

## **IAPWS President's Report**

Welcome to the delegates and everybody else to the IAPWS Meeting 2022 here in Rotorua, New Zealand. This time we have the traditional face-to-face type of annual meeting following the one in Banff (2019). We have been suffering from the pandemic COVID-19 and the CIVILIZATION DESTRUCTION in Ukraine by Russia. We hope that this aggression will stop as soon as possible. I thank the Chair of NZAPWS, Mr. David Addison, for great efforts in assembling this meeting. I am happy to have a chance of expressing my thoughts about the present situation and future perspectives of our organization, IAPWS,

Many thanks to the hard-working chairs, Karsten Meier, Nobuo Okita, Ken Yoshida, and David Addison, respectively, of the IAPWS Working Groups; TPWS, (Thermophysical Properties of Water and Steam), IRS (Industrial Requirements), PCAS (Physical Chemistry of Aqueous Systems), and PCC (Power Cycle Chemistry). All the chairs have worked elaborately to make creative contributions to IAPWS. Many participants have joined us to stimulate and deepen our discussions in the IAPWS 2022 meetings in New Zealand. Consider how best to utilize such IAPWS products as Releases, Guidelines, Technical Guidance Documents (TGD), and IAPWS Certified Research Needs (ICRN). All of these are characteristic of the IAPWS business. The useful IAPWS products are now popular all over the world. You can make access to the IAPWS website when you have any interest or question about water/steam (WS). I am sure you can learn about the treatment, handling, and monitoring of WS as well as the scientific formulation and meaning. Here are so many good engineers and scientists.

Where are we going now with Water and Steam in IAPWS? Any kind of technology is unavoidably subjected to changes after some level of saturation. In the ancient age, humans discovered how fire could be combined with hot water and steam to generate power required for cooking. In the longterm human dreams are variable and unsaturated. Hundreds of years after the Renaissance, James Watt succeeded in dramatically improving the steam engine that employs Water and Steam by a boiler. Many ideas employed at that time have been transferred to the technology used in power/electricity generation. Now we meet input and output energy problems as fuels are burned to transform the chemical bond energy to heat. For example, steam engines have been taken over by electric motors on a large scale. We should recognize electricity is required for our life; even EVs (Electric Vehicles) that can reduce carbon emissions and cool down Earth to some extent. EVs can't run without electricity. It is said: The cheaper the better. The cheaper the more poisonous. Don't forget about possible dangers around us. Nothing is perfect; Water and Steam are not exceptional.

It is highly expected that Earth can be cooled down by decarbonation or CCS. At present nobody knows to what extent we can reduce the global warming rate by sustainable energies. I hope something more will be done by the geothermal energy inherent in Earth. As mentioned in the last year's president statement, most of the energies, originate from the Sun as in the form of light and heat with the broad range of electromagnetic wavelength. The Sun is continuously producing huge amounts of atomic energy by nuclear fusion reaction of hydrogen. Geothermal energy is being born in the Earth's core that has nuclear fission reactions at the high temperature and high pressure. The nuclear high energy generated in the core is transformed into thermal energy through the deep and thick magma, hot melted rock below the Earth surface. Strong radiation is mostly confined in the core and screened and diluted before reaching the very thin Earth crust. Moreover, the use of geothermal energy can reduce the possibility of dangerous explosions of volcanoes by releasing the excess atomic energy in the Earth core and help us cool down Earth as well as the sustainable ones. Through geothermal power we can use inexhaustible WS as the heat energy carrier. WS are friendly to Earth while such light-element heat carriers as Li and He are very expensive. I mean WS power will continue under the influence of a variety of technological developments.

We tend to fear the radioactivity produced by nuclear reactions. When we feel a fear danger it is important to recognize the permissibility range of danger, the concentration, the degree of dilution or the strength. Of course, the time scale difference is to be understood between the two cases mentioned. Some of the nuclear reaction products have a long lifetime, say, a few ten thousand years that are much shorter than the time spent by human beings from the birth. We are not killed by viruses if the concentration is lower than the limit. The dilution and the decay timer of radioactive species are of great importance. Nuclear energies can't be neglected until sustainable energies have been sufficiently developed. We should be patient. Humans are tough. We are always thinking about devising a new way to overcome such rough water as a deluge and the strong electricity from lightning. We should be careful and sensitive enough to the possible negative factors brought to us by the demerits of technical developments and democracy. We love peace at any time and are to be responsible for the future.

The behavior of Water and Steam is controlled by the free energy changes. The hydration/solvation free energy is key to understanding metal/water interfaces. The stability changes in the interfacial binding among water, organics, and metals are not singly dependent on the products but also on the initial states. In the case of IAPWS businesses the hydration states sensitively vary according to the density and temperature of supercritical water. Recently novel developments have been made for a better understanding of interfacial structure, interactions, and reactions through molecular-level theoretical calculations. They can be used for complicated engineering and biochemical interfacial phenomena, where no analytical solution formulae are available yet. Machine learning using computers is changing the way of molecular simulations based on ab-initio force fields and dramatically expanding the size

and time scales. For the future of IAPWS we should work together to expand engineering by inventing new techniques/methods necessary for the safety and efficiency. Energy-security co-operation contributes to worldwide peace. We should not miss the good chance at this time. Thank you for your exciting attention. Finally, thanks Barry for your beautiful arrangement of the EC meetings.