Japan's Involvement in International Standardization for Water Industry

Activities of ISO/TC 224 and ISO/TC 282 Technical Committees

Work on international standardization in the water industry is moving ahead at a rapid pace. In recent years, this has expanded beyond product specifications and measurement techniques to include service standards that are formulated from a user's perspective and standardization work aimed at resolving societal challenges. The ISO/TC 224 committee on service activities relating to drinking water supply, wastewater, and stormwater systems has published more than 15 international standards over the 18 years since it was first established and continues to work actively on new standards in areas such as crisis management, water loss management, and corporate governance. The ISO/TC 282 committee on water reuse is also working on standards regarding reclaimed water applications, quality grades, and various treatment technologies. This article describes the current work and future plans for these two committees, including examples of how Japan is contributing to their activities.

Takahiro Tachi
Hiroki Nakamura, Ph.D.

1. Introduction

Work on international standardization in the water industry has been moving ahead at a rapid pace over recent years. One such international standardization body, the International Organization for Standardization (ISO), has technical committees (TCs) currently working on international standards for things like drinking and waste water, water recycling, and the treatment of sludge.

This article describes recent developments and gives examples of how Japan is contributing at two of these TCs in particular: ISO/TC 224, which deals with the drinking water supply, wastewater, and stormwater industries, and ISO/TC 282, which deals with water reuse.

2. Developments in International Standardization for Water Industry

Table 1 lists the main ISO technical committees that deal with international standardization for the water industry[(1)]. Whereas work in the past has involved product standards that stipulated things like designs, materials, and measurement techniques, recent years have also seen progress on service standards that are

Table 1 — Main ISO Technical Committees Dealing with Water (as of September 1, 2019)[1]

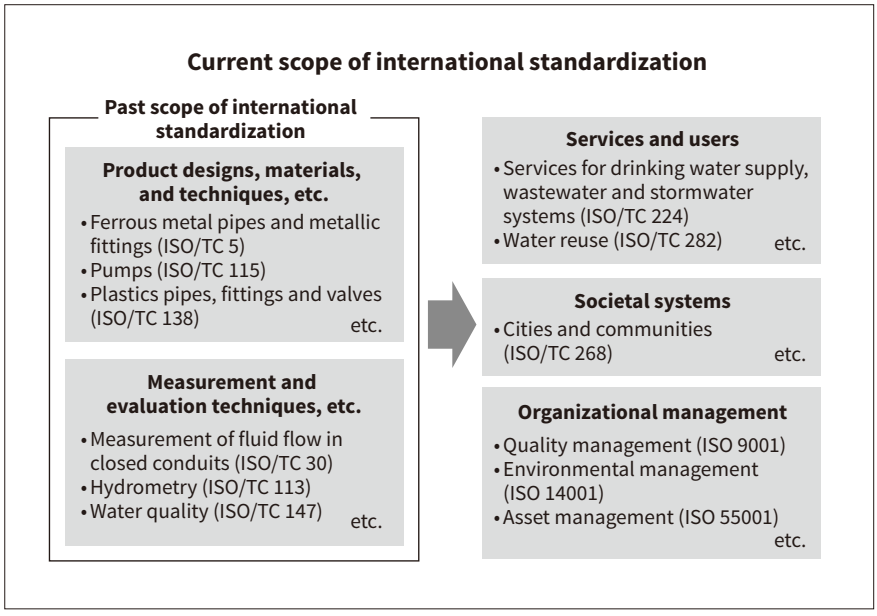
Work on international standardization in the water industry impacts on numerous ISO committees. Fields such as services and the resolution of societal challenges have been prominent areas for international standardization since the establishment of ISO/TC 224 in the 2000s.

