water purification for the laboratory

The latest Reverse Osmosis (RO) technology can help to improve water quality and laboratory productivity, provided that basic process and operating guidelines are followed.

SUEZ

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This paper offers advice on how to choose between stand alone and centralised systems and highlights the key issues that technicians and laboratory staff need to consider when choosing an appropriate system.

Reverse osmosis (RO) is a powerful method of producing purified water for a wide range of laboratory duties. Poor specification and incorrect maintenance procedures can significantly reduce the quality of output from reverse osmosis (RO) water purification systems. However, a well specified, well managed RO water purification system from a trusted and experienced supplier can deliver to the laboratory an efficient, economical and reliable supply to an exceptionally high level of purity.

Choosing, operating and maintaining an RO system should be straightforward. So what are the specific problems that prevent the best results from being achieved in the lab? In some cases, the specification fails to match the application, while in others it is simply that efficiently processed pure water is wrongly used.

A series of key issues need to be considered by technicians and laboratory staff when choosing an appropriate water purification system. Armed with this knowledge, the latest technology can then be specified to help to improve water quality and laboratory productivity.

Specification

Specification should begin with a consideration of the standardised grades of water purity, the available methods of delivering them and the requirements of the laboratory itself. This will ensure that any immediate and forthcoming needs are catered for and prevent any unnecessary expense further down the line that may be incurred by altering the design. Having established the level of purity required, you then need to assess the volume needed on a regular basis. This is followed by the decision as to whether to install centralised or stand-alone units and this will be dictated by the overall costs and the operational demands of each option.

Reverse osmosis

Reverse osmosis is capable of producing purified water, in large volumes, from a 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 organic macromolecules.

There are several grades of water purity, expressed in terms of conductivity, defined in the current standards as

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BS EN ISO 3696 or ASTM D1193-06 'Water for analytical laboratory use'.

ASTM Type 1 represents the highest level of purity at the maximum of 18.2 µs/cm, Type 3 (< 0.2 µs/cm), Type 2 (< 1 µs/cm) and Type 4 (< 5 µs/cm).

ISO Grade 1 (< 0.1µs/cm),Grade 2 (< 1µs/cm), and Grade 3 (<5µs/cm).

Deionisation

An excellent method of producing a Grade 1 supply is deionisation. Disposable deionisation or ion exchange cartridges can be connected directly to a mains water supply. Each cartridge uses a mixture of resins to remove anionic and cationic contaminants from the feed water, 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.

Some resin mixes are supplied with colour changing dyes to indicate when the cartridges need changing. So why use RO when deionisation is capable of delivering Grade 1 purified water? The answer brings us back to the points made earlier regarding specification. For example, deionisation can be uneconomical if the feed water contains a high level of dissolved solids and the demand for purified water is more than say 10 litres per day.

Combined efficiency

In some cases, the most efficient way to raise the level of purity is to apply a combination of reverse osmosis and deionisation. This uses the RO membrane to cope with the main purification process, and produces a pre-purified feed to the deioniser cartridge, allowing it to "polish" the water, further improving the quality and extending the life of the resin.

RO pre-treatment

Pre-treating of the feed supply is a mandatory requirement for all RO based systems and has an especially positive effect on efficiency where the feed water stream contains high levels of organic contamination, hardness and free chlorine. This 'pre-treatment' of the feed stream with a carbon filter has the added benefit of protecting and extending the life of the RO membranes.

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Stand-alone

Today's stand-alone water purification systems for laboratory applications come in a range of specifications. For example, SUEZ's Select family of products, comprising the Analyst, HP, Fusion and Neptune, provides a wide choice of options, with water purity up to 18.2 MΩ.cm at flow rates of up to 48 litres per hour. Typical usage ranges from humidification and hydroponics, reagent makeup and media preparation, to tissue culture, IVF, life science and molecular biology.

Centralised system

Despite the fact that pre-treated feed water processed by a stand-alone reverse osmosis water purification unit can achieve Grade 1 output, there are situations where it is more efficient and economical to install a centralised system. There are many benefits in specifying a centralised system that feeds a ring-main to supply a series of locations; not least that valuable space can be saved. Efficiency gains can also be achieved by integrating variable speed drives and thus preventing any unnecessary energy consumption from power-hungry pumps. Even the best water purification systems will only perform at their peak when supported by routine cleaning and maintenance, and so to maximise efficiency consider specifying equipment that is quick and easy to maintain with easy to change consumable parts. Similarly, the cost of consumables should be taken into account, as systems that use high volumes of resins, chemicals and cleaning solutions can quickly become uneconomical.

Regular quarterly cleaning of RO membranes is relatively straightforward and is typically carried out using specialised cleaning solutions such as SUEZ's range of ROclean chemicals. Acid based cleaners are used to remove scale, and alkaline based solutions to remove organic matter; if required, special chemicals can also be used for disinfecting, but should only be added once all scale and organic matter has been removed. Solutions are simply circulated through the RO system and then flushed to drain. There are clearly many factors to consider when specifying and installing water purification equipment, but the performance and successful operation of any RO system depends on the quality of the equipment and installation, and on the ability of the end user to monitor a number of simple, but nevertheless key, process parameters on a regular basis. However, by working with a supplier who is willing to assist you on-site and help you to specify the best solution for your needs, your efforts will be rewarded with the most efficient, economical and reliable supply of purified water for your specific laboratory needs.

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