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THEMATIC REPORT 10

China Laboratory Pure Water Equipment Industry

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1. Overview of Laboratory Pure Water Equipment industry

1.1. Definition of Laboratory Pure Water Equipment industry

Laboratory pure water equipment is a kind of water treatment device used to remove from water solid impurities, salt ions, and bacterial viruses, just to name a few. The removal is possible, for example, through filtration, reverse osmosis, electrodialysis, ion exchanger, and ultraviolet sterilization. These processes are used in preparation of industrial and laboratory ultra-pure water. The laboratory pure water equipment industry described in this report includes both industrial ultra-pure water equipment and laboratory ultra-pure water equipment.

Industrial ultra-pure water equipment	Used for the preparation of industrial ultra-pure water, usually with a large volume, and most of which have a water output of 1-20 tons/hour.
Laboratory ultra-pure water equipment	Used in medical, scientific research and other fields, with a relatively small volume, most of which have a water output of about 2L/min.
Laboratory pure water equipment (ultra-pure water equipment)	Includes both industrial ultra-pure water equipment and laboratory ultra-pure water equipment.

Table 1 Classification of Laboratory Pure Water Equipment (Ultra-Pure Water Equipment).
Data source: GEP Research.

1.2. Common Water Pollutants and Detection Methods

The raw water (tap water) mainly contains five types of impurities. These are electrolytes, organic substances, particulate matters, bacteria and microorganisms, and dissolved gases.

1.2.1. Electrolytes

Electrolytes refer to substances existing in an ionic state in water. They include soluble inorganic substances, organic substances and charged colloid ions. Among them, the cations include H+, Na+, K+, Ca2+, Mg2+, Cu2+, etc., while the anions include Cl-, NO3-, HCO3-, HSiO3-. Charged colloidal particles include iron, silicon, aluminum compounds and organic colloidal compounds. In addition, they also include organic acid ions. Since electrolytes are conductive, it would be possible to detect this kind of impurities through measuring the resistivity (MΩ.cm) or conductivity (μs/cm) of water.

1.2.2. Organic Substances

Organic substances in water mainly refer to natural-occurring and synthetic organic substances, such as organic acids and organic metal compounds. This kind of substances are bulky and often exist in negative or neutral state. The content is usually measured with a total organic carbon analyser.

1.2.3. Particulate Matters

The particulate matters in water include sand, dust, organic matters, microorganisms, colloids particles, to name a few. Particulate matters are insoluble and are generally detected with SDI instrument.

1.2.4. Bacteria and Microorganisms

The bacteria and microorganisms in water include bacteria, algae and fungi. They could be measured through culture method or membrane filtration method.

1.2.5. Dissolved Gases

The dissolved gases in water include, for example, N2, O2, Cl2, H2O, CO, CO2, and CH4. They could be measured through gas chromatography, liquid chromatography and chemical methods.

1.3. Laboratory Pure Water Preparation Technology

There are many water quality purification methods, among which are distillation, ion exchange, continuous electrodeionization (EDI), reverse osmosis, ultrafiltration, membrane filtration, activated carbon filtration, and UV light irradiation. In the actual application process, it is possible to adopt one or more purification methods according to the specific project and water quality requirements.

No.	Equipment	Use
1	Integrated PPF precision filter element	Filters sediment and particulate matters
2	Integrated activated carbon filter element	Adsorbs organic matters and residual chlorine
3	Reverse osmosis membrane device	Implements the first desalination step and remove bacteria and organic matters in tap water
4	Pressure pure water bucket	Stores reverse-osmosis pure water, while providing water extraction power
5	Ion exchange column	Implements the second desalination step, with a resistivity of more than 10 MΩ
6	Nuclear-grade ultra-purification column	The third deep desalination step, with a resistivity of more than 18.2 MΩ
7	Terminal 1 micron microporous filtration	Filters fine particulate matters
8	0.45 + 0.2 micron pore-size ultimate filter dedicated for ultra-pure water (optional)	Removes bacteria and impurities
9	Other electronic components	Provides various control functions

Table 2 Standard Configuration of Ultra-Pure Water Equipment.
Data source: GEP Research.

2. Standards and Policies for Laboratory Pure Water

Different laboratories have different requirements with regards to the quality of pure water, and many international organizations, including ASTM, NCCLS, CAP, USP, have issued their own standards and guidelines for pure water quality. In the tables below, the mainstream standards for water quality classification are presented.

Project	Grade III	Grade II	Grade I
Resistivity (MΩ·cm)	> 0.05	> 1.0	> 18.0
TOC (μg/L)	< 200	< 50	< 10
Microbes (cfu/ml)	< 1000	< 100	< 1
Soluble silicon (mg/L)	< 1	< 0.1	< 0.01

Table 3 Water Quality Standards for Pure Water (Grade I water is ultra-pure water).
Data source: Grade I water is ultra-pure water.