ISO technical committee	Description (Secretariat)	Year established	No. of participating nations
TC 5	Ferrous metal pipes and metallic fittings (China)	1947	18
TC 8/SC 13/WG 3	Seawater desalination (China)	2015	—
TC 23/SC 18	Irrigation and drainage equipment and systems (Israel)	1980	10*
TC 30	Measurement of fluid flow in closed conduits (UK)	1947	20
TC 113	Hydrometry (India)	1964	17
TC 115	Pumps (France)	1964	20
TC 138	Plastics pipes, fittings and valves for the transport of fluids (Japan)	1970	39
TC 147	Water quality (Germany)	1971	43
TC 224	Service activities relating to drinking water supply, wastewater and stormwater systems (France)	2001	34
TC 251	Asset management (UK)	2010	35
TC 268	Sustainable cities and communities (France)	2012	46
TC 275	Sludge recovery, recycling, treatment and disposal (France)	2013	20
TC 281	Fine bubble technology (Japan)	2013	9
TC 282	Water reuse (Japan, China)	2013	23
TC 292	Security and resilience (Sweden)	2014	49
PC 316	Water efficient products - Rating (Australia)	2018	17
PC 318	Community scale resource-oriented sanitation treatment systems (USA, Senegal)	2018	32*

ISO: International Organization for Standardization TC: technical committee PC: project committee SC: sub-committee WG: working group
The number of participating nations is the total number that are participating (P) members. Japan is a P member of all except two committees*, where it is an observing (O) member.

Figure 1 — Expansion in Scope of Water-related International Standardization

Whereas work in the past was devoted to product standards that stipulated things like designs, materials, and measurement techniques, the scope of international standardization has since expanded to include service standards that are formulated from a user's perspective as well as things like societal systems and organizational management.



formulated from a user's perspective (see **Figure 1**). Recognizing this changing environment, Japan, too, has expanded the scope of its Japanese Industrial Standards (JIS) to include things like data and services[2].

Service standards that consider the users of those services have been a key focus at ISO/TC 224 since it was first established. Examples include guidelines for the quantitative performance indicators of water and wastewater services published in 2007 and requirements and guidelines on the efficient use of water (ISO 46001) in 2019. Besides, ISO/TC 282 deals with the reuse of municipal/industrial wastewater and has been developing guidelines to meet the user needs with regard to applications and quality grades of reclaimed water.

In both cases, this work on standardization in which international standards are developed from the perspective of service users as well as manufacturers and service providers can also be seen as being directed at resolving the challenges facing society.

3. ISO/TC 224: Services for Drinking Water Supply, Wastewater and Stormwater Systems

3. 1

Past Activities

ISO/TC 224 "Service activities relating to drinking water supply and wastewater systems – Service quality criteria and performance indicators" was established in 2001 in response to a French Republic's proposal. The committee's early work focused on developing international standards for performance indicators (PIs) for the quantitative evaluation of water and wastewater services, with guidelines for the assessment of service by water and wastewater utilities and users being published in 2007 (ISO 24510, 24511, and 24512)[(3), (4), (5)]. These stipulate the underlying concepts for nations to use when defining PIs for their own domestic standards, with Japan's domestic guidelines also being adopted. These were published in 2012 as JIS standards (JIS Q 24510, 24511, and 24512). These ISO standards are coming due for their 10-yearly review and Japan is among those involved in the discussions.

From 2008, the focus shifted to specific topics, including asset management, crisis management, and stormwater management. The scope of the committee was subsequently expanded in 2017 to "service activities relating to drinking water supply, wastewater, and stormwater systems."

Table 2 lists the ISO/TC 224 working groups and the standards they have published or are currently working on (as of September 1, 2019). Japan is participating in all of the working groups through its own national committee for working with ISO/TC 224 on water and wastewater. This national committee includes members from the private sector as well as public agencies.

3. 2

Current Activities

(1) Asset management

Social infrastructure such as water and sewerage needs to be maintained and managed appropriately over long periods of time. This has led to

Table 2 — ISO/TC 224 Working Groups and International Standards Formulated (as of September 1, 2019)

A total of 16 international standards relating to water and wastewater services have been published, with a large number of active working groups.

Working group	Description (Chair)	ISO standards under preparation or already published (standards indicated by [ ] are at the proposal stage)
WG 1	Terminology (UK)	24513 (published)
WG 2 (disbanded)	Service to users (Spain)	24510 (published)
WG 3 (disbanded)	Drinking water (Canada, Malaysia)	24512 (published)
WG 4 (disbanded)	Wastewater systems (Austria, South Korea)	24511 (published)
WG 5 (disbanded)	Examples of the application of 2451X standards (Canada)	24514 (published)
WG 6	Asset management (Germany) Drinking water (pipes and infrastructure) Wastewater (pipes and infrastructure) Water and sewage benchmarking Water loss management (Israel)	24516-1 (published), 24516-2 (published), [24516-5] 24516-3 (published), 24516-4 (published), [24516-6] 24523 (published) CD 24528
WG 7	Crisis management of water utilities (Israel)	24518 (published), 24520 (published), DIS 24527, CD 24541, WD 24519
WG 8	Onsite domestic wastewater management using low technologies (Kenya, Austria)	24521 (published), WD 24525
WG 9 (disbanded)	Decision support systems (Israel)	24522 (published)
WG 10 (disbanded)	Flushable products (Canada)	24524 (published)
WG 11	Storm water management (Japan)	FDIS 24536, WD 24539
WG 12	Water efficiency management (Singapore)	46001 (published)
WG 14	Effective corporate governance and service to users (France)	WD 24540

