Application Bulletin
DEIONIZED WATER

Years ago, high purity water was used only in limited applications. Today, deionized (DI) water has become an essential ingredient in hundreds of applications including: medical, laboratory, pharmaceutical, cosmetics, electronics manufacturing, food processing, plating, countless industrial processes, and even the final rinse at the local car wash.

THE DEIONIZATION PROCESS

The vast majority of dissolved impurities in modern water supplies are ions such as calcium, sodium, chlorides, etc. The deionization process removes ions from water via ion exchange. Positively charged ions (cations) and negatively charged ions (anions) are exchanged for hydrogen (H^+) and hydroxyl (OH^-) ions, respectively, due to the resin's greater affinity for other ions. The ion exchange process occurs on the binding sites of the resin beads. Once depleted of exchange capacity, the resin bed is regenerated with concentrated acid and caustic which strips away accumulated ions through physical displacement, leaving hydrogen or hydroxyl ions in their place.

DEIONIZER TYPES

Deionizers exist in four basic forms: disposable cartridges, portable exchange tanks, automatic units, and continuous units. A two-bed system employs separate cation and anion resin beds. Mixed-bed deionizers utilize both resins in the same vessel. The highest quality water is produced by mixed-bed deionizers, while two-bed deionizers have a larger capacity. Continuous deionizers, mainly used in labs for polishing, do not require regeneration.

TESTING DI WATER QUALITY

Water quality from deionizers varies with the type of resins used, feed water quality, flow, efficiency of regeneration, remaining capacity, etc. Because of these variables, it is critical in many DI water applications to know the precise quality. Resistivity/conductivity is the most convenient method for testing DI water quality. Deionized pure water is a poor electrical conductor, having a resistivity of 18.2 million ohm-cm (18.2 megohm) and conductivity of 0.055 microsiemens. It is the amount of ionized substances (or salts) dissolved in the water which determines water's ability to conduct electricity. Therefore, resistivity and its inverse, conductivity, are good general purpose quality parameters.

Because temperature dramatically affects the conductivity of water, conductivity measurements are internationally referenced to 25°C to allow for comparisons of different samples. With typical water supplies, temperature changes the conductivity an average of 2%/°C, which is relatively easy to compensate. Deionized water, however, is much more challenging to accurately measure since temperature effects can approach 10%/°C! Accurate automatic temperature compensation, therefore, is the "heart' of any respectable instrument.

RECOMMENDED INSTRUMENTATION

Portable instruments are typically used to measure DI water quality at points of use, pinpoint problems in a DI system confirm monitor readings, and test the feed water to the system. The handheld Myron L® Company instruments have been the first choice of DI water professionals for many years. For two-bed DI systems, there are several usable models with displays in either microsiemens or ppm (parts per million) of total dissolved solids. The most versatile instruments for DI water is the 4P or 6PFC^E Ultrameter II™, which can measure both ultrapure mixed-bed quality water and unpurified water. It should be noted that once DI water leaves the piping, its resistivity will drop because the water absorbs dissolved carbon dioxide from the air. Measuring of ultrapure water with a hand-held instrument requires not only the right instrument, but the right technique to obtain accurate, repeatable readings. Myron L® Company instruments offer the accuracy and precision necessary for ultrapure water measurements.

In-line Monitor/controllers are generally used in the more demanding DI water applications. Increased accuracy is realized since the degrading effect of carbon dioxide on high purity water is avoided by use of an in-line sensor (cell). This same degradation of ultrapure water is the reason there are no resistivity calibration standard solutions (as with conductivity instruments). Electronic sensor substitutes are normally used to calibrate resistivity Monitor/controllers.

