Write-up for nomination of Dr. Norihito Tambo for the IWA Global Water Award

Professor Tambo has discussed and proposed the matters regarding to our metabolic activities of cities for many years on