AWI: approved work item WD: working draft CD: committee draft DIS: draft international standard FDIS: final draft international standard

wider adoption of the concept of asset management, whereby social infrastructure is treated as an asset with enhancements to its functions and performance made through a planned and strategic approach to maintenance and upgrades. The ISO 55000, 55001, 55002 international standards for asset management were published in 2014. ISO 55001 specifies requirements for establishing asset management systems for social infrastructure and for administering, maintaining, and improving them. In Japan, more than 60 organizations had obtained ISO 55001 certification as of the end of May 2019, mainly in the water and sewerage, river, and road management sectors[6].

At ISO/TC 224, Working Group 6 (WG 6) chaired by the Federal Republic of Germany has formulated guidelines for the management of assets of water supply and wastewater systems (ISO 24516) using the ISO 55000 series of standards as a reference. ISO 24516 is made up of guidelines on drinking water distribution networks (Part 1), waterworks (Part 2), wastewater collection networks (Part 3), and wastewater treatment plants, sludge treatment facilities, pumping stations, retention and detention facilities (Part 4), with a compilation of good practice also planned. Japan is actively participating in and contributing to this work, primarily through utilities and public agencies.

Another area of work by WG 6 is a guideline for surveying water loss in urban supply systems (ISO 24528) based on an Israeli proposal. Japanese utilities are actively contributing their opinions, having experience with water loss management and being able to provide examples of advanced practices[7].

(2) Crisis management

Water and wastewater services face a wide variety of potential emergencies, including natural disasters and equipment faults. Established in response to an Israeli proposal, Working Group 7 (WG 7) has published guidelines on how water utilities should respond to unexpected crises (ISO 24518) and examples of good practice (ISO 24520). This involves collating management practices at each stage, from preparatory work and mounting an organized response when a crisis strikes through to the subsequent recovery and restoration of normal services. By drawing on experience that includes the Great East Japan Earthquake, Japan has had its views incorporated into the standards on topics such as cooperation between neighboring utilities.

Working Group 9 (WG 9), meanwhile, has produced guidelines on the event detection process (detecting and responding to events on the basis of various measurements and reporting) that were published as a standard (ISO 24522) in 2019. Japan's involvement has included presenting example systems, including systems that support decision-making on things like whether to halt river water intake when water quality incidents are detected upstream, and for preventing the flooding of sewerage infrastructure when heavy rainfall events are detected.

WG 7 is continuing to work on new proposals, including guidelines on alternative drinking water service provision during a crisis (ISO 24527), guidelines for the implementation of continuous water quality and operation mode monitoring systems in a drinking water network (ISO 24541), and water services for temporary settlements for displaced persons (ISO 24031)[7].

(3) Other activities

Through the Ministry of Land, Infrastructure and Transport (MLIT), sewerage utilities, and other relevant national organizations, Japan has a leadership role in Working Group 11 (WG 11) that produces standards for storm water management. Currently nearing completion are guidelines on flood prevention measures and related matters (ISO 24536) and a compilation of good practice that deals primarily with the planning and design stages.

As noted above, Working Group 12 (WG 12) has, in response to a proposal by Singapore, developed guidelines and requirements for water efficiency management systems intended for water-using organizations that are planning or implementing measures for saving water. These were published in 2019 (ISO 46001). The standard has attracted interest, including for the requirements it contains.

Work on a standard specifying principles for effective corporate governance of water utilities (ISO 24540) based on a joint proposal by France, China, and Australia commenced in 2018 at Working Group 14 (WG 14). Covering topics such as project management and evaluation, including public-private

partnerships, the standard has attracted increasing attention from interested parties.

