



# Acetylene and Acetylene Delivery System

**Tim Maykut, Business Development Manager**

*Welcome to another podcast from Air Products, I am Ed McKendry and today speaking with Tim Maykut. Tim is a Business Development Manager in our Electronics Division. Today's topic, we're talking about Acetylene, Acetylene material as well as an Acetylene Delivery System.*

*Tim, we'll jump right into the first question here, typically when we think of Acetylene, it's really associated with more industrial applications like welding and cutting, it's not something that we think of being used very much in the semiconductor industry, is that true?*

Yes, that's true. Industrial applications are the majority of the use for acetylene, electronics has started using it fairly recently and it's really a very small volume compared to other applications.

*Can you give us an overview of how acetylene is used in a semiconductor application?*

Sure, very briefly, acetylene is used to deposit an amorphous carbon film for high aspect ratio etching. This is sometimes called double patterning, what it does is extend the lithography capability of existing equipment. It allows our customers to use their existing photolithography for smaller geometries in their lithography and delay investment in new lithography equipment.

*Traditional industrial uses are so different, what are some of the challenges with the application of acetylene in a semiconductor process?*

There are many challenges, the biggest one is probably impurities and also consistency of the quality of the product. In applications like welding and cutting, customers are just burning the material so, if there are low levels of impurities, it really doesn't matter. However, low levels of impurities in a semiconductor application can affect the process itself. It'll affect how thick the film is that is deposited.

So, our applications have challenges to provide ppm-level impurities in the material, to have consistent quality, consistent level of impurities across all the batches that we create, throughout the cylinder. We also have different leak integrity requirements. Most of our customers put these into their fabs and systems that have gas detection that's at a much higher level than any of the industrial applications have. And also we have a unique supply chain. The usage pattern in the supply and demand cycle for semiconductor customers is very different from the industrial setting. And finally, there is an impurity that is inherent to the product itself. Acetylene, because it naturally wants to decompose, is packaged with a solvent. It's actually dissolved in the cylinder in either acetone or DMF. These solvents can be a problem in a semiconductor application. As you withdraw the acetylene from the cylinder, some of that solvent comes with a process gas. So, we need to find a way to remove that contaminant from the process gas stream.

*You've listed four or five different challenges there, how is Air Products addressing these challenges? What's the Air Products answer?*

We have several strategies to address these things. One, first starts with the product itself, our source of material. We are getting our material from a petrochemical source. Typically, there's two ways that people produce acetylene. One is a carbide process and one is a petrochemical process. The petrochemical process we have selected because it provides us a much more consistent product. We don't have the variability from batch to batch that you would get in the carbide

process. We've also, due to our familiarity and experience with electronics customers, have been able to transfer our procedures and protocol for handling acetylene and handling the packages into acetylene, just like we do for all our other materials. So, we address leak integrity and impurities and consistency in the product that way. We also have a lot of experience with supply chain. So, we have distribution networks in place, warehouses in place, and we're leveraging those to provide material in a timely manner to our semiconductor customers. And finally, to address the acetone or solvent withdraw problem, we have developed a proprietary delivery system that combines some existing pieces of equipment that customers are very familiar with but, the combination of them is unique and provides a material that is virtually acetone-free.

*Talk a little bit about that delivery system. What makes it different? What are the components of all that?*

There are three main components to the delivery system. The first is a Chiller. We use a chiller to reduce the temperature of the cylinder itself. We have a recirculating chiller with an insulated jacket that goes around the cylinder, we reduce the temperature of the cylinder, that reduces the vapor pressure of the acetone, which helps keep the acetone in the cylinder.

Then we have our standard gas cabinet and our GASGUARD® product line. Finally, we combine that with a purifier. So, the purifier provides final removal, final polishing of the product itself down to a consistent, stable, acetone level throughout the life of the cylinder.

*So, that consistency that you just mentioned is obviously, one of the benefits. Talk a little bit about the benefits of this delivery system for the customer, in their eyes.*

There are several benefits, consistency is one but cost is another. What happens now, because the acetone comes out with the product gas, with the acetylene, the way customers are managing that today is to reduce the amount of product they are withdrawing from the cylinder. So, in some cases, as little as 20% of the usable volume of acetylene in the cylinder is actually withdrawn to the process. Leaving approximately 80% of the acetylene in the cylinder. So, with our method we can use more of each cylinder. So it increases the cylinder utilization. So that's a cost of material benefit to the customer.

The other cost benefit is in labor. Because we're using more of the cylinder, there are less cylinder changes required, there's less labor required to support this materials delivery to their process.

From a consistency perspective, in addition to acetone coming out with the acetylene, there's a profile over the usable volume of the cylinder. The faster you withdraw, or the lower you get in the cylinder, the more acetone you get out per volume of acetylene. So with our product, you don't have that variability across the usable volume of the cylinder.

Our solution provides a consistent, stable acetone concentration nearly zero, less than 10ppm throughout the entire usable volume of the cylinder.

We also provide a safety benefit. Acetylene is inherently unstable, it wants to decompose, and our system monitors the cylinder pressure and provides delivery of the material in a safe way to the process.

*If you had, for our listeners really, what is the key message that you would like our listeners to take away from this discussion?*

Air Products' acetylene offering is a safe, low-cost solution to consistently provide quality acetylene to the carbon hard mask process.