# ASI TODAY

**A newsletter for customers of Analytical Sensors & Instruments Ltd.** **Fall 2007**


## Selecting the Proper pH Glass for your Application

The measurement of Hydrogen ions to maintain and control pH at the proper level is essential to every water use on the planet whether for lab measurements, process controls, environmental studies, or endless applications. In agriculture, proper pH of the soil ensures the good crop productivity and efficient use of fertilizers; for drinking water, municipal plants have to control pH in order to produce safe drinking water; in wastewater, pH is measured to ensure treatment is complete; in environmental studies, pH monitoring and control are critical to prevent damage or deterioration of the quality of all plant, animal and human life.

At ASI, we have been helping customers fine-tune their electrode to be the best possible choice for their application. To accomplish this, we consider the reference junction design and the body housing material, along with the shape, composition and construction of the glass sensor. In fact these design inputs together often make the difference between a measurement taking a few seconds, to a few minutes, or not at all!

To understand how differences in glass pH sensors impact performance, it is important to have a basic understanding of what makes a glass useful as a pH sensing glass. Of course, ASI has a number of trade secret methods, formulas, and manufacturing techniques that we hold closely – none of that will be revealed here!

The pH glass is similar to common glass (such as window glass) in that it is a silicate matrix based on molecular network of silicon dioxide ($SiO_2$) but differs from regular glass with its addition of other metal oxides, such as Na, K, Li, La, Al, B, Ca, etc. It is very different from the common glasses (often called "soda-lime glass" that comprises most manufactured glass) in that it has a layer that is called a hydration layer and an extremely high electric resistance (~50800 M ). Because of this electrically conductive layer and resistance, the pH glass can be used with a high impedance measuring device to make measurements. Adjusting the formula of the glass, its shape and thickness are ways to specialize its capability in targeted applications.

### *Typical Applications and their challenges*

The specific applications that cause analysts the most difficulty are often times those that require the best accuracy and precision, are typically in an expected and small range, and have interferences present. These applications typically require a fast response time due to the nature of the sample, number of samples, or frequency of the test.

### *Common Applications*

General Purpose Testing – General purpose, laboratory, and education are the most commonly used testing applications. Users would like a sensor that can be used in an pond one day and then in the classroom to measure a potable water sample the next. These users prefer to have a sensor that is full range, durable, accurate and not easily broken. ASI's Type V and VIII are excellent choices.

***Selecting*** *continued on page 2...*

## Chemist Corner

In this newsletter we are discussing the pH sensing glass and I thought I would share some of the technical aspects of our glass. The primary reason that our pH sensing glass performs according to specification and is so reproducible is due to the talents and abilities of our glassblowers in our glass shop. I am always impressed by the consistent and uniform products these five people produce. It takes a lot of training and dedication to do their job, but when I ask the people in the glass shop what they do during their work day they simply say that they blow bubbles all day long. It is more complicated as they have had years of training before they even made their first pH sensing bulb and their work is tested daily here at ASI before it reaches the customer.

As noted elsewhere in this issue and in our catalog we at ASI have five different types of pH sensing glass. Each type of sensing glass has a specific set of specifications that make them uniquely qualified for the application they were designed. Our Type II glass was one of our earliest sensing glasses. The Type III glass has the same range but it is shapeable so we can make a variety of designs with this glass. Type IV glass is a moderate range glass and Type V glass is our low ionic strength and low sodium error glass, perfect for water analysis. Type VIII glass is our most used glass and it has relatively low impedance making it good for some low ionic strength samples.

Coupled with our five sensing glasses we offer six different shapes of glass. We cannot make all of the shapes with all of the types of glasses so specific needs will need to be discussed with an ASI sales representative. The first shape is our Hemispherical (Hemi) bulb which is our traditional full bulb. We also offer a Flat bulb which is great for applications where the pH sensor must be cleaned. Our Convex (or Semi-Flat) bulb has a slight radius to the glass and is also useful in applications where the pH glass must be cleaned frequently. The Spear Tip is a sharp point of glass that is used for penetrating surfaces. This probe is used in the food industry to measure the pH of cheese and meats as well as other products. We also offer a Dome shape bulb that is usually used in industrial process sensor products. Our last shape is the Hard Dome which is a special dome shape made from a glass that can withstand extreme and harsh samples. The hard dome shape is usually used in applications where HF is being measured or there are particulates in the sample that could crack the pH sensing glass, although no glass can withstand impacts indefinitely or of a large magnitude.

***Chemist*** *continued on page 3...*

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***Selecting** continued from page 1...*

Environmental waters – Besides being durable, these sensors need to provide a fast response in cold, low-ionic strength water (needs low resistance) and other challenging samples. These users are much like general purpose users and the ASI's Type II, V, or VIII are excellent choices.

Wastewater and other dirty water samples - While reference junction design and maintenance protocols may be the more critical design inputs for this sample type, the glass sensor needs to be able to withstand frequent cleaning and be durable enough, and accurate enough to meet reporting and user expectations. ASI's Type III or V are excellent choices.

