Access to your success
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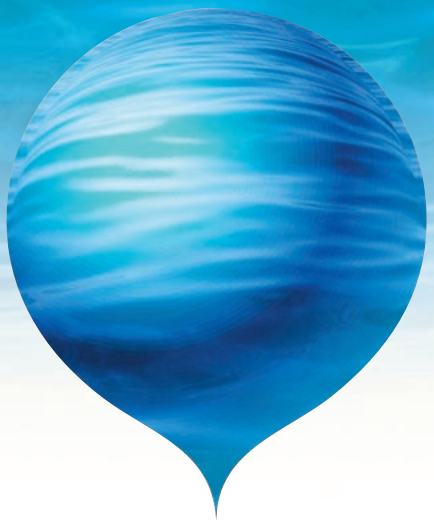
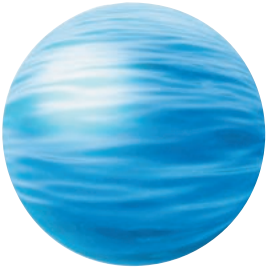
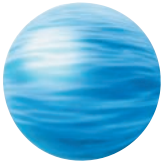
C10G-E007B





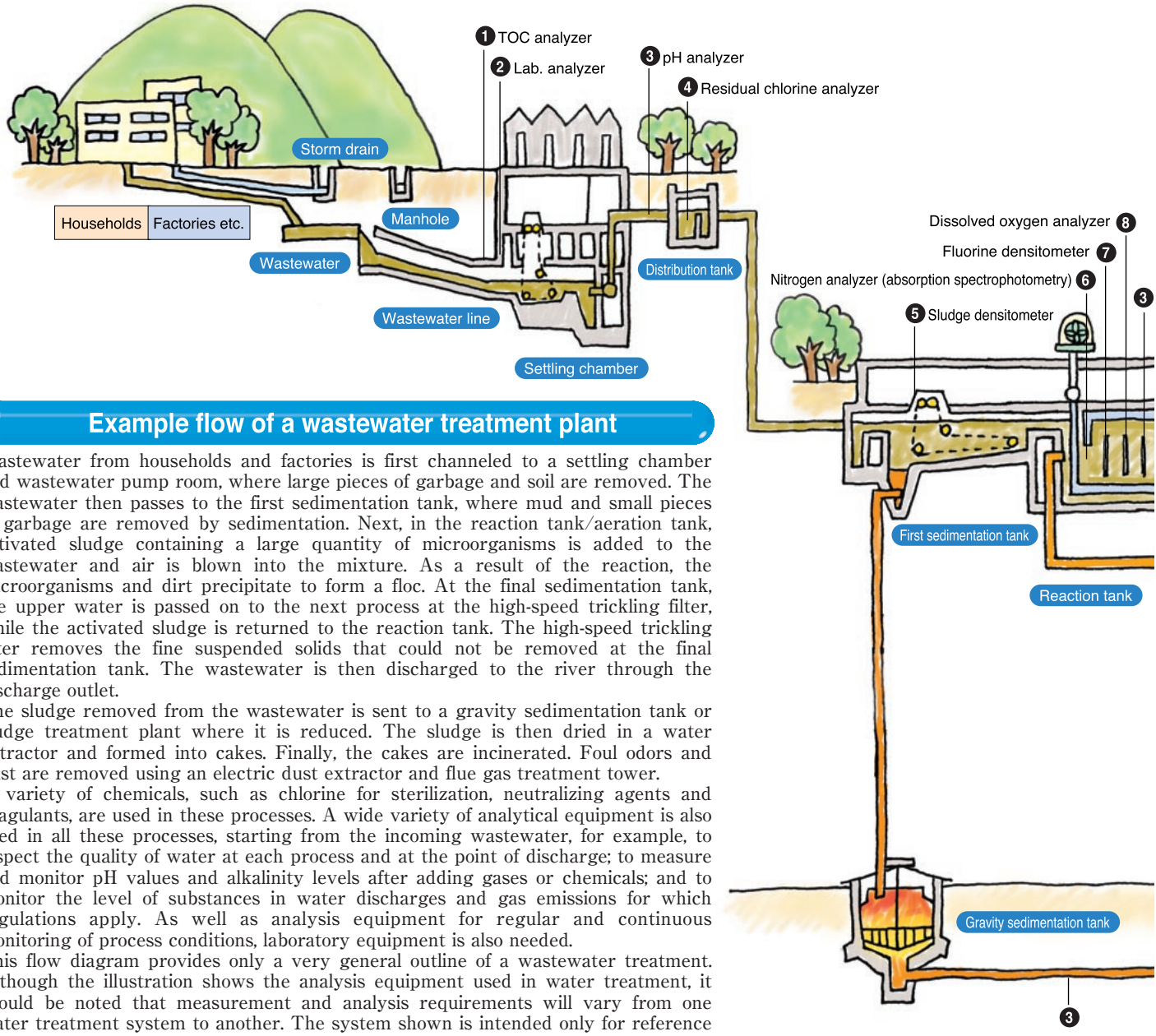
Water Treatment Systems and Measuring Instruments



Water Treatment Systems and Shimadzu Measuring Instruments

Along with the rising populations of cities and rapid expansion of industrial infrastructure, the issue of securing water resources is drawing increasing attention. In addition, with the influence of global warming and dramatic changes in annual rainfall levels, there is a growing need to ensure supplies of drinking water, domestic water and industrial water in many parts of the world. Furthermore, the problem of water pollution is making it increasingly necessary to utilize treatment processes both for water quantity and water quality, and water quality controls are being constantly revised. As a comprehensive maker of analysis and process system equipment, Shimadzu offers a broad range of effective systems and instrumentation for today's complex and sophisticated water treatment systems, utilizing its wealth of software technology and expertise in scientific instruments.

In this catalog we present a detailed guide to the analytical instruments needed in water treatment systems.



Example flow of a wastewater treatment plant

Wastewater from households and factories is first channeled to a settling chamber and wastewater pump room, where large pieces of garbage and soil are removed. The wastewater then passes to the first sedimentation tank, where mud and small pieces of garbage are removed by sedimentation. Next, in the reaction tank/aeration tank, activated sludge containing a large quantity of microorganisms is added to the wastewater and air is blown into the mixture. As a result of the reaction, the microorganisms and dirt precipitate to form a floc. At the final sedimentation tank, the upper water is passed on to the next process at the high-speed trickling filter, while the activated sludge is returned to the reaction tank. The high-speed trickling filter removes the fine suspended solids that could not be removed at the final sedimentation tank. The wastewater is then discharged to the river through the discharge outlet.

The sludge removed from the wastewater is sent to a gravity sedimentation tank or sludge treatment plant where it is reduced. The sludge is then dried in a water extractor and formed into cakes. Finally, the cakes are incinerated. Foul odors and dust are removed using an electric dust extractor and flue gas treatment tower.

