# purified laboratory water

mark bosley, technical director, highlights some of the considerations when specifying water purification equipment

# purified laboratory water

**Purified water has long been an essential raw material used in many laboratories, in sectors ranging from commercial research and design, to pathology and haematology laboratories in the public sector.**

Regardless of the application or the volume or quality of water required, there are certain critical factors that should be considered at the outset if water purification systems are to function at optimum performance and minimum cost.

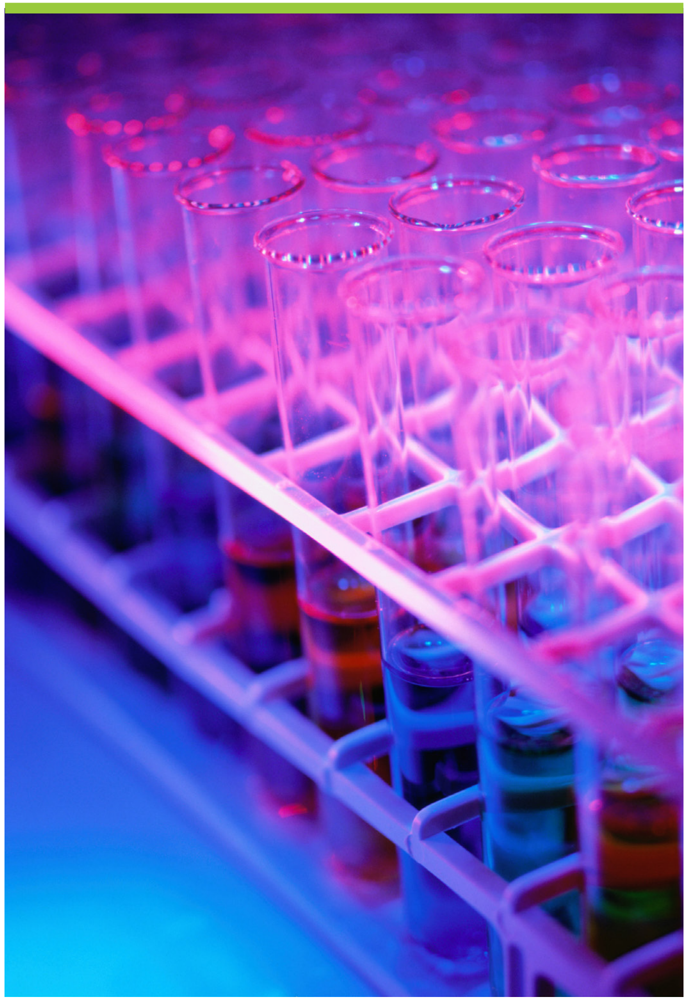
Before considering these factors, it is worth looking at the equipment available to comply with the current standard, BS EN ISO 3696:1995 'Water for analytical laboratory use'. This defines three grades of water purity, expressed in terms of conductivity. Grade 1 is the highest level of purity, 0.01mS/m (0.1µs/cm), with Grade 2 being 0.1mS/cm (1µs/cm), and Grade 3 at a level of, 0.5mS/m (5µs/cm).

Smaller laboratories often use bottled distilled water or on-site distillation units. Neither is a particularly efficient option, as bottled water has to be transported to site, increasing its carbon footprint, while the distillation process itself uses high levels of energy, with around 1kW of power being required for every litre of water produced. It is also relatively slow so it is difficult to produce water on demand, and can at best only produce water to Grade 2 standards, which limits its use to lower level duties. Distilled water also has to be used immediately or be carefully stored to ensure that it remains pure, as it can readily become contaminated with impurities such as atmospheric carbon dioxide that will affect certain laboratory procedures; stills used in hard water areas also require regular de-scaling and cleaning.

Disposable deionisation or ion exchange cartridges can offer an alternative to distillation stills. Cartridges can be connected directly to a mains water supply and produce purified water on demand. Flow rates are between 30 and 120 litres per hour, to Grade 1 or 2 standards, with units being easy to install as they require just a tap or stopcock and no electrical supply.