Industrial Applications – These samples vary tremendously but often require a durable glass that is free from interferences and hard enough to withstand abrasive or chemically etching environments. More specifics about the application are necessary to match the electrode to the sample challenges (e.g. HF presence, high temps, range).

Drinking water – While one of the most commonly tested water applications, this low ionic strength, sometimes combined with cold temperatures make this sample very difficult to test. In fact, this sample is known to be very reactive and unstable (even breathing on the sample can cause the pH to change due to absorption of $CO_2$). ASI's Type IV and Type V are good choices when combined with technique and storage protocols.

Ultrapure water – Like Drinking Water, this sample is very reactive and difficult to get a stable pH reading. ASI's Type IV and Type V are good choices when combined with technique and storage protocols.

## Glass Shapes

Glass formula is not the only glass property that should be considered in your application specific design. The shape of the glass can facilitate the measurement or long term durability of the sensor. In fact, formula and shape are often intertwined in that formula determines the shape-ability of the glass. As well, shape is a significant factor in impedance specifications. Some examples of glass shapes include:

*Hemi (Full) Bulb* – Common, sphere-like shape used in most applications. This design gives a consistent impedance and is reasonably durable. It is not as easily cleaned as other designs nor is it good for surface testing.

*Flat* – This very durable design is an excellent choice for surface testing like skin, foods, or films, or in dirty samples since it is easily cleaned. It also has merit in moving samples that contain abrasive materials since it can be positioned in a way that does not get damaged.

*Convex* – This semi-flat shape expands the capability of some glass formulas by allowing an easy-to-clean sensor with an easily formed shape.

*Spear-tip* – A specialized shape for penetrating fruits, cheeses, meat and other food samples. This is a durable design with good impedance capabilities and is easily cleaned.

*Dome tip* – A variation to the round bulb specifications and design are critical elements of an application-specific pH electrode.

As well, it is also important to consider the rest of the electrode design and the care, maintenance, and preparation of the electrode. Making the measurement once is good, but having a long life is a critical requirement for most users. ASI will provide future newsletter content elaborating on the importance of the following electrode design, care and preparation considerations.

## Other Application-Specific Influences

It is easy to see how the glass sensor specifications and design are critical elements of an application-specific pH electrode. As well, it is also important to consider the rest of the electrode design and the care, maintenance, and preparation of the electrode. Making the measurement once is good, but having a long life is a critical requirement for most users.

## Reference Junction

The reference junction can be the most important part of the electrode. Wastewater, industrial water, and other dirty water samples contain sulfides, heavy metals, and other elements that can quickly and irreversibly poison the reference junction of an electrode in as little as one measurement. Protecting the reference system is a critical design input that is accommodated by junction designs, other chemical barriers and other technologies.

Body material, fill solutions, cable specifications, sensor protection, and sensor size all play a part in the application specificity of your pH sensor.

| Type II | Type III | Type IV | Type V | Type VIII |
|---|---|---|---|---|
| 45 - 360MΩ | 200 - 600MΩ | 45 - 360MΩ | 20 - 315MΩ | 120 - 675MΩ |
| 0 - 12 pH | 0 - 12 pH | 0 - 13 pH | 0 - 13 pH | 0 - 14 pH |
| General Purpose | Penetration Apps | General Purpose | Self Cleaning | General Purpose |
| Low Ionic Strength | Rugged Surface | Low Impendance | Low Sodium Error | Full Range |

Hemi

Dome Spear

Hemi

Flat/Convex

Hemi Dome

# people propHiles

**Dr. Barone, Drew & Mrs. Money**
**ASI Laboratory**

The ASI Lab Research Team is currently made up of three hard working employees. They hope to add additional two members later this year. On any given day of the work week, they can be found making the many different types of solutions used for manufacturing, testing, and shipping all of ASI's electrodes. The Team is also responsible for creating and investigating different types of sensor-related solutions, testing techniques, and troubleshooting manufacturing or customer problems while still finding time to test new products and designs.

Dr. George C. Barone III, Ph.D., is ASI's Senior Research Chemist. George enjoys the diversity of the ASI staff and learning about different cultures. George is originally from Buffalo, NY. When not immersed in a new product investigation or troubleshooting a customer or manufacturing challenge, George is often seen drinking a mug of his favorite beverage - coffee!

Our Senior Lab Technician is Yongxuan Zhu (known at ASI as Drew). Drew is responsible for a number of regular QC and test plans and is originally from Sichuan, P.R. China. Besides the opportunity to help customers, Drew's favorite part of working at ASI is hearing the different languages and dialects spoken throughout the building. In his spare time, he enjoys reading and watching action movies.

XiuMing Gian (known as "Mrs. Money" at ASI) has been a Lab Technician at ASI for six years and has been involved in a number of new product investigations and QC reviews. She is originally from Shanghai, P.R. China. Her favorite Holiday to celebrate is the Chinese New Year. When she isn't ensuring the quality of ASI's sensor technologies, she enjoys spending time with her children.

