Gases – FAQ's answered

ENVIRONMENTAL ANALYSIS

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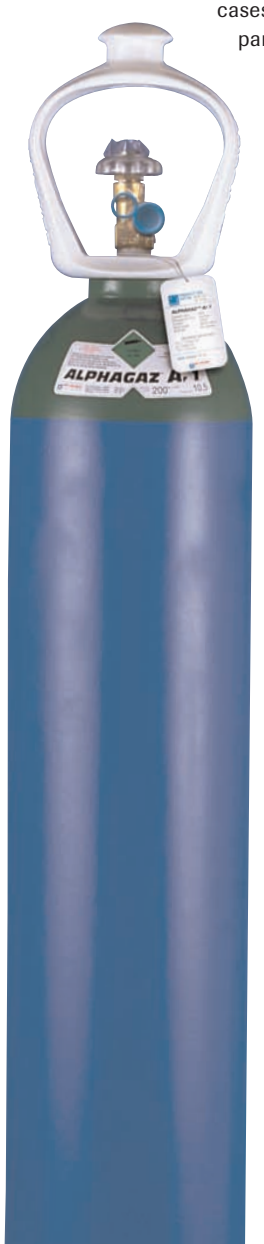
In many analytical operations a key focus is put onto the analytical equipment and the selection of the correct specification. In many cases a significant capital investment is required, so the focus is understandable, in the same way as when choosing a new car. For a car if you choose the wrong lubricants and fuel the results can be messy and expensive. The same can be said for gases which are essential to the smooth running of your analytical equipment. However there are a lot of cases where there are misunderstandings in terms of selection, handling and safe use and storage. In many cases the choices are made unconsciously – "we have always done it that way" – with the original decision maker and reasons lost in the mists of time. This article will look to address a number of frequently asked questions and misconceptions, which will hopefully make it easier for users of gases make an informed choice in their use of an important part of their day to day operations.

What Gases are Available?

The Air Liquide Encyclopaedia of Gases (Published by Elsevier Press) lists 138 pure gases. In addition to this for calibration requirements there are a myriad of different mixtures available, all developed for specific applications. Depending on the application some of these mixtures have limited shelf life and so may be mixed to order. For many analytical applications there are only 9 pure gases that are in common usage. These are Nitrogen; Hydrogen; Helium; Argon; Oxygen; Acetylene; Carbon Dioxide; Nitrous Oxide and Air (either compressed or Synthetic).
The one potentially confusing point here is that Air is not generally classed as a mixture but a pure gas. In all cases it is important to understand the properties of a gas, particularly in terms of flammability, toxicity, asphyxiation dangers and oxidising potential. In all cases it is essential to obtain a copy of the Material Safety Datasheet as part of the risk assessment on the use of a gas.



How Pure is a Pure Gas?

There is no standard (national or international) governing the definition of purity of gases. The only gases that have minimum specifications are pharmaceutical and medical grade products. From a recent assessment are over 20 different nomenclatures of grading of pure gases that could turn up in a laboratory. That is 20 per gas, and so potentially a selection of up to 200 products to choose from. Some of these are just numerically labelled, such as 5.0 or 99.999 and there is a further group, which have some sort of Brand name. The only common convention is that the purity is 100% less the sum of the impurities. Just because something is classed zero grade does not mean it will be the same as gas from another supplier even though it can have the same headline gas purity – because what is critical is the main impurities. For most analytical applications the key impurities are moisture, oxygen and hydrocarbons. In specifying a pure gas requirement it is therefore important not just to specify the overall purity but also set limits for these critical impurities.

What types of certification are available?

As standard most gases are sold against a sale specification. In many cases this will be not much more than the headline purity – for example 99.999% nitrogen. The next level of certification is a certificate of conformity (or C o C). This declares that the product supplied conforms to a specific product specification. Typically this will be managed by the gas supplier by taking a sample from a batch of cylinders filled at the same time. It is important to understand how the process of quality assurance is being achieved. The next level is a Certificate of Analysis (C o A) this is an actual analysis of the product being supplied. In addition to these forms of certification there are also other forms of certification for accredited mixtures. In UK accreditation is managed by UKAS but in fact there is a mutual recognition agreement on a European wide basis so Accredited mixtures from across Europe can be used.

What does Stability of a Gas Mixture Mean?

Most gases mixtures will be supplied with a stability period which is equivalent to the shelf life of that product from manufacture. This shelf life will depend upon the types of gases, the levels of key components and the uncertainty level on the mixture. Reasons for mixtures losing stability can be separation of components but in many cases it is related to adsorption or desorption of components onto and from the walls of the cylinders. Gas suppliers invest a significant amount of research into coatings for cylinders, preparation techniques and filling and analysis procedures. For some mixtures such as ppm levels of HF in Nitrogen it is an achievement to offer mixtures with a reliable 6 month shelf life. The shelf life is determined based on statistical analysis of measured stability of mixtures over the shelf life period and beyond. It is also important to note however that it is possible to give an apparently longer shelf life by relaxing the tolerance on the mixture components, i.e. the possible error bands on mixture accuracy. Therefore both components need to be considered when making a selection. Also it should be noted that if say a cylinder of gas is used in 6 months there is no benefit in purchasing say a mixture with a 3 year shelf life as opposed to 12 months.