Each cartridge uses an intimate mixture of resins to remove anionic and cationic contaminants from the feedwater, exchanging them with active hydrogen and hydroxyl ions, which combine to form water molecules.

During usage, the capacity of the resin to exchange impurities and release active hydrogen and hydroxyl ions is gradually consumed with the resins changing colour as they become exhausted, to indicate when cartridges need changing.



# purified laboratory water


Disposable deionisation cartridges are a simple and cost effective method of producing purified water to a consistent quality whenever it is required and in low volumes. It should, however, be noted that they will only remove charged ions and can become fouled if the feedwater contains a large concentration of dissolved organic materials.

Where a large volume of water or high purity water is required then compact, self-contained reverse osmosis (RO) systems are ideal. These use a water supply fed under pressure into a module containing a semi-permeable membrane, which removes up to 98% of inorganic ions, plus virtually all colloids, micro-organisms, endotoxins and macromolecules.

A stand-alone RO unit can produce a level of purity that meets Grade 3 standards. For higher levels of purity, a combination of RO and deionisation is often used.
For Grade 1 water, the permeate is continually circulated and purified through the deionisation resin until the required level of purity is reached. Larger integrated systems can incorporate electro-deionisation system (EDi), for secondary purification when fed with permeate from the RO system, producing water with a quality of 10 to 15MΩ.cm, depending on flow rates and the quality of the feedwater.

Where Grade I water with enhanced microbial quality is required, the RO/deionised purified water is further processed using UV irradiation at 254nm and sub-micron filtration between 0.2 and 0.05 microns to remove bacteria and fine particulate matter.

Although selection of the deionisation cartridges is relatively straightforward, the specification of RO systems is slightly more complex to ensure that the optimum level of performance, energy efficiency and operating costs is achieved.

As most purification systems will have to comply with BS EN ISO 3696 and provide water on demand, wherever in the lab they are needed, the nature of the laboratory work may dictate that one or more self-contained units need to be positioned at different locations; alternatively, a centralised system feeding a ring-main may be required. With space being a valuable commodity in most laboratories, the chosen water purification solution needs to be as unobtrusive as possible while still delivering the required quantity and quality of water.

In addition, it is essential to consider the quality of water needed and if that quality is required throughout the laboratory, or if different levels of purity are needed in each work area. Similarly, the volume of water needed

# purified laboratory water

should be analysed based on the patterns of daily use, considering peaks and troughs in water requirements over extended periods. It should be remembered that, although an RO system may be able to deliver the total volume of water required over time, it may not be able to meet sudden surges in demand, so sufficient purified water storage facilities must also be considered.

Although a system needs to be able to deliver the required volume of purified water, it should not be oversized. Oversized systems require extra space, cost more and can suffer degraded performance as RO is potentially less efficient where the plant is only operational for short periods.

Likewise, diversity should be taken into account, with a realistic estimate being made of the number of take-off points that will be in use at any one time. If it is simply assumed that all points will be in use at once, the result can be a dramatically oversized system.

Depending on the nature of the raw water it may also be necessary to pre-treat the feed stream to protect the RO membrane, especially in areas where feedwater has high levels of organic contamination, hardness and Free Chlorine. Additional pre-treatment may, therefore, be necessary.

It is also important to consider the fact that all water purification systems require routine cleaning and maintenance to ensure consistent levels of performance and reliability.

The key is to choose a unit that is quick and easy to maintain with easy to change consumable parts. Similarly, the cost of consumables should be considered, as systems that use high volumes of resins, chemicals and cleaning solutions can quickly become uneconomical.

Ultimately, the same criteria applied to any high value item of laboratory equipment should be applied to the choice of a water purification system. In particular, choose a supplier who is willing to work with you on-site, helping you specify the best solution for your specific application, and who can offer ongoing technical support to ensure that your laboratory remains as productive as possible.

**It is essential to consider the quality of water needed and if that quality is required throughout the laboratory, or if different levels of purity are needed in each work area.**

## Contact

**Water Purification Systems**

**Email:** mail.waterpurificationsystems.uk@suez.com

**Web:** www.suezwatertechnologies.com