept
1922 L. Greenburg & G. W. Smith impinge
1936 ASME Power Test Codes
1940 British Standard 893:1940 -- Method of Testing Dust Extraction Plant and Emission of Solids from Chimneys
1941 ASME Power Test Code 21
1943 R. l. Beatty, L.B. Berger, & H.H. Schrenk -- PDS NOx Method
1945 Great Britain, Dept. of Scientific & Industrial Research, -- Methods for the Detection of Toxic Gasses in Industry
1949 M. B. Jacobs -- Analytical Chemistry of Industrial Poisons
1952 LA Methods Manual
1956 P. L. Magill, et al., -- Air Pollution Handbook
1955 Bureau of Mines Information Circular #7718 -- Ringelmann Smoke Chart
1957 ASME Power Test Code 27
1961 British Standard 3405:1961 -- Simplified Methods of Grit and Dust Emission from Chimneys
1966 Nomograph
1969 NSPS Methods 1-8

Our Present

1. We are hung up on our electronic gadgets and pretend they will solve our sampling problems. We are too ready to ignore our science when an instrument brings us ease of collection of apparent valid numbers. Example:
   EPA Method 7E, using chemiluminesent analyzers and cold traps, was a good compromise in the 1980's when the majority of the NOx was NO. Now we are seeing gas turbines with permit levels less then 10 ppmv @ 7% O2. The problem is that most of the NOx is now NO2

and there is NH3 in the gas stream as well. Chemiluminesent analyzers need to reduce the NO2 to NO and thus in order to analyze it. These reducers are slow and mostly ineffectual when they are needed the most. Also, NH3 interferes with this process. Adding to this problem is the notion that sonic dilution will remove the NO2 removal problem. Although this prevents NO2 loss it adds an unknown dilution error due to the inability to provide a known moist calibration gas. Each problem in itself is solvable but by the time we are finished we have a monster. What is needed is a fresh look at this problem instead of tenaciously holding on to the chemiluminesent analyzers.

2. We use the term CEM to mean to many things. CEM means continuous emission monitoring, CEMS means continuous emission monitoring systems, and instrumental methods are not CEM or CEMS. Instrumental methods such as EPA Methods 6C and 7E are referred to as CEMS. This confuses the novice as well as the professional.
3. We desperately want mercury and Dioxin/Furan CEMS and instrumental methods. For this we ignore the aerosol part of the emission and its spacial distribution and do not sample isokinetically and/or traverse.
4. It offends us that the Orsat, patented over 100 years ago, is still a better instrument then our electronic gadgets when correcting for diluant gasses.

If you think about it, the computer and electronics have reduced the stack sampler to a laborer dependent on instruments they cannot repair or repair in the field. The stack sampler has to carry or hoist the equipment to the site and install it. Then he must turn it on and off. No special skill is needed for this task. He must assume it works right and is in a proper application.

Accreditation

Accreditation Programs are a way to relieve anxiety about purchasing and reviewing data. It is also a way to take pressure off of the tester after he is accredited. The program should certify both the organisation and the onsite in-charge individual. Accreditation is not a substitute for audits, co-location, and quality checks. Accreditation programs do:

1. Keep out new guys.
2. Don't guarantee good data.
3. Assumes Accreditor knows better.
4. Make an entry hurdle.
5. Insure some knowledge.
6. Do not guarantee good decisions.
7. Do not guarantee good equipment.
8. Requires observation and review of reports.

Co-location

Co-location removes need for most observation and review requirements. Co-location is a method of evaluating the skill of the tester. EPA Method 18 now has co-location requirements. Cp-locations must have criteria such as for EPA Method 5:

1. ± 10% of the mean value for each run or ± 2.5 mg which ever is larger.
2. Must meet above two out of three runs. Answer will still be average of all three runs.
3. Analysis conducted by an analyst not financially connected to sampling company.
4. Assumes reproducibility equals accuracy. Must have good methods for this.
5. It requires all quality checks in order to be reproducible. (It is very hard to make the same error exactly the same each time.)

6. Integrity is still needed. Wrong nozzle sizes on both trains could still help give reproducible results. Later they could be changed to make it look as if they were correct.

It does:

1. Proves skill for each run. Even on bad day which accreditation does not.
2. Removes need to observe leak tests and other QA checks.
3. Still requires application knowledge that accreditation will help.

Our Future

We are at a crossroads. We can be slaves to instruments and instrument manufactures or we can be the masters. To be masters we require (and must demonstrate) skill. We must:

1. Prove our skill every time we sample.
2. Prove our application of instrument every time we sample.

Ways of doing this:

1. Demonstrate precision. Co-location on manual methods. Co-location of dissimilar instrumental methods or separate analysis and sample handling calibration or both. Prove spatial unimportance with instrumental methods.

2. Demonstrate accuracy. Audits on manual and instrumental methods. Dilution of calibration gasses exacerbates cylinder error.

Our future will have lots of instruments with lots of claims. We will either blindly believe the claims or find ways to prove each and every application. Our science is in this proof.