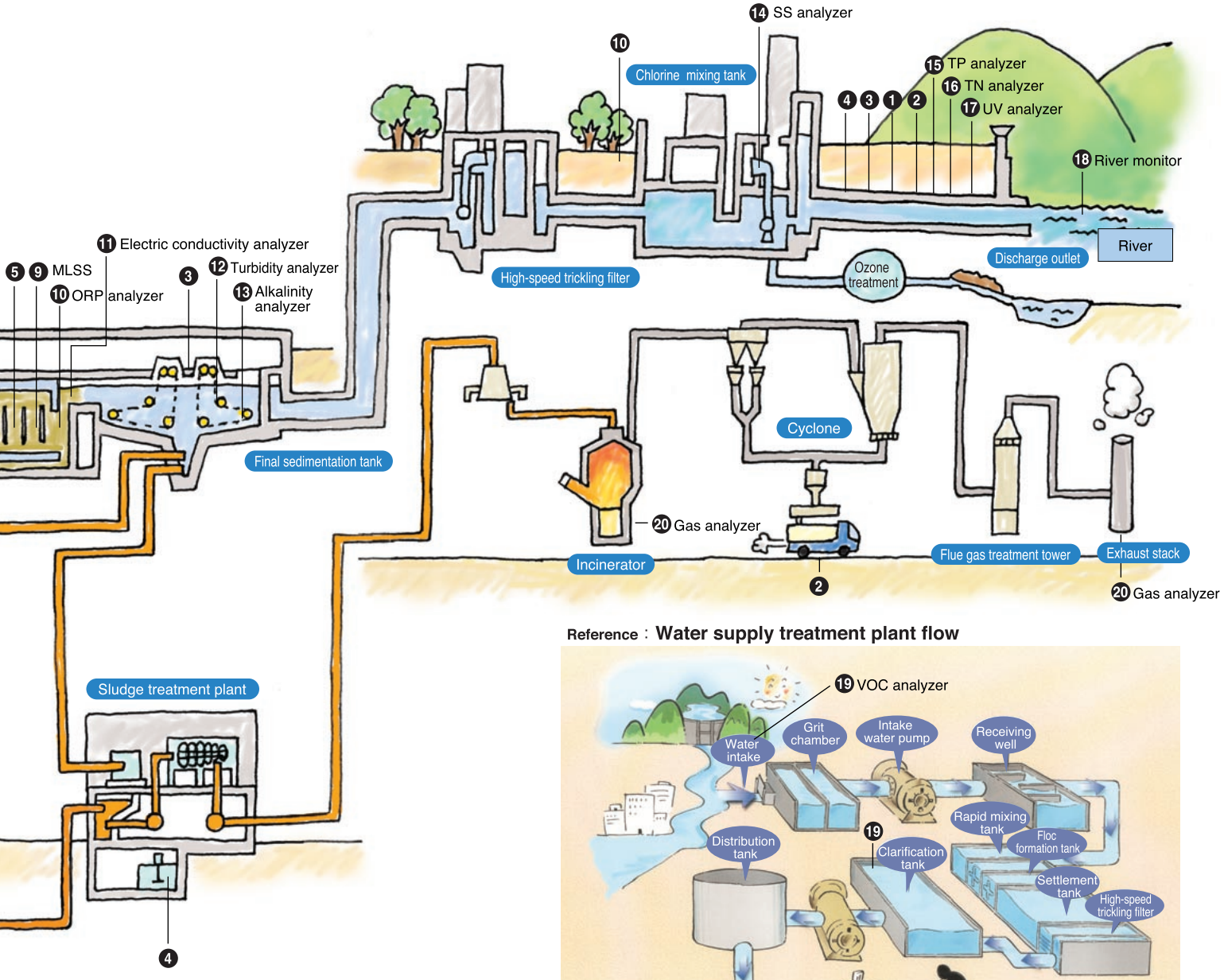
A variety of chemicals, such as chlorine for sterilization, neutralizing agents and coagulants, are used in these processes. A wide variety of analytical equipment is also used in all these processes, starting from the incoming wastewater, for example, to inspect the quality of water at each process and at the point of discharge; to measure and monitor pH values and alkalinity levels after adding gases or chemicals; and to monitor the level of substances in water discharges and gas emissions for which regulations apply. As well as analysis equipment for regular and continuous monitoring of process conditions, laboratory equipment is also needed.

This flow diagram provides only a very general outline of a wastewater treatment. Although the illustration shows the analysis equipment used in water treatment, it should be noted that measurement and analysis requirements will vary from one water treatment system to another. The system shown is intended only for reference purposes.

The numbers in the illustration are explained on pages 4 & 5.

Securing our water: the vital element of life and industry

A wide range of water treatment plants, of different conditions and different scales, are needed to ensure our water supplies. The outline of the process of collecting and purifying water can be understood by seeing the process of treating wastewater. Other water treatment systems can be considered as subsets of the wastewater treatment system flow. Accordingly, here we will cover the flow of a typical wastewater treatment system, and then present you with the analysis equipment that is needed for such a system. For details of the analysis equipment needed for each type of system, please refer to the sections on analysis and measuring instruments for water treatment systems from page 4, and on water quality standards and measurement methods on pages 6 and 7.



Reference : Water supply treatment plant flow

Continuous Analyzers for Use in Water Treatment Systems

❶ TOC (Total Organic Carbon) Analyzer

On-Line Total Organic Carbon Analyzer TOC-4110
Handles a wide range of TOC measurements, from water intake to final discharge.
See page 10 for details.

❷ Laboratory analyzers

See page 8.

❸ pH measurement

pH analyzers
The pH of source water is used as a measure for adjusting the injection rates for neutralizing substances such as soda ash and sulfuric acid. These analyzers can be used to measure the pH of source water, treatment water in sedimentation tanks, as well as purified water, according to the situation.

❹ Residual chlorine measurement

Residual chlorine analyzers
Chlorine is used in water treatment systems to destroy microorganisms, algae, shellfish, etc., and to ensure that the water meets the quality requirements of its intended purpose. However, the addition of excessive amounts of chlorine can leave an unpleasant odor in water supplies and lead to the discharge of harmful substances into rivers. For this reason, it is necessary to use a residual chlorine analyzer to measure, monitor and control the level of chlorine in water treatment systems.

❺ Sludge density measurement

Sludge densitometers
Sludge density measurements are essential for effective and efficient operation of reaction tanks and sludge processing plants.

❻ ❼ Nitrogen and fluorine measurement

See the section on laboratory analyzers on page 8.

❽ Dissolved oxygen (DO) measurement

In water treatment systems that make use of activated sludge, dissolved oxygen measurements are necessary for controlling the quantity of air supplied to the aeration tank and to maintain the DO level in the tank at an optimum value.

❾ Activated sludge density measurement

MLSS analyzers
MLSS analyzers are used for continuous measurements of activated sludge density (MLSS) in activated sludge treatment processes in sewage and industrial wastewater treatment systems.

❿ Redox potential measurement

ORP (Oxidation-Reduction Potential) analyzers
ORP analyzers are very useful in cases where water contains any substances with a powerful oxidizing or reducing effect.

⓫ Electric conductivity analyzers

Electric conductivity analyzers
Electric conductivity needs to be monitored because it is an indicator of wastewater contamination.
Electric conductivity is a measure of the quantity of electrolytic substances dissolved in the water under treatment. It is widely used because it is the simplest method for determining the purity of water.

⓬ Turbidity (SS) measurement

Turbidity analyzers
Suspended solids (SS) made up of particles of different sizes are mixed in the water. Turbidity of the water is determined by the quantity of SS.

⓭ Alkalinity measurement

Alkalinity analyzers
Alkalinity analyzers are used to control the injection of coagulants for eliminating the turbidity of source water and for preventing corrosion in pipelines.

⓮ SS analyzers

See item ⓬

⓯ TP analyzers

See page 11.

⓰ TN analyzers

See page 11.

⓱ Organic pollutant measurement

UV Organic Pollutant Monitor UVM-402
This device offers lower set-up cost, lower running cost and lower maintenance costs than a comparable COD analyzer. It offers great reliability too, since it works according to a simple principle and has a simple construction. And maintenance is easy.

Load Calculator WPC-102
This device takes the concentration level signals from COD, TOC, TOD and UV analyzers and processes them according to a designated method. By performing a computation using the COD value and discharge water quantity, it can calculate the daily pollutant load.


UVM-402

⓲ River water monitoring

Inquire about other product literature.

⓳ Putridity/VOC monitoring

Wate Putridity/VOC Monitoring System VMS-PT
Using the Purge & Trap GC-MS method, this system can be used to perform continuous on-site measurements of putridity-causing substances (2-methyl-isoborneol, geosmin) and VOCs (Volatile Organic Compounds) in river water and water supply lines.


VMS-PT

20 Gas measurement and control

Oxygen analyzers, CO_2 analyzers, NOx analyzers and SO_2 analyzers are used for combustion monitoring and flue gas measurement in incinerators.

Combustion monitoring

Oxygen analyzers, $CO/CO_2/CH_4$ analyzers, NOx analyzers and SO_2 analyzers are used for combustion monitoring and flue gas measurement in incinerators.

Portable Oxygen Tester POT-101

Measuring the concentration of $CO/CO_2/CH_4$ generated by combustion devices

This analyzer is suitable for a wide range of applications, such as performance and quality control, combustion control, and pollution monitoring of combustion devices, boilers and waste incineration facilities.

Infrared Gas Monitor CGT-7000

Measurement of SO_2 concentration in flue gas

One analyzer can be moved between multiple measurement points. It can be used whenever you want to perform measurements of boiler flue gas; as a backup device for continuous flue gas monitoring systems; for on-request measurements of boiler flue gas; and for quantitative emissions monitoring.

Flue Gas Sulfur Dioxide Analyzer SOA-7000

Measurement of NOx-O_2 in flue gas

This analyzer measures the concentration of nitrogen oxides (NOx) andO_2 in gas emitted from boilers, combustion devices and waste incineration plants. Since the analyzer can measure over a wide range of concentrations, it is suitable for a broad variety of applications, including combustion control of various combustion devices, pollution monitoring, and gas analysis for testing and research.