3. 3
Future Plans

ISO/TC 224 has already published more than 15 international standards over the 18 years since it was first established. Nevertheless, it continues to work actively on developing standards in areas such as crisis management, water loss management, and corporate governance. It is anticipated that Japan will continue to contribute to this work through a partnership of industry, government, and academia.

4. ISO/TC 282: Water Reuse

4. 1
Past Activities

ISO/TC 282 "Water reuse" was established in 2013, chaired by Israel and with a secretariat from Japan and China. In Japan, the development of international standards on water reuse is promoted in cooperation with relevant domestic and overseas organizations under the leadership of a national committee administrated by the Director for Watershed Management at the Sewerage and Wastewater Management Department of MLIT.

Table 3 — ISO/TC 282 Working Groups and International Standards Formulated (as of September 1, 2019)

A total of 15 international standards relating to water reuse have been published, with a large number of active working groups.

Subcommittee or working group		Description (Chair)	ID number of ISO standard under preparation or already published
WG 1		Reuse of mine wastewater (Israel)	(Cancelled)
WG 2		Terminology (Japan)	20670 (published)
WG 3		Water systems for biopharma industries (Israel)	22519 (published)
SC 1		Treated wastewater reuse for irrigation (Israel)	
	WG 1	Treated wastewater use for irrigation projects Disinfection of treated wastewater	16075-1–4 (published) CD 22238
	WG 2	Adaptation of irrigation systems	20419 (published)
SC 2		Water reuse in urban areas (China)	
	WG 1	Centralized system design	20760-1 (published)
	WG 2	Centralized system management	20760-2 (published)
	WG 3	Reclaimed water safety evaluation	20761 (published)
	WG 4	Decentralized systems	DIS 23056
	—	Design principle of a RO desalination system	DIS 23070
SC 3		Risk and performance evaluation of water reuse systems (Japan)	
	WG 1	Health risk assessment and management Water quality grade classification	20426 (published) 20469 (published)
	WG 2	Performance evaluation General Environmental performance evaluation Performance evaluation of specific technologies (ozone treatment, UV disinfection, membrane filtration, ion exchange, advanced oxidation processes) Economic performance evaluation	 20468-1 (published) 20468-2 (published) DIS 20468-3, 5 (published) CD 20468-4, 6, 7 AWI 20468-8
SC 4		Industrial water reuse (China, Israel)	
	WG 1	Characterization of energy consumption for industrial wastewater treatment	21939-1 (published)
	WG 2	Industrial wastewater classification and treatment/reuse technology evaluation	DIS 22447 CD 23043
	WG 3	Industrial cooling water reuse Technical guidelines, Cost analysis	DIS 22449-1, 2
	WG 4	Pilot plan for industrial wastewater treatment facilities in the objective of reuse	DIS 22524
	WG 5	Guidelines for softening and desalination of industrial wastewater reuse	DIS 23044

RO: reverse osmosis

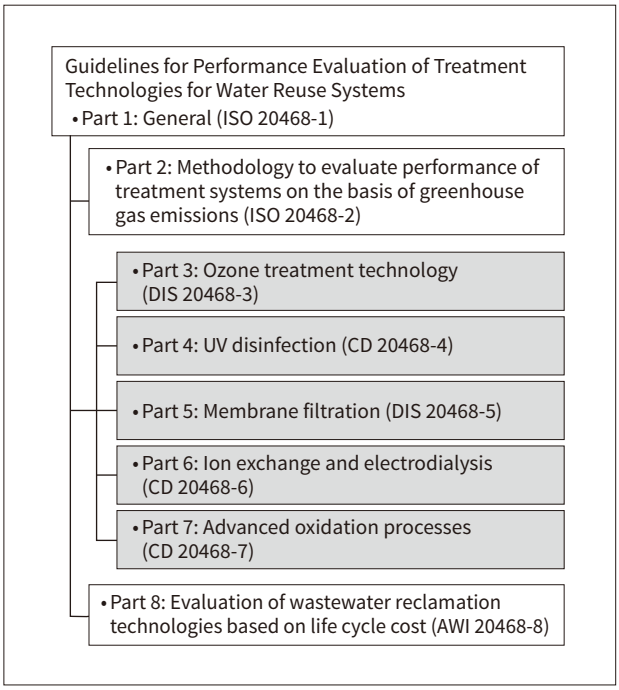
The inaugural meeting of TC 282 held in Tokyo in 2014 established Sub-committee 1 (SC 1) on treated wastewater reuse for irrigation, which is coordinated by Israel, Sub-committee 2 (SC 2) on water reuse in urban areas proposed by China, and Sub-committee 3 (SC 3) on risk and performance evaluation of water reuse systems proposed by Japan. SC3 in turn has established Working Group 1 (WG 1) to deal with health risks and Working Group 2 (WG 2) to deal with performance evaluation. WG 1 is working on: (1) Health risk assessment and management, and (2) Water quality grade classification. WG 2, meanwhile, is developing guidelines for (3) Performance evaluation of treatment technologies for water reuse systems. The guidelines for health risk assessment and management have been published as ISO 20426, the guidelines for water quality grade classification as ISO 20469, the guidelines for performance evaluation of treatment technologies Part 1 (general) as ISO 20468-1, and Part 2 (evaluation on the basis of greenhouse gas emissions) as ISO 20468-2[8),(9),(10),(11)].

