



Process Admissions Characterizations and Abatement System Evaluations

Bob Ridgeway

Welcome to another Podcast from Air Products.

Hello, I'm Ed McKendry and our topic today is Process Admissions Characterizations and Abatement System Evaluations and we're speaking with Bob Ridgeway who is a research associate with Air Products and has been with Air Products for 16 years. During that time Bob's career, he has been with electronics' customer applications group and he's worked in areas like semiconductor process admissions monitoring, process optimization, abatement system evaluations, and process characterizations. Bob was also a part of a team from Air Products who was honored in 2002 with the EPA Award in this area. Bob thanks a lot for being with us today. To get started, can you in general talk about the capabilities that Air Products has in this area?

Yes, Ed, back in the early to mid-1990s the semiconductor industry was faced with coming up with a method to quantify the PFCs or Perfluorinated Compounds that were coming out of their semiconductor processes. There was heightened interest in the intentional admissions of these molecules because they can act as global warming gases and they have extremely long atmospheric lifetimes. So in response to that Air Products developed some metrology, some analytical metrology, based on Fourier transform infrared spectroscopy and quadruple mass spectrometry to actually measure at the fabs while the customers were running these processes to measure what these emissions were. We then subsequently took that metrology that we developed and extended that to the next level of testing which would include evaluating some of the remediation systems that were put in place to abate some of these compounds, these PFCs as well as other compounds.

So we developed metrology to do scrubber and abatement testing and then this kind of snowballed into actually applying metrology to testing fab-wide (OK) systems for things such as hazardous air pollutants—the water scrubbers for those; for volatile organic compound systems—VOC emissions; also quantifying scrubber by-products such as NOX-type compounds—NO and NO₂.

So when Air Products goes into a customer location and does this type of testing, what kind of information are you providing to the customer at the end of that testing?

Well we could provide a whole host or range of information. The customers are primarily interested in the process gases that are consumed during the process, what fraction of a process gas is consumed, how much is coming out of the back end, what types of by-products are formed—then they can predict whether the by-products are going to be abated through their abatement systems or their house scrubbers. We can actually provide them with the quantitative value of emissions. For example, if it's a CF₄ based etch process we can tell them based on the metrology and the methodology, how many pounds of CF₄ are emitted per wafer. We can provide that information. We can also provide them with whether or not the abatement efficiency is hitting its targets. The abatement systems they put in place—the point of use abatement systems. We can provide them with that information. We can provide them with the performance of their fab-wide systems whether they're hitting targets.

So you go into a customers location, you do all this testing of many different testing points throughout their process, you then have some data that you share with the customer—what does the customer. . .what kind of things can they do with that data?

Well, the customers will take that type of information and they will create emissions models. Emissions models are pretty much fab encompassing. So for a given number of wafer starts per week or per month or whatever, a fab and the ES&H group within a fab can determine or predict what their typical emission levels are going to be.

They can also then knowing what comes out of the tools and then knowing how well their scrubbers are working, they can actually, pretty accurately predict what's potentially going to come out of their factory and this is very important information for the customers. A lot of times, from a compliance standpoint - local, regional, national compliance. There's also some voluntary programs within the industry such as the PFC Greenhouse Reduction Program. This allows customers to benchmark whether they're compliant with some of these programs.

Is this activity global?

Ed, this activity is global, particularly in the area of PFCs. There is an industry-wide consortium where a memorandum of understanding to help control PFC emissions to predetermine levels. So this is a global activity.

The information that you have available from these testing services - is it helpful to customers for newer technologies?

It can be very helpful to customers for newer technologies. As technology advances there are newer materials that are being brought into the fab and a lot time a typical question for the process group and the environmental group will be, how does this material behave in our chamber? What types of by-products are created? Is there any special abatement needs or any special considerations that we must take into account before we adopt this chemical? So we have worked with many customers in evaluating and assessing the potential environmental impact of newer chemistries. This could be very helpful because if abatement technology is needed and the chemical is process enabling, this will allow the customer to get the appropriate technology in place.

The customers are always trying to make their process more efficient. Can you talk a little bit about how this type of service and this type data can help make a process more efficient?

Sure, I believe that this program dovetails very nicely with our Chamber Clean Optimization Program in that a lot of times from emissions data a process engineer, facilities engineer can look at the data and say that, hey, perhaps we can optimize this process. If we're over etching for too long a period of time we can shorten the etch time or if we have a purge step that's involved we can shorten this purge time. This will allow us to improve the throughput of the process and will also allow us to reduce the amount of consumables.

This information can also be very helpful from the allocation of capital for abatement-type devices where if you have a whole host of processes you want to apply the abatement device in the processes where you get the biggest bang for your buck in terms of if you have a process that's emitting 10 times the amount of material versus another process certainly you want to put your abatement device on that process. It can also be helpful in looking at the operational efficiency of abatement devices. Perhaps you can run your burn box at a lower temperature and still get the same destruction or removal efficiency allowing you to save on natural gas costs or your wet scrubber can be operated at a lower blow down rate which is the liquid replacement rate which can save you on your acid waste neutralization costs. So there can be significant potential savings and optimization that goes along with this program.

So in general terms, how does the industry benefit from this type of service?

Back when we first embarked on this type of service, really there wasn't a lot of information available and no one was really aware, in the case of PFCs what their PFC emissions were. So in developing this metrology, we really have enabled the industry to go in and benchmark previous technologies. They're currently benchmarking emissions from current technologies and they'll be able to benchmark future technology emissions in addition to looking a new chemistries and looking at the potential environmental impact of new chemistries. So this metrology has provided the industry with a means to monitor and database what their emissions are and if they're achieving their compliance, their government compliance, and also their voluntary compliance in programs like the global warming gas production for PFCs.

If someone listening today wanted some more information, more detail on this topic, how can they get that?

They can contact me directly. My Air Products e-mail address is ridgewrg@airproducts.com or they can call me at 610-481-4436.

Once again for listeners, Bob's e-mail address is ridgewrg@airproducts.com and he has graciously given out his phone number here at 610-481-4436. We'd also like to continue to encourage you to visit airproducts.com/electronics to hear new Podcasts as they are posted. Bob thank you very much for your time today.

Thank you Ed.

Thank you for listening to this Air Products Podcast.