# From the GP's Desk

***Peter Cai,*** GP & CFO

*Dear Customers & Friends:*

It has been over three months, since I wrote to you all last time. I would like to continuously give you most updated information on Aurora progress. In my last letter, I shared our workshop facilities improvement and production line layout improvement. Now our "Hardware" has been improved, and we are ready to create and implement a new "Software", i.e. a more effective quality control system for our production to enhance our productivity.

Recently, I hired a couple of highly experienced and well-trained total quality control managers to join Aurora. I am going to form a small team within Aurora with these managers to develop Aurora Business Management System. This system is focused on production effectiveness and total quality control. This team will study the current management system Aurora is using in our daily activities first. Then, they will analyze the pros and cons of our current system. After this analysis, they will find where we need the improvements, so that they could develop a new system. In doing so, they will also adopt good parts from ASI Business Management System and from other business management systems of some well managed large and well known companies. My plan is to have an organized system by the end of the year. The plan must be practical and easy to follow. Next year, we will be concentrating on the implementation of this system. In that phase, we will continuously improve Aurora. The whole purpose of doing so is to continuously improve our productivity and quality control.

ASI and Aurora both have achieved great successes in last 9 months this year. We will continue our efforts to secure a wonderful year for 2007 and years to come.

We highly praise our Lord for our success and may His blessing over all of us.

Thank you again.

Peter Cai

*Peter Cai*

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***Chemist*** *continued from page 1...*

George Barone, Ph.D.
Research Chemist

If five types of glass coupled with six shapes weren't enough choices, we also offer six different stem sizes. The stem is the term for the glass that the pH sensing glass is coupled with in order to make the sensor. The larger the size of the stem leads to a larger pH sensing bulb. The size of the pH sensing bulb is related to the impedance of the pH sensing glass which is important in the sensors ability to measure certain samples, like low ionic strength samples. We have stem sizes of: 0.015, 0.135, 0.195, 0.235, 0.310, and 0.325 inches. Which are 2.92, 3.43, 4.95, 5.97, 7.87, and 8.26 mm in the metric system.

Our lead glassblower makes all of our glasses from different chemicals. He weighs and mixes the different powders in crucibles and melts the powder into a glass at very high temperatures. This also takes skill and training to make the glass and to know when it is ready. Since each crucible must be heated and cooled many times the lifetime of these crucibles is relatively short. My input into this process was to design tests for the crucibles of glass. My group measures the pH glass from every crucible that ASI makes. We have a series of tests that total 13 different measurements on 11 different pH buffers and solutions. Then I review the results of the tests and carefully examine the slope, impedance, and the responses in certain key test solutions that we know will produce very high quality pH sensors. We do this to ensure the quality of the pH sensing glass is in your product even before we assemble the probe!

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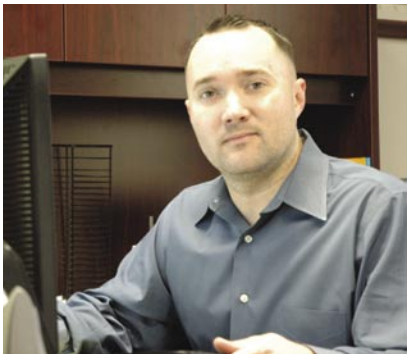
# From the President's Desk



***Brian Williams***
President & CEO

*Dear Customers & Friends:*

The Fall is an exciting time of year with leaves changing colors and Houston temperature finally falling out of the 90's! Along with that, school is back in session and my summer interns have departed. A special thanks to this years interns, Eva Boutemy and Spencer Mickum who helped out tremendously and learned first hand that work is really 'work"!.

ASI, I am happy to report, is doing very well this year and well on our way to finishing another highly successful year. Our gratitude goes out to our many customers who rely on ASI to not only be the technical resource in electrochemical sensor design, but also as trusted partners on their new product design teams. ASI values all of these relationships and if you have never worked with ASI on a new product design, you are missing one of our most important capabilities.

The ASI design team is headed by Steve Zelenak (VP Engineering) who has a couple of decades of electrochemical sensor design experience behind him, as well as a comprehensive team of design engineers, CAD designers, project managers and R&D production people that support this function at ASI. In addition to Steve, Dr. George Barone III supports our engineering design team with the chemistry side of the design. This includes new internal fill solutions, new ion selective membrane formulations, new reference electrolytes and comprehensive testing along the way to prove out each and every step.

This group of individuals works diligently each day on new product designs, product re-designs, and new application development. They are the backbone of our creative center at ASI and can deliver on each of your new products.

As the end of the year approaches, don't forget ASI on what you have planned for 2008!

One last house cleaning note, if you would like to have product shipped during the holiday break your purchasing agents should place their end of the year orders on or before December 7th .

Happy Thanksgiving,

Brian Williams