On manufacturing a mixture it is important to ensure that on completion of filling that the mixture is stable. Therefore if the mixture is made to order then the delivery period should include sufficient period for the manufacturer to mix the product and then to allow a significant grace period to ensure that the mixture is stable before dispatch.

In what forms can Gases be Supplied?

For many applications the most appropriate form of delivery for high quality gas is a cylinder, particularly for mixtures. These are high pressure receptacles manufactured from steel, aluminium alloy or on occasion a composite material. Gases will typically be stored in the range of 100 to 200 bar, and on occasion up to 300 bar when full. Cylinders can also be supplied in multiple arrays on a pallet where all the cylinders are connected to a common manifold. This is termed a bundle or a bank of cylinders.

For larger flow requirements then some pure gases can be supplied in liquefied form. This would not work for mixtures as the liquefaction process would cause separation or preferential distillation of one component. Typically Nitrogen, Argon, Oxygen and Carbon Dioxide are available as liquefied gases – however it is again worth checking purity specifications and comparing them against those supplied in other forms. For operations that do not require a gas supply every day then a liquid supply is less appropriate as the liquid will tend to boil away as it will be stored as a cryogenic liquid in an insulated vessel.

The final alternative is to generate gases on site. This is most commonly seen for purified air, nitrogen, and hydrogen in the analytical environment. Again it is important to consider purity and pressure requirements when looking at a specification. If certification of purity required then this would also be a complicating issue. However for a steady demand this can be an attractive option. It is necessary to undertake a lot more evaluation work with this type of system to match the output of any unit to the demand. There is also a more significant initial investment however the long term savings can be very attractive. It is also possible to use cylinder supplies to cater for any peak demands or to act as a back up to the system in event of break down or maintenance.

What HSE guidance exists on handling and use of gases?

HSE has produce some guidance on cylinder gases but this is limited to a handful of documents and in the main the references it uses are documents and Codes of Practise produced by the Industrial Gas industry itself through the member association the BCGA – British Compressed Gas Association. (www.bcga.co.uk for list of publications). HSE is regularly involved in discussion with the BCGA and has the opportunity to comments on codes of practise.

How do I ensure my staff are handling cylinders correctly?

It is important to ensure that all staff involved with gases are properly trained and are aware of the hazards. Inadequate training and supervision is first on the list of causes of accidents relating to Gas Cylinders produced by the HSE. Many of the most common incidents relate to manual handling issues. Your supplier should be able to provide training and advice but as a starting point the BCGA have produced a free Technical Information sheet that can be downloaded from their website. TIS 12 (2005) provides some clear information for both yourself and your employees. For example if you have more than 5 employees in your organisation you should undertake a formal manual handling risk assessment. For more detailed information then Guidance Note – GN3, should be referred to. This is “Safe Cylinder Handling and the Application of the Manual Handling Regulations to Gas Cylinders”.

Are there any regulations or recommendations on correct storage of gases?

It is vital to segregate types of gases appropriately. Especially to ensure that oxidants and flammables are kept with suitable separation distances. There is a complete Guidance Note produced by the BCGA (and referenced by the HSE in their documentation on Gases) in relation to the “Guidance for the Storage of Gas Cylinders in the Workplace”. Whilst your gas supply can provide advice, the responsibility for ensuring safe implementation rests entirely with the user.

What should I do about a cylinder that has been sitting in the corner for years?

In general terms advice from the HSE on stock management is as follows. Gas cylinders should not be stored for excessive periods of time. Only purchase sufficient quantities of gas to cover short-term needs. Rotate stocks of gas cylinders to ensure first in is first used. There will of course be occasions where a particular product is taken for a project and may then sit unused for an extended period. In the first instance you should determine whether the product is past its stability period. If it is then it is not recommended to use it. If there is no medium term likelihood of use for that product then it may well make more economic sense to return the cylinder, as there is likely to be a monthly rental charge. It is also worth noting that cylinders have periodic test dates as they are pressure receptacles. The test date should be marked on the cylinder and all cylinders will have a test date ring. If in doubt note the colour and shape of the plastic ring at the cylinder neck and consult the supplier. It is not advisable to retain cylinders for extended periods beyond their test date.

Do I need to conduct any checks on pressure regulators?

It is recommended to tag pressure regulators and to keep a system logging when they were purchased and brought into service. For non corrosive gases then the Code of Practise relating to Pressure Systems, indicates that Pressure Regulators attached to cylinders or pressurised gas supply should be either replaced or refurbished every 5 years. If you are operating regulators with no logging system or record of inspection and refurbishment it is recommended to replace these regulators.

This is the first of two articles looking to address commonly arising questions. The second article will be timed to appear in conjunction with the MCERTS exhibition. If there are questions that are not addressed here and you feel that an answer would be of interest, please contact us and we will look to include the question and the response in the second article.