Flue Gas NOx and O_2 Analyzer NOA-7000

Dioxin control in waste incinerators

Measurement of CO and O_2 in flue gas is an effective method of diagnosing combustion efficiency. Continuous measurement of these two substances indirectly allows continuous monitoring of dioxins. The COA-3030 performs very stable and continuous monitoring of CO and O_2 levels in flue gas, which serve as good indicators of combustion conditions in waste incineration. This analyzer can monitor incineration day and night to guard against the generation of dioxins.

Continuous Carbon Monoxide Analyzer for Incinerators COA-3030

Simultaneous monitoring of various flue gas constituents

The flue gas emitted from combustion facilities includes a variety of gases that lead to air pollution, such as nitrogen oxides and sulfur oxides. The NSA-3080 enables you to perform high-precision, continuous measurement of up to five flue gas constituents NOx, SO_2, CO, CO_2, and O_2 using just a single machine. It can also be used for boiler flue gas monitoring.

Flue Gas Multi-Component Gas Concentration Analyzer NSA-3080

Water quality laboratories

Testing and analysis in water treatment systems is mandatory and covers a fairly broad spectrum, including testing for compliance with raw water quality acceptance criteria in water treatment plants; analysis of discharge water for compliance with quality standards for discharge to rivers; for waste disposal; for quality analysis of sludge for compliance with regulations; and for flue gas measurement in gas ducts for incinerators. Below is a list of regulatory limit values for water constituents given by Japanese environmental laws, along with corresponding measurement methods. (These limit values are subject to frequent revision. Please always refer to the latest laws and regulations.)

Regulatory limits in water-related regulations in Japan, and corresponding measurement methods

Water type		Public water bodies	Wastewater	Tap water		Measurement methods					
Symbols		●	○	△							
Criteria		H・L・M・W	T・L	W・R		UV	AA	ICP	ICPMS	Ion chromatography	Others
Metal	Cadmium	0.01	0.1	0.01			●○△▼	●○△▼	●○△▼		
	Lead	0.01	0.1	0.05			●○△▼	●○△▼	●○△▼		
	Sexivalent chrome	0.05	0.5	0.05		●○▼	●○△▼	●○△▼	●○△▼		
	Arsenic	0.01	0.1	0.01			●○△▼	●○△▼	△		
	Total mercury	0.0005	0.005	0.0005			●○△▼				
	Selenium	0.01	0.1	0.01			●○△▼	●○△▼	△		
	Antimony	Monitor		Monitor			●△		△		
	Vanadium										
	Chrome		2				○▼	○▼	○△▼		○
	Manganese		10	0.05			○△▼	○△▼	△		
	Iron		10	0.3			○△▼	△▼			
	Nickel	Monitor		Monitor		●△	●△	●△	△		
	Copper		3	1			○△▼	○△▼	○▼		
	Zinc		5	1			○△▼	△▼	△▼		
	Molybdenum	0.7		0.07			●△	●△	△		
	Sodium			200			△	△		△	
	Beryllium										
	Aluminum			Monitor			△	△	△		
	Uranium			?				△	△		
	Hardness			300							△
Nonmetal	Cyanide	ND	1	0.01		●○△▼					
	Fluoride	0.8	15	0.8		●○△▼				○△▼	
	Chloride ion			200						△	△
	Residual chlorine			Monitor							
	Boron	1		Monitor				●△	●△		
	Nitrogen		120	150,240		●○△▼					
	Nitrate & nitrite nitrogen			10						△	
	Phosphorus		16	20,30		●△					
Basic items	pH	6.5～8.6	5.8～8.6								△
	Suspended solids (SS)	25～100	200								△
	COD		160	10							○△
	BOD	1～10	160								○△
	DO	2～7.5									△
	Organic substances ($KMnO_4$ consumption)		10								△
	Residue on evaporation		500								△
	Turbidity		2								△
	Chromaticity		5								△

Concentrations shown in unit of mg/L

Water quality regulations for public water bodies (environmental standards)
(H)Health : Environmental regulations relating to protection of human health
(L)Living : Environmental regulations relating to protection of living environments
(M)Monitor : Items to be monitored
(W)Water : Water quality protection

Water quality regulations for wastewater
(T)Toxic : Toxic substances
(L)Living : Living environment items

Water quality regulations for tap water
(W)Water: Water quality regulations, recommended water quality levels
(M)Monitor: Items to be monitored
(R)Raw water: Raw water quality protection

Water quality regulations for sewage water
(S)Specific: Wastewater discharge restrictions for specific plants

Water type		Public water bodies	Wastewater	Tap water	Wastewater	Measurement methods			
Symbols		●	○	△	▼				
Criteria		H･L･M･W	T･L	W･R	Specific	GC	GC-MS	HPLC	UV
Volatile organic matter	Chloroform	*0.06*		0.06		△	△		
	Bromoform			0.09		△	△		
	Dibromochloromethane			0.1		△	△		
	Bromodichloromethane			0.03		△	△		
	Trichloroethylene	*0.03*	0.3	0.03	0.3	●○△▼	●○△▼		
	Tetrachloroethylene	*0.01*	0.1	0.01	0.1	●○△▼	●○△▼		
	Dichloromethane	*0.02*	0.2	0.02	0.2	●○△▼	●○△▼		
	Carbon tetrachloride	*0.002*	0.02	0.002	0.02	●○△▼	●○△▼		
	1,2-Dichloroethane	*0.004*	0.04	0.004	0.04	●○△▼	●○△▼		
	1,1-Dichloroethylene	*0.02*	0.2	0.02	0.2	●○△▼	●○△▼		
	cis-1,2-Dichloroethylene	*0.04*	0.4	0.04	0.4	●○△▼	●○△▼		
	1,1,1-Trichloroethane	*1*	3	0.3	3	●○△▼	●○△▼		
	1,1,2-Trichloroethane	*0.006*	0.06	0.006	0.06	●○△▼	●○△▼		
	Benzene	*0.01*	0.1	0.01	0.1	●○△▼	●○△▼		
	trans-1,2-Dichloroethylene	*0.04*		Monitor		△	△		
	1,2-Dichloropropane	*0.06*		Monitor		△	△		
	p-Dichlorobenzene	*0.3*		Monitor		△	△		
	Toluene	*0.6*		Monitor		△	△		
	Xylene	*0.4*		Monitor		△	△		
Sterilization by-products	Formaldehyde			Monitor		△			
	Dichloroacetic acid			Monitor		△			
	Trichloroacetic acid			Monitor		△			
	Chloral hydrate			…		△	△		
	Dichloroacetonitrile			Monitor		△			
organic matter	PCB	*ND*	0.003		0.003	●○▼			
	Dioxins			10pg/L	10pg/L		△▼		
	Phenols		5	0.005	5				●○▼
	n-hexane extraction amount		5/30	Monitor					
	Diethyhelxyl phthalate	*0.06*		Monitor		△	△		
	Anionic surfactant			0.2					△
	Alkyl mercury	*ND*	ND		ND	●○▼			
Agricultural chemicals	Organic phosphates		1		1	○▼			
	1,3-Dichloropropene	*0.002*	0.02	0.002	0.02		●○△▼		
	Thiuram	*0.006*	0.06	0.006	0.06			●○△▼	
	Simazine	*0.003*	0.03	0.003	0.03	△	●○△▼		
	Thiobencarb	*0.02*	0.2	0.02	0.2	△	△		
	Phenitrothion (MEP)	*0.03*		0.003		△	△		
	Diazinon	*0.005*		0.005		△	△		
	Isoxathion	*0.008*		0.008		△	△		
	Chlorotaronile (TNP)	*0.05*		0.05		△	△		
	Phenobcarb (BPMC)	*0.03*		0.03		△	△		
	EPN	*0.006*		0.006		△	△		
	Dichlorbos (DDVP)	*0.008*		0.008		△	△		
	Iprobenfos (IBP)	*0.008*		0.008		△	△		
	Chlornitrofene (CNP)	Monitor		…		△	△		
	Isoprothioran	0.04		0.04		△	△		
	Copper oxine	0.04		0.04				△	
	Propizamid	0.008		0.008		△	△		
	Pentazocine	0.2					●		
	Carbofuran	0.005							
	2,4-D dichlorophenoxyacetic acid	0.03					●	●	
	Trichlopyr	0.006					●		
	Acephate	0.08							
	Methalaxyl	0.05					●	●	
	Dithiopyr	0.008					●		
	Pyributycarb	0.02					●△		
	Chlorpyrfos	0.03				●	●		
	Trichlorfon (DEP)	0.03				●	●		
	Pyridafenthion	0.002				●	●		
	Iprodione	0.3				●	●		
	Trichlofosmetyl	0.2				●	●		
	Frutoranil	0.2				●	●		
	Pencycuron	0.04				●	●		
	Mepronil	0.1				●	●		
	Butamifos	0.004				●	●		
	Bensulide (SAP)	0.1				●	●		
	Pendimethalin	0.1				●	●		
	Imidachloprid	0.2				●	●		
	Etofenblocks	0.08				●	●		
	Esbrocarb	0.01				●	●		
	Edifenphos (ESSP)	0.006				●	●		
	Carbaryl (NAC)	0.05				●	●		
	Dichlofen (ECP)	0.006				●	●		
	Simetryne	0.06				●	●		
	Tricyclazole	0.1				●	●		
	Fthalide	0.1				●	●		
	Buprofezin	0.01				●	●		
	Pretilachlor	0.04				●	●		
	Probenazole	0.05				●	●		
	Bromobutide	0.04				●	●		
	Marathion	0.01				●	●		
	Mefenacet	0.009				●	●		
	Morinale	0.005				●	●		