Myron L® Company manufactures a variety of in-line instruments, including resistivity Monitor/controllers which are designed specifically for DI water. Seven resistivity ranges are available to suit any DI water application: 0-20 megohm, 0-10 megohm, 0-5 megohm, 0-2 megohm, 0-1 megohm, 0-500 kilohm, and 0-200 kilohm. Temperature compensation is automatic and achieved via a dual thermistor circuit. Monitor/controller models contain an internal adjustable set point, Piezo alarm connectors and a heavy-duty 10 amp relay circuit which can be used to control an alarm, valves, pump, etc. Available options include 4-20 milliamp output, 3 sensor input, 3 range capability and temperature. Internal electronic sensor substitutes are standard on all Monitor/controllers.

Sensors are available constructed in either 316 stainless steel or titanium. All sensors are provided with a 3/4" MNPT polypropylene bushing and 10 ft./3 meters of cable. Optional PVDF or stainless steel bushings can be ordered, as well as longer cable lengths up to 100 ft./30 meters.

The following table briefly covers Myron L® Company instruments for DI water applications. For details and recommendations, please refer to Myron L data sheets, visit our website (www.myronl.com), or contact us by phone, fax, or email (sales@myronl.com).

DI SYSTEM	WATER QUALITY	HANDHELD INSTRUMENTS			RESISTIVITY MONITOR/CONTROLLERS			CONDUCTIVITY MONITOR/CONTROLLERS		
		Model	Display	Readout	Model	Display	Readout	Model	Display	Readout
Two Bed, Weak Base Anion	20,000-50,000 ohms (50-20 µS)	6PIIFC^{E} 4PII 9PTKA PT1 EP EP-10 532M1	digital digital digital digital analog analog analog	kilohm kilohm kilohm µS µM/MΩ µM µM	752II-17 753II-17	analog digital	kilohm kilohm	756II-111 757II-111	analog analog	µS µS
Two Bed Strong Base Anion	50,000-200,000 ohms (20-5 µS)	6PIIFC^{E} 4PII 9PTKA PT1 EP EP-10 532M1	digital digital digital digital analog analog analog	kilohm kilohm kilohm µS µM/MΩ µM µM	752II-17 753II-17	analog digital	kilohm kilohm	756II-109 757II-109 758II-109	analog digital digital	µS µS µS
	0.05-2.0 megohm (20-0.5 µS)	6PIIFC^{E} 4PII EP	digital digital analog	µS/MΩ µS/MΩ µM/MΩ	752II-14 753II-14	analog digital	megohm megohm	756II-109 757II-109 758II-109	analog digital digital	µS µS µS
Mixed Bed	1-18.23 megohm (1-0.055 µS)	6PIIFC^{E} 4PII EP	digital digital analog	µS/MΩ µS/MΩ µM/MΩ	752II-11 753II-11	analog digital	megohm megohm	756II-101 757II-101 758II-101	analog digital digital	µS µS µS

RESISTIVITY VS. CONDUCTIVITY

18.2 megohm	10 megohm	5 megohm	1 megohm	100,000 ohms	10,000 ohms	1,000 ohms	100 ohms	20 ohms	10 ohms	1 ohms
ULTRA PURE	PURE WATER	PURE WATER			CITY SUPPLIES		SEA WATER			
0.055 µsiemens	0.1 µsiemens	0.2 µsiemens	1 µsiemens	10 µsiemens	100 µsiemens	1,000 µsiemens	10,000 µsiemens	50,000 µsiemens	100,000 µsiemens	1 mho

USEFUL CONVERSIONS

$$\frac{1}{\text{megohm}} = \text{microsiemens (micromho)} \qquad \frac{1}{\text{microsiemens (micromho)}} = \text{megohm}$$

Examples: 1 micromho (µmho) = 1 microsiemen (µS); 0.5 microsiemens = 2 megohms (2,000,000 ohms)
200 kilohm (200,000 ohms) = 0.2 megohm = 5 microsiemens

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Built On Trust. Founded in 1957, the Myron L® Company is one of the world's leading manufacturers of water quality instruments. Because of our commitment to product improvement, changes in design and specifications are possible. You have our assurance any changes will be guided by our product philosophy: accuracy, reliability, and simplicity.

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