A new joint proposal by China and Israel in 2016 saw the establishment of Sub-committee 4 (SC 4) on industrial water reuse, with Working Group 3 (WG 3) of TC 282 commencing development of a standard for water systems for biopharma industries (water for injection pretreatment and production systems) in 2017 based on a proposal by Israel. In Japan the Water Reuse Promotion Center is administrating a national committee for SC 4 and the Association of Membrane Separation Technology, Japan is dealing with WG 3.

Table 3 lists the ISO/TC 282 working groups and the standards they have published or are currently working on (as of September 1, 2019). Israel and China are leading the development of standards on methods for water reuse for irrigation, urban areas, and industry, while Japan, through SC 3, is pursuing the development of standards for risk and performance evaluation that can be applied across all areas of water reuse. SC 4, meanwhile, deals with the treatment and reclamation of industrial wastewater for reuse in industry and SC 2 (water reuse in urban areas) does the same for municipal wastewater.

Figure 2 — Structure of ISO 20468 (Guidelines for Performance Evaluation of Treatment Technologies for Water Reuse Systems) (ISO/TC 282/SC 3/WG 2)

ISO 20468 is made up of a section describing the general concepts that underpin performance evaluation (Part 1) and the individual standards that specify the application of the general concepts (Parts 2 to 8).



4. 2
Current Activities

(1) Performance evaluation of treatment technologies

Based on a proposal by Japan, SC3/WG2 is developing guidelines for performance evaluation of treatment technologies for water reuse systems. The working group is creating comprehensive guidelines for the performance evaluation of practical treatment technologies, with the standard being made up of a general section (Part 1) that describes the concepts of performance evaluation, especially the indicators and methods for evaluating the performance of treatment technologies appropriately, and the individual standards that specify the application of the general section (Parts 2 to 8). The individual standards cover evaluation of the environmental performance of treatment systems (Part 2), the performance of five process (technologies) commonly used in these systems (Parts 3 to 7), and the economic evaluation of the technologies (Part 8) (see **Figure 2**). The five technologies are: ozone treatment, UV disinfection, membrane filtration, ion exchange and electrodialysis, and advanced oxidation processes. The standard for

advanced oxidation processes (Part 7) is based on a proposal by South Korea.

Part 1, which describes the concepts behind the performance evaluation of treatment technologies, recognizes the importance of the two different types of performance requirements (functional and non-functional) that suit different purposes of water reuse, and specifies indicators and evaluation methods for both. Functional requirements require that certain criteria be satisfied and emphasize water volume and quality and the ability to eliminate microbes and pathogens so as to control risks to human health in particular. However, focusing mainly on non-potable water reuse, the specific evaluation methods primarily deal with defining monitoring indicators and setting criteria for the quality of reclaimed water intended for general use. Non-functional requirements, on the other hand, cover factors for such as environmental and economic evaluation where improvements are needed with respect to benchmarking and other criteria. Environmental performance indicators evaluate the performance of treatment systems on the basis of greenhouse gas emissions, while economic indicators evaluate them on the basis of life cycle cost (LCC). The specific methods are specified in Parts 2 and 8 respectively.