Agricultural chemicals : Water quality evaluation standards for agricultural chemicals in public water areas (Notification by the Chief of the Wate r Quality Bureau of the Environment Agency, April 15, 1994) 27 types

Revision to Environmental Standards Relating to Water Pollution, 1999, Water Quality Bureau of the Environment Agency, No. 49

Tap water-based water quality regulations

ND “not detectable”

Some instruments require sample pretreatment devices (in addition to a main instrument such as GC and GCMS)

Analytical and measuring instruments for laboratories

Shimadzu offers a broad diversity of the laboratory analysis instruments needed for water treatment plants. In addition, it offers analysis software and comprehensive consulting services covering the entire range of laboratory instruments, utilizing its long experience in this field. Laboratory analysis for water treatment systems can be categorized into four types, as follows.

1. Analysis of items that are necessary for operational management, but which cannot, by their nature, be measured continuously, e.g. SS, BOD and COD
2. Analysis of items that can be measured and analyzed infrequently, e.g. TOC (when it is not continuously monitored) and coliform bacteria counts
3. Analysis of toxic substances that must be measured using designated analysis methods, e.g. heavy metals, PCBs, VOCs (Volatile Organic Compounds)
4. Research and development-related items

Analysis of metals, ions and molecules

UVmini-1240 features in-built support for measurements of 55 items of 34 types, including chrome and cyanogens, that must, by regulation, be measured by the absorption method. This is the first small and popular instrument equipped as standard with spectroscopic measurement. The machine handles everything from color analysis to advanced spectroscopic and quantitative measurements. Shimadzu also offers more advanced models, such as the UV-2450/2550, which features PC control capabilities.

UV-VIS Spectrophotometer
UVmini-1240 Water Analysis System

Measurement of metals in water

AA-6800: Features automatic switching between flame and furnace modes
AA-6300: Requires manual switching between flame and furnace modes, but highly cost-effective
HVG-1: An accessory device for use with the AA, for measuring arsenic, selenium, etc. using the hydride generation method.
MVU-1A: An accessory device for use with the AA, for measuring mercury by a method that atomizes mercury by reduction and vaporization.

Atomic Absorption/Flame Emission Spectrophotometer
AA-6800/ AA-6300 Series

Rapid measurement of multiple chemical elements

This spectrometer can perform high-resolution measurements over a wide range of wavelengths. With its automatic analysis function, the machine greatly enhances analysis in water-related applications and a variety of other fields.

Sequential Plasma Spectrometer
ICPS-8100

PPT (parts per trillion)-order measurements

This is a packaged kit with everything needed for tap water and environmental analysis.

Inductively Coupled Plasma Mass Spectrometer
ICPM-8500 Water

Measurement of chloride

Choose between the Suppressor Ion Chromatograph (HIC-SP Super) or Non-Suppressor Ion Chromatograph (HIC-VP Super), according to the types of ions and their concentration levels. This machine also handles two-pass measurements for simultaneous analysis of anions and cations, as well as a concentration analysis system for on-line concentration of dilute specimens. It also handles PPb-level ion analysis easily.

Suppressor Ion Chromatograph
HIC-SP Super/ HIC-VP Super

Volatile organic matter analysis

Head space sampling is a very effective method for analyzing volatile components in liquids or solids. The method can be applied to a wide range of applications, including analysis of organic components in water. Since wastewater contains a large quantity of matrix components, it is best to analyse it using a syringe-type headspace, which makes it is easy to change and wash syringes.

Gas Chromatograph Mass Spectrometer
with Headspace Auto-Sampler

Analysis of underwater VOCs (Volatile Organic Compounds) (Headspace Method)

The Headspace GC-MS analysis system makes use of the Headspace GC-MS method to measure volatile organic compounds (VOCs) in water, even at very low concentrations. The system heats up a water specimen to a specified temperature and captures a certain quantity of the VOCs that have passed into the gas phase as a sample. It then passes the sample to the GCMS for analysis. This system can also be used for measurement of putridity-causing substances.

Headspace GC-MS Analysis System
GCMS-QP2010

Analysis of underwater VOCs (Volatile Organic Compounds) (Purge & Trap Method)

The Purge & Trap GC-MS analysis system makes use of the Purge & Trap GC-MS method to measure volatile organic compounds (VOCs) in water, even at very low concentrations. The system forces VOCs out of the water specimen by using a purge gas, and then concentrates the VOCs in an absorption pipe. It then heats up the absorption pipe to drive off the VOCs for analysis in the GCMS. This system can also be used for measurement of putridity-causing substances.

Purge & Trap GC-MS Analysis System
GCMS-QP2010

Ion analysis, agricultural chemicals and endocrine disruptors

The LC-10AVP system is a multi-purpose HPLC system. With a simple change in configuration, the system can be upgraded for use as a bromate analysis system, for analysing bromate ions and cyanogen ions, or as a post-column derivative system for analysis of cyanogens and other substances. With the addition of a concentrating device, the system can also be used for high-precision analysis of endocrine disruptors and agricultural chemicals, such as bis phenol A and thiuram.

Liquid Chromatograph LC-10AVP System

Analysis of agricultural chemicals and micro cysteines

The analysis of the toxic micro cysteines produced in algal blooms as a result of eutrophication requires a LCMS system. This spectrometer features greatly enhanced sensitivity through a newly designed ion optical device, “Q-array” (patent pending), and a highly effective interface. The high-speed scanning capabilities of this device (6000 amu/sec) allows for maximum efficiency of simultaneous negative and positive ion measurements.

Liquid Chromatograph Mass Spectrometer LCMS-2010A

Analysis of semivolatile organic compounds such as agricultural chemicals, chlorination by-products, and endocrine disruptors

Semivolatile organic compounds such as agricultural chemicals, chlorination by-products, and endocrine disruptors can be extracted from river water or tap water by solid phase extraction or liquid-liquid extraction. The extracted samples can then be measured using a GC/MS machine.

Gas Chromatograph Mass Spectrometer
GCMS-QP2010 (includes Auto Sampler AOC20i + 20S)

Auto Solid Phase Micro Extraction GC-MS Analysis System

The Solid Phase Micro Extraction (SPME) method is a preprocessing method in which a fiber that is coated with a liquid layer is left in a water specimen, or its head space, to selectively extract the target substances. This fiber is then heated in the vaporizing chamber of a gas chromatograph to drive off the target substances. This system automatically performs a series of operations for solid phase micro extraction. It is suitable for analysis of agricultural chemicals, putridity, VOCs and other substances.

Solid Phase Micro Extraction GCMS Analysis System

Quality control software for GC-MS Analysis

Accuracy control (quality assurance/quality control) is considered very important for environmental analysis. GCMSsolution, a software application supplied with the GC-MS, provides powerful accuracy control functions for environmental analysis. The software also features a number of convenient functions to support accuracy control, such as statistical tools.