	Technical Indicator and Unit	GB/T6682-2008	IS03696；1995	ASTM D1193-99
Grade I Water	pH value (25 ℃)	—	—	—
	Conductivity (μS/cm, 25 ℃)	≤0.1	0.1	0.056
	Impedance (MΩ·cm, 25 ℃)	>10	_	18
	Absorbance (254nm, 1cm optical path)	≤0.01	0.01	_
	Total organic carbon (TOC) (μg/L)	_	_	50
	Soluble silicon (Sio2, mg/L)	≤0.01	0.01	0.003
Grade II Water	pH value (25 ℃)	_	_	_
	Conductivity (μS/cm, 25 ℃)	≤1	1	1
	Impedance (MΩ·cm, 25 ℃)	>1	-	1
	Absorbance (254nm, 1cm optical path)	≤0.01	0.01	-
	Total organic carbon (TOC) (μg/L)	-	-	50
	Soluble silicon (Sio2, mg/L)	≤0.02	0.02	0.003
Grade III Water	pH value (25 ℃)	5.0-7.5	5.0-7.5	-
	Conductivity (μS/cm, 25 ℃)	≤5	5	0.25
	Impedance (MΩ·cm, 25 ℃)	>0.2	-	4

	Absorbance (254nm, 1cm optical path)	-	-	-
	Total organic carbon (TOC) (μg/L)	-	-	200
	Soluble silicon (Sio2, mg/L)	-	-	0.5

Table 4 Laboratory Pure Water Standards and Main Technical Indicators Issued by International Organizations.
Data source: GEP Research.

3. Demand Analysis and Prospect Forecast of the Laboratory Pure Water Equipment Industry in China

3.1. Market Capacity and Market Penetration Rate of the Laboratory Pure Water Equipment Industry

In 2018, the market scale of the laboratory pure water equipment in China (ultra-pure water equipment) was about RMB 1.5 billion. With the development of the electronics industry in China, the laboratory pure water equipment (ultra-pure water equipment) industry would usher in a period of rapid development. It is expected that, by 2020, the market scale of the laboratory pure water equipment (ultra-pure water equipment) market would reach RMB 2.1 billion, at an annual compound growth rate of about 18% from 2018 to 2020. On a global scale, the Asia-Pacific region is the largest application market of the laboratory pure water equipment (ultra-pure water equipment). It is then followed by North America and Europe.

The market scale of industrial ultra-pure water equipment market is more than RMB 1 billion per year. The compound growth rate is estimated to be of about 20% in the next two years. It will affect mainly the electronics industry, especially the semiconductor chip manufacturing process. In addition, other industries, such as the photovoltaic, electroplating, and optoelectronic, will also have higher demand for industrial ultra-pure water equipment.

The laboratory ultra-pure water equipment has a market scale of several hundred million yuan per year. It is mainly used in the medical, electronics, and environmental fields, and is expected to have an annual compound growth rate of about 15% in the next two years. In the medical industry, the aggregate demand from general hospitals at or above grade II, specialized hospitals, traditional Chinese hospitals and disease prevention and control centers is above several hundred million yuan per year. Medical laboratories (medical colleges at universities, research institutes, pharmaceutical companies, etc.) only have small demands for laboratory ultra-pure water equipment. In addition, the electronics research institutes and electronics industry, including universities, company-related research, and development laboratories, also have small demand for laboratory ultra-pure water equipment. Other fields including environment, materials, agriculture, food safety, etc. have an aggregate demand for laboratory ultra-pure water equipment of about several hundred million yuan per year.

3.2. Analysis of Import and Export Situation

From 2016 to 2018, the import volume of the laboratory pure water equipment (ultra-pure water equipment) in China was not large, with a stable proportion of import structure per year, i.e., 60% in the electronics industry, 20% in the medical industry and 20% in other industries. The import structure ratio is calculated by first dividing the import amount of certain industry by the total import amount, and then by multiplying the result of the division by one hundred percent.

The import units of industrial ultra-pure water equipment are mainly semiconductor and liquid crystal

manufacturing companies in the electronics industry. The import units of laboratory ultra-pure water equipment are mainly medical units and various research laboratories. Ultra-pure water equipment are usually imported and sold by the branch offices of foreign-funded companies or trading companies.

Japanese and American companies mainly provide industrial ultra-pure water equipment. The water output of mainstream equipment is 1-20 tons per hour. They mainly supply laboratory ultra-pure water equipment enterprises. The water output of mainstream equipment is 1-3 L/min.

3.3. Driving Factors for Industrial Development

Industrial ultra-pure water equipment is mainly applied in the electronics field, especially the chip-manufacturing in the semiconductor industry. At present, China is vigorously developing its domestic chip manufacturing industry. In 2018, the market scale of the chip manufacturing industry in China was about USD 17.5 billion, at a year-on-year growth rate of 35%. It is expected that the ultra-pure water demands in the electronics industry would further increase in the future.