(2) Other activities

With regard to the activities of the different sub-committees proposed by other countries, SC 1 (treated wastewater reuse for irrigation) has already published a standard that includes guidelines for ensuring the safety of the crops produced. SC 2 has published standards on centralized systems for urban water use and is now working on decentralized on-site systems, developing design concepts for water reuse systems based on the size and layout of residential areas. Similarly, SC 4 is developing standards that cover areas such as the classification of different types of industrial wastewater and the reuse of industrial cooling water.

4. 3
Future Plans

The standards for performance evaluation of treatment technologies proposed and developed by Japan are expected to contribute internationally to sustainable water use through the export of high-quality infrastructure given an appropriate evaluation of long-term reliability, environmental performance (energy efficiency), and economics (LCCs and similar), factors that have not in the past received adequate consideration. These activities are being promoted through a partnership involving the Water Reuse Promotion Center, Kyoto University, and other relevant organizations as part of a project by the Ministry of Economy, Trade and Industry relating to international standardization for energy efficiency, with the work also being coordinated with the national committee administrated by Japan's MLIT. Further such cooperation will be needed in the future as partnership between industry, government, and academia on the development of standards becomes more essential than ever.

5. Conclusions

Hitachi Review last reported on developments in international standardization for the water industry in 2015[(12)], and the field has continued to see a lot of activity since then. Japan has the potential to make a major contribution through its experience with many different water treatment technologies and maintenance practices, and in areas such as disaster response. It is expected that this participation will continue in work on international standardization through partnership between industry, government, and academia to help resolve the global challenges facing water.

References

1) Technical committees, International Organization for Standardization (ISO), https://www.iso.org/technical-committees.html
2) Ministry of Economy, Trade and Industry, "Revision of the Japanese Industrial Standardization Act (JIS Act)," https://www.meti.go.jp/policy/economy/hyojun/JISho.html in Japanese.
3) ISO, "ISO 24510:2007 Activities relating to drinking water and wastewater services — Guidelines for the assessment and for the improvement of the service to users," https://www.iso.org/standard/37246.html
4) ISO, "ISO 24511:2007 Activities relating to drinking water and wastewater services — Guidelines for the management of wastewater utilities and for the assessment of wastewater services," https://www.iso.org/standard/37247.html

5) ISO, "ISO 24512:2007 Activities relating to drinking water and wastewater services — Guidelines for the management of drinking water utilities and for the assessment of drinking water services," https://www.iso.org/standard/37248.html

6) Japan Association of Asset Management, "List of ISO 55001 Certificated Organization," https://www.ja-am.or.jp/en/certified_org.html

7) H. Sasayame et al., "Overview of ISO/TC 224/WG7, WG9 and WG6 Meetings in Tel Aviv," Journal of Japan Water Works Association, Vol. 88, No. 5 pp. 43–50, Japan Water Works Association (May 2019) in Japanese.

8) ISO, "ISO 20426:2018 Guidelines for health risk assessment and management for non-potable water reuse," https://www.iso.org/standard/67972.html

9) ISO, "ISO 20469:2018 Guidelines for water quality grade classification for water reuse," https://www.iso.org/standard/68138.html

10) ISO, "ISO 20468-1:2018 Guidelines for performance evaluation of treatment technologies for water reuse systems — Part 1: General," https://www.iso.org/standard/68137.html

11) ISO 20468-2:2019 Guidelines for performance evaluation of treatment technologies for water reuse systems — Part 2: Methodology to evaluate performance of treatment systems on the basis of greenhouse gas emissions.

12) T. Tachi et al., "Contribution to and Future Prospects for ISO/TC 224 and ISO/TC 282 International Standardization Activities in the Water Industry," Hitachi Review, 64, pp. 618–623, (Dec. 2015).

Authors

Takahiro Tachi
Water Solutions Division, Water & Environment Business Unit, Hitachi, Ltd. *Current work and research:* General management of water infrastructure business and R&D. Certifications: Expert for Standardization, Japan (SE00346). *Society memberships*: Working group 7 under International Organization for Standardization (ISO)/Technical Committee (TC) 224, the Society of Environmental Instrumentation, Control and Automation (EICA), and the Catalysis Society of Japan (CATSJ).

Hiroki Nakamura, Ph.D.
Engineering Division, Water Reuse Promotion Center. *Current work and research:* Development of evaluation methods and international standards on water production technologies. *Society memberships*: Working groups under International Organization for Standardization (ISO)/Technical Committee (TC) 224 and 282.