Water Control by TOC

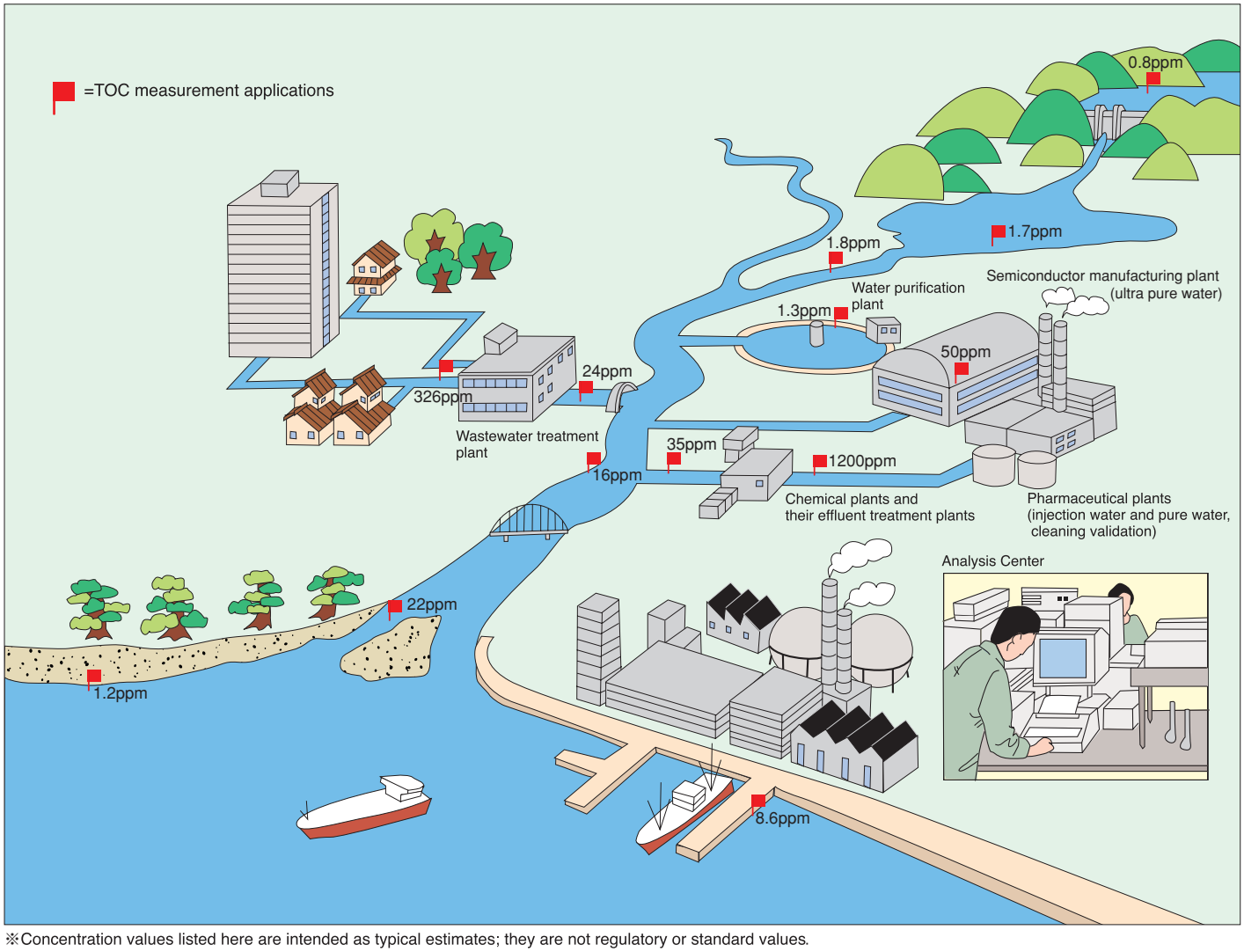
TOC analyzers are widely used for management of the effluents from production plants for compliance to the ISO 14001 standard; for water control at the river water intakes of water purification plants; for analysis of highly processed water; for control of water discharges from wastewater treatment systems; for control of collected and recycled water in manufacturing processes; for control of water used for pharmaceutical manufacture; and for pollution monitoring in rivers, lakes, ports and bays.

Other pollution indexes such as BOD or COD take from several hours to several days to produce measurement results, and their detection rates vary according to the organic components.

In contrast, in TOC analysis, accurate measurement results for all organic substances can be obtained immediately. Thus, TOC is the best control index for water treatment systems designed to eliminate organic components.

The illustration lists some of the applications for which TOC analyzers are commonly used. TOC equipment is used for everything from high-purity process water to highly contaminated wastewater.

TOC measurement applications



※Concentration values listed here are intended as typical estimates; they are not regulatory or standard values.

Shimadzu TOC Analyzers, TN and TP Analyzers

On-line Total Organic Carbon Analyzer TOC-4110

This analyzer can cover a very wide range of TOC concentrations, for analysis of everything from raw treatment source water to final effluent. This on-line analyzer offers high performance thanks to a 680°C catalytic combustion method that has earned widespread industry acclaim in a wide range of fields throughout the world. Shimadzu also offers a cubicle model, the TOC-4100P, which offers excellent weather-resistance.

On-Line Total Nitrogen Analyzer TN-4110

This analyzer can cover a very wide range of TN concentrations, for analysis of everything from raw treatment source water to final effluent. This on-line analyzer offers high performance due to its thermal decomposition/chemiluminescence analysis method. Shimadzu also offers a cubicle model, the TN-4100P, which boasts excellent weather-resistance.

(With optional sample preparation tank attached)

On-Line Total Organic Carbon/ Nitrogen Analyzer TOCN-4110

This on-line, high-performance TOC-TN analyzer allows simultaneous measurement of TOC and TN by providing a combustion oxidation/infrared detection-type TOC analyzer and thermal decomposition/chemiluminescence-type TN analyzer in one compact machine. Shimadzu also offers a cubicle-type model, the TOCN-4100P, for excellent weather-resistance.

On-Line Total Nitrogen/ Phosphorus Analyzer TNP-4110

This automatic water analyzer measures total nitrogen and total phosphorus. It offers outstanding ease-of-use and easy maintenance.

Total Organic Carbon Analyzer TOC-V Series

TOC-VCS/CP

Featuring the 680℃ combustion catalytic oxidation method, developed and popularized around the world by Shimadzu, this machine offers high-efficiency measurement of all organic components. With its ultra wide measurement range, extending all the way from 4 g/L to 25000 mg/L, it is suitable for everything from ultra pure water to highly contaminated water. The TOC-VCS/CP is available as a standalone or PC-controlled machine, with either high sensitivity or standard specifications, for a total of four different models.

TOC-VWS/WP

This TOC analyzer utilizes a wet oxidation/ NDIR method for extremely high sensitivity and power. It features a newly designed high-sensitivity NDIR for true ultra high sensitivity measurements. It is also equipped with a powerful oxidizing function that combines peroxodisulfuric acid, UV irradiation and heating. It is available in two models: standalone and PC-controlled.

TOC-VE

This TOC analyzer is equipped with just the basic functions. With manual injection and simple operation, the machine was designed primarily for easy measurement. Like the TOC-VCS/CP, the TOC-VE also utilizes a combination of 680℃ combustion catalytic oxidation and the newly designed NDIR, both of which are key features of Shimadzu TOC analyzers. It also allows decomposable organic compounds to be oxidized and measured with high efficiency.

ON-LINE TOC-VCSH

The On-line TOC-VCSH can be used for continuous automatic high-sensitivity monitoring of water samples such as pure water and tap water

Total Organic Carbon Analyzer TOC-V Series Options

Autosampler ASI-V

The ASI-V can be combined with any of the TOC-V series (except TOC-VE) to construct an automatic measurement system. Vials are available in three different capacities (24, 40 and 125 mL). Specimen vials and specimen racks can be selected according to the samples to be analyzed.

8-port Sampler OCT-1

The OCT-1 can be combined with the TOC-V series (except TOC-VE) to construct an automatic measurement system at reasonable cost. Since no special vials are needed, setup is very easy. The sampler uses an 8-port valve, and has a small and simple construction.

TN (Total Nitrogen) Unit TNM-1

The TNM-1 can be combined with any of the catalytic oxidation TOC-V series to construct a system for simultaneous measurement of TN and TOC. The system can perform a wide range of measurements, from 0.1 mg/L up to 4000 mg/L. The unit enables very rapid TN measurements, utilizing a thermal decomposition/chemiluminescence process that conforms to JIS K 0102.

Solid Sample Combustion Unit SSM-5000A

The SSM-5000A can be combined with any of the catalytic oxidation TOC-V series to enable TC, IC and TOC measurements of water samples and various solids, such as soil, sludge and sediment. It also enables measurement of carbon in adherent residues, using the swab method from the cleaning validation of the revised GMP (Good Manufacturing Practices).