Laboratory ultra-pure water equipment is mainly applied in the medical, environmental, and electronic fields. The medical industry maintains rigid demands for ultra-pure water equipment mainly because of newly built hospitals and the increased internal penetration rate of the industry. With a gradual increase of the investments in the electronics field, especially the semiconductor field, the research investment of various companies would increase accordingly. It would further drive the increase in the demand for laboratory ultra-pure water equipment. In recent years, as China has put more and more emphasis on environmental protection, the penetration rate of ultra-pure water equipment in various environmental monitoring stations and environmental laboratories has also gradually increased. Furthermore, many fields such as those regarding agriculture, materials, and food, have demand for laboratory ultra-pure water equipment. It is estimated that the growth rate of the market scale of laboratory ultra-pure water equipment would reach around 15% in the next three years.

4. Analysis of Supply and Competition in the Laboratory Pure Water Equipment Industry in China

4.1. Analysis of Supply Quantity and Scale of the Laboratory Pure Water Industry

In recent years, with the rapid development of many industries in China, such as the electronics, pharmaceutical, and biological ones, the demand for laboratory pure water equipment (ultra-pure water equipment) have expanded continuously. As of the end of 2018, about 50 ultra-pure water equipment manufacturers have been announced with large market space but fierce competition.

Industrial ultra-pure water equipment mainly relies on import. In 2018, the total value of the industrial ultra-pure water equipment market exceeded RMB 1 billion. The United States and Japan are among the main importing sources.

In 2018, the scale of laboratory ultra-pure water equipment market was worth several hundred million yuan, of which half accounted for imported equipment. Most Chinese enterprises are concentrated in the laboratory ultra-pure water equipment market, with fierce competition.

4.2. Market Share of Key Enterprises in the Laboratory Pure Water Equipment and Industrial Concentration Ratio

Industrial ultra-pure water equipment mainly relies on import. Most of the equipment is imported from Japanese and American enterprises. Laboratory ultra-pure water equipment is mainly imported from American enterprises. Most equipment companies in China mainly produce laboratory ultra-pure water equipment.

The industrial ultra-pure water equipment industry has a relatively high concentration, with CR4 (top 4) of about 35%, while the laboratory ultra-pure water equipment has a relatively low concentration, with CR3 of only about 10%.

4.3. Analysis of the Profitability and Life Cycle of the Laboratory Pure Water Equipment Industry

The overall gross profit margin of benchmarking enterprises in the laboratory pure water equipment (ultra-pure water equipment) industry is about 20-50%. Chinese enterprises with laboratory ultra-pure water equipment as their main business are small in scale and have high gross margins, up to 40-60%. The domestic and foreign benchmarking enterprises mainly engaged in the production of industrial ultra-pure water equipment are relatively large in scale with a gross margin of 10-30%, which is mainly affected by the low gross profit margin of back-end wastewater treatment.

At present, China is vigorously developing the electronics manufacturing, chip production, and other high-tech industries. It would further drive the increase in ultra-pure water demands. Meanwhile, as affected by the Sino-US trade war, the industrial ultra-pure water equipment is expected to have explosive growth in the future.

The laboratory pure water equipment is mainly affected by the medical and scientific research level as well as the internal penetration rate of the industry, with relatively stable growth rate. It is expected that the growth rate of market scale will reach about 15% in the next three years.

5. User Analysis of the Laboratory Pure Water Equipment Industry in China

5.1. Price Appeal

At present, the price of domestic laboratory ultra-pure water equipment in China is generally tens of thousands of yuan. The price of industrial ultra-pure water equipment varies from several hundred thousand yuan to even millions of yuan, because of different demands for water output. Currently, according to customer feedback, domestic laboratory pure water equipment (ultra-pure water equipment) is cheap, but the consumables are required to be replaced frequently, resulting in higher maintenance costs.

5.2. User Concerns

At present, the hospital and pharmaceutical industries have relatively high requirements for laboratory pure water equipment. For this reason, they would choose to purchase high-quality and high-end equipment.

Most Chinese companies rely on low-cost strategies and sell products through local distributors. However, local distributors cannot provide good sales services and after-sales services, leading to a poor user experience. Compared with the price appeals, customers pay more attention to product quality and after-sale services.

In addition, users would compare key components when selecting laboratory pure water equipment (ultra-pure water equipment). The main concerns include UV lamps, reverse osmosis membranes, DI resins, ultra-purification columns, solenoid valves, pipe joints, just to name a few.

The semiconductor industry has a large water consumption demand, and requires ultra-pure water equipment to have a water output of 1-20 tons/hour or higher. The medical and scientific research industries generally require laboratory ultra-pure water equipment to have a water output of 1-3 L/min. The medical industry usually requires a water production volume of 10-500 L/h, while the scientific research laboratories require a water production volume of 5-200 L/h.

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