Wastewater management conforming to ISO 14001

Shimadzu TOC analyzers are used as follows to enhance environmental protection:

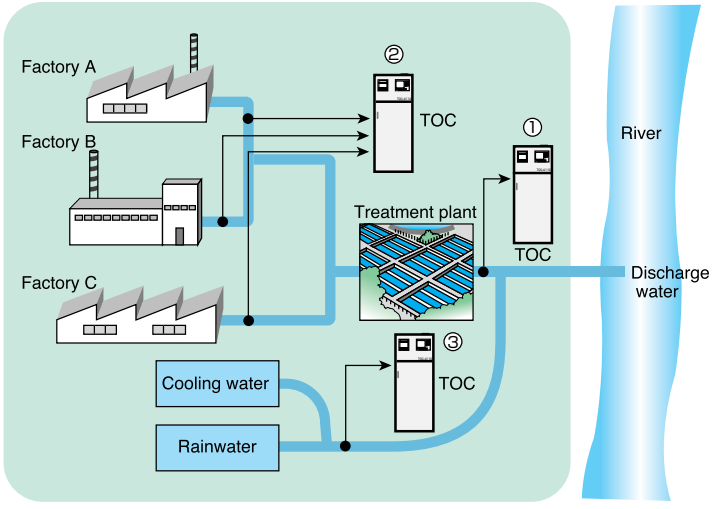
1. Final effluent management (measurement point ① in the figure)

Continuous monitoring of treated water (specific discharge water) from wastewater treatment processes to check that quality is within voluntary standards at the point of discharge

2. Intake water management in wastewater treatment plants (measurement point ② in the figure)

Improving the control and management of wastewater treatment processes is essential for raising the quality of discharged water (to reduce the load on the environment). When wastewater is discharged from multiple points (plants and process), continuous monitoring of TOC at each discharge point enables the following benefits.

(1) The load on wastewater treatment devices can be maintained at its optimum value.
(2) If highly contaminated water is suddenly discharged as the result of an accident, the problem can be immediately detected and fixed (e.g. by shutting off supply to the treatment device). -> Advance prevention of environmental pollution
(3) The discharge points involved in an accident can be easily identified, thereby making it easier to develop effective measures to prevent recurrence.
(4) The use of wastewater treatment agents can be reduced to the minimum required level.
(5) The degradation time of adsorbents (e.g. chelating resins, activated carbon) can be evaluated.



3. Rainwater and cooling water management (measurement point ③ in the figure)

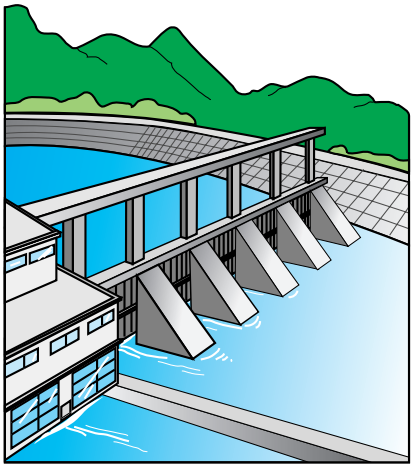
In many cases, rainwater and cooling water are discharged directly into public water bodies because it is mistakenly assumed that they are not contaminated. However, water with high concentrations of organic pollutants is sometimes discharged into public water bodies untreated, due to leakages resulting from damage to pumps, pipes or storage tanks containing organic solvent or oil, or perhaps due carelessness or human error. This kind of occurrence can cause serious environmental pollution.

Using the TOC-4110 to continuously monitor each drainage pit in a plant ensures that accidents are quickly discovered and addressed when they occur.
Also, with the addition of a Shimadzu TOC-4110 multiple flow line switching device, samples from up to six systems of different TOC concentrations can be measured by automatically switching between lines. This means that a single analyzer can be used for three purposed; monitoring of discharge water, monitoring of intake water, and monitoring of rainwater and cooling water.

Water management at river water intakes in water purification plants

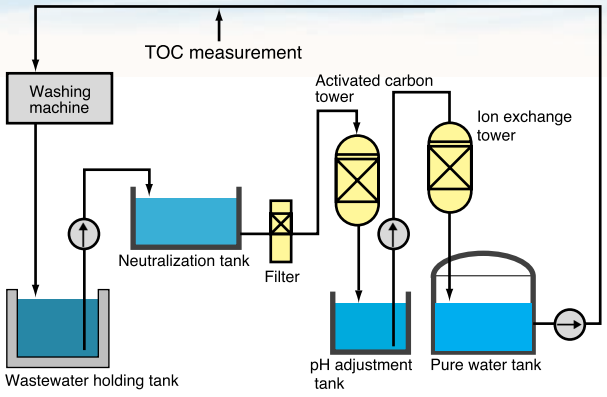
The use of Shimadzu on-line TOC analyzers for water intake management offers the following benefits.

●All kinds of unpredictable organic pollution, including contamination by perishable organic matter due to stagnancy or turbidity at the water intake and contamination by oil and chemicals can be monitored because TOC analyzers are capable of grasping any change in the total amount of organic matter, regardless of the types of organic substances.
●Since measurement cycles are short (approx. 4 minutes), changes in organic pollution levels can be detected easily. This means that problems can be dealt with quickly, e.g. by shutting of water intake, and that problems in water treatment systems can be prevented in advance.
●Water quality data for water intakes can be recorded and stored automatically over long periods of time.
●TOC and TN (Total Nitrogen) can both be monitored continuously (using the TOCN-4110).



Management of collected and recycled water in water-based cleaning systems

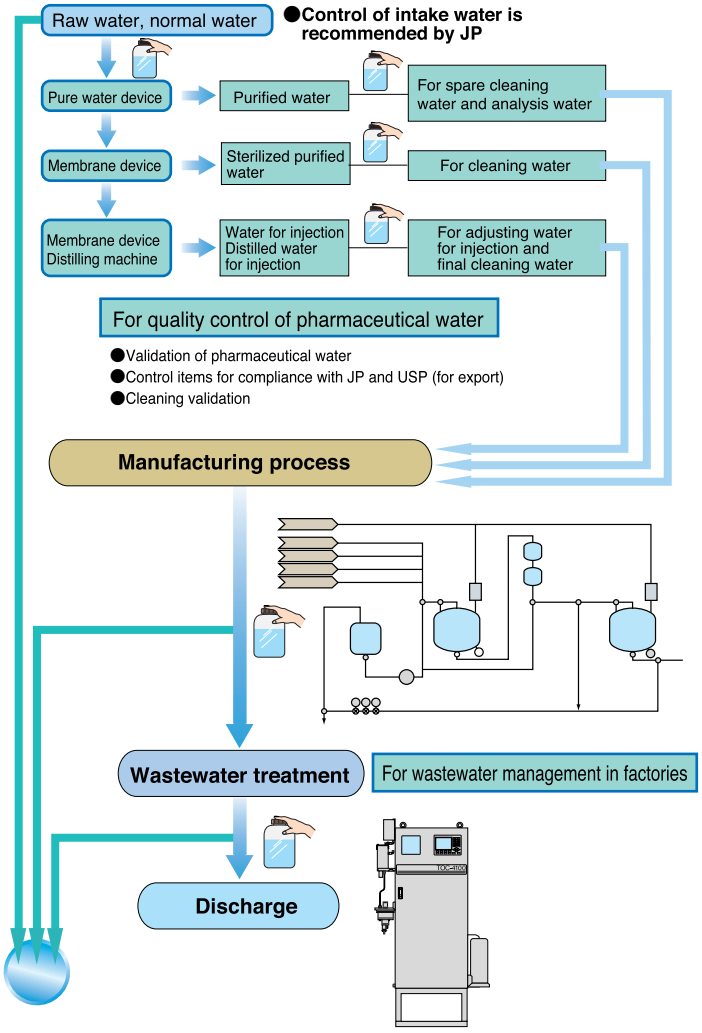
Cleaning water for water-based cleaning systems, such as those for printed circuit boards, electronic components and machinery parts, often contains a variety of organic substances, e.g. surfactants, chelating reagents and cutting oils. Since the concentration of organic contaminants in wastewater after cleaning is relatively low, in closed systems the water is collected and treated by ion exchange, activated carbon adsorption, or other method, and then reused as cleaning water. However, any contaminants still in the recycled water can remain as a residue on products after drying, resulting in degraded product quality. It is, therefore, essential to control the level of contaminants in cleaning water.



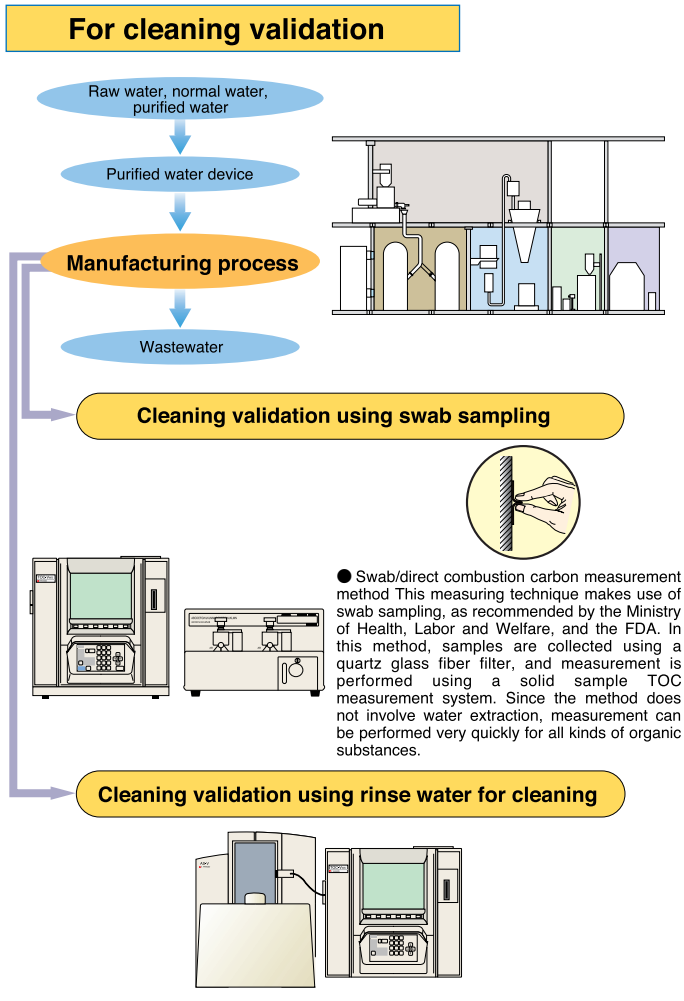
The prevailing method of controlling contaminants in recycled treatment water up to now has been to use an electric conductivity meter. However, water-based cleaning agents contain large amounts of non-electrolytic organic substances. So, even if these are dissolved in water, they do not readily dissociate into ions. For this reason, the use of electric conductivity meters is not very effective as a measurement method for controlling organic foreign substances such as surfactants, chelating reagents and cutting oils.

In contrast, TOC is a reliable measure for the total amount of organic matter in water. And since Shimadzu TOC analyzers employ a combustion oxidation method, all organic matter is detected. That is why TOC is the most effective water quality control index.

In manufacture of injection water and transfusion liquid



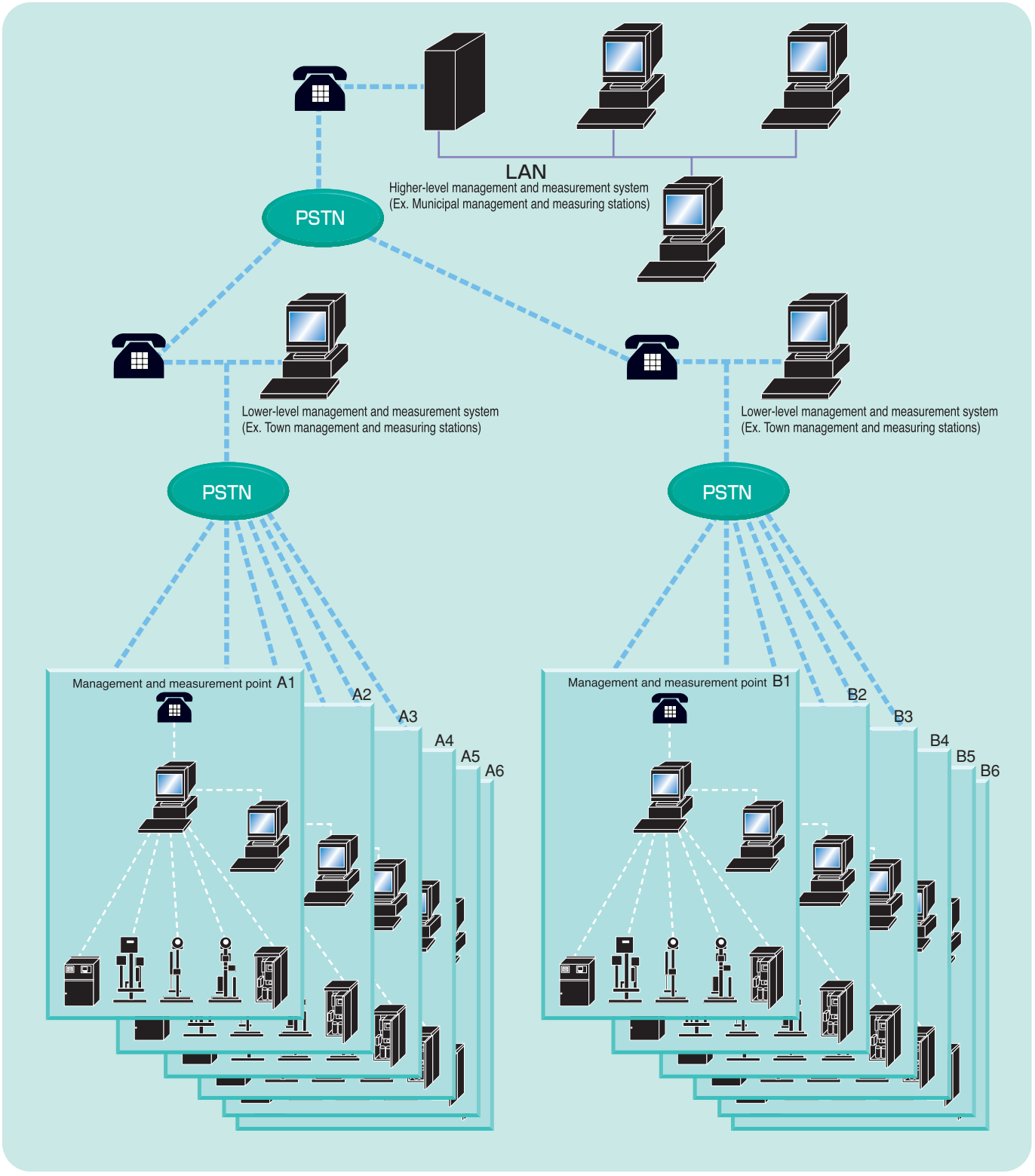
Manufacturing of solid preparations



● Swab/direct combustion carbon measurement method This measuring technique makes use of swab sampling, as recommended by the Ministry of Health, Labor and Welfare, and the FDA. In this method, samples are collected using a quartz glass fiber filter, and measurement is performed using a solid sample TOC measurement system. Since the method does not involve water extraction, measurement can be performed very quickly for all kinds of organic substances.

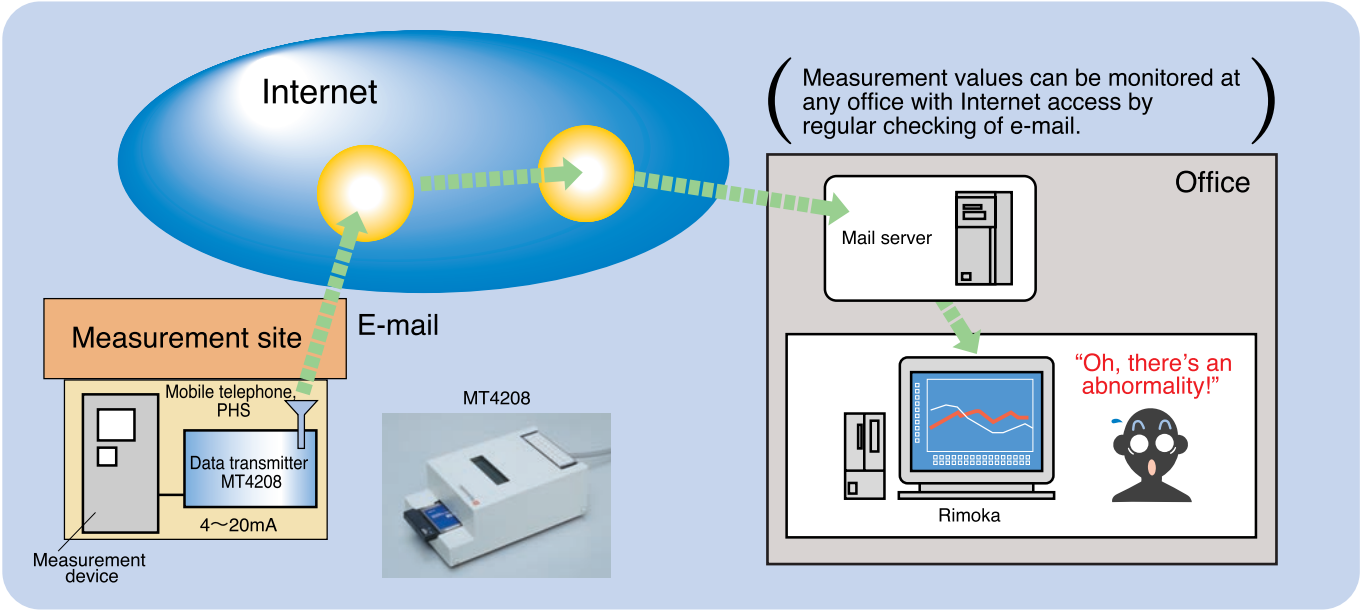
Wide Area System Communication Platform

Unified control of management and measurement point data over a wide area can be achieved using the inexpensive and widely available public telephone network (PSTN).

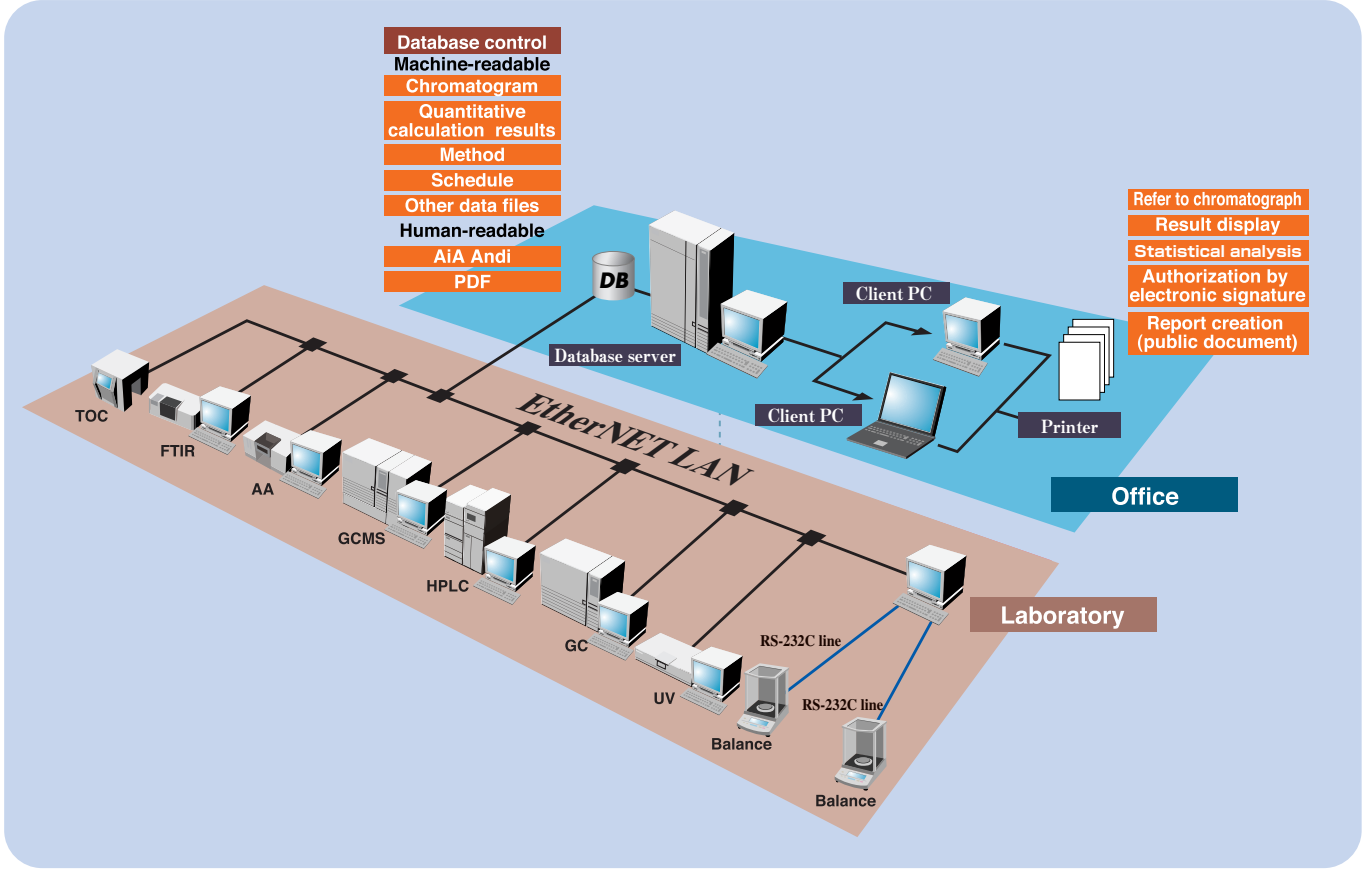


Examples of remote monitoring and analysis data integration for water treatment systems

Example of a remote monitoring system



An example of a client-server system using CLASS-Agent ver2



WHO drinking water quality guidelines

The guideline values set by WHO (World Health Organization) apply to water contaminants that are proven to be harmful to human health. These guidelines have been formulated based on scientific research and evaluation of drinking water quality. Please note that conformity to these guideline values is not enforced by any regulations. The list below compares the WHO guideline values with those set in Japan's water quality regulations.

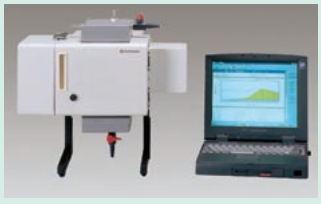
Classification	Substance name	Unit	Guideline values		Water quality standard values(Regulatory values, target values, guideline values, water quality targets)		
			Guideline values	Remarks	Water quality regulatory values	Remarks	
Inorganic substances	Antimony	mg/L	0.005	Tentative	0.002	Monitor (tentative)	
	Arsenic	mg/L	0.001	Tentative	0.01	Standard	
	Barium	mg/L	0.7				
	Boron	mg/L	0.3		1	Monitor	
	Cadmium	mg/L	0.003		0.01	Standard	
	Chromium	mg/L	0.05	Tentative	0.05	Standard	Sexivalent chrome
	Copper	mg/L	2	Tentative	1	Standard	
	Cyanide	mg/L	0.07		0.01	Standard	
	Fluoride	mg/L	1.5		0.8	Standard	
	Lead	mg/L	0.01		0.05	Standard	
	Manganese	mg/L	0.5	Tentative	0.5	Standard	Safe value is 0.01
	Total Mercury	mg/L	0.001		0.0005	Standard	Mercury
	Molybdenum	mg/L	0.07		0.07	Monitor	
	Nickel	mg/L	0.02		0.02	Monitor (tentative)	
	Nitrate (Nitrate Ion)	mg/L	50		10	Standard	Amount of bound nitrate and nitrite nitrogen
	Nitrite (Nitrite Ion)	mg/L	3	Tentative	0.05	Monitor (tentative)	
	Selenium	mg/L	0.01		0.01	Standard	

*In part from the Japan Water Research Center website http://ygnet.mizudb.or.jp/ippan/YugaiHoukoku/Asp/IsseiFrame.asp

Shimadzu can also meet your needs for many related devices

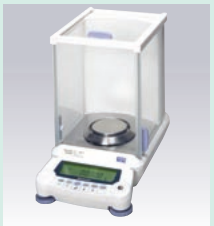
Measurement of pathogenic microorganisms

This measurement device is equipped with two functions: high-sensitivity turbidity measurement, and ultra high-sensitivity granulometry measurement. This device can measure granulometry even at very low concentrations—down to 1,000 times lower than normal concentration. It can also be used to monitor pathogenic microorganisms and other substances in water, based on turbidity and particle diameter.



High Sensitivity Turbidity and Particle Diameter Analyzer LATS-1

Electronic Balances



Analytical Balance AU Series

UW Series (with built-in counterweights)

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Printed in Japan 2310-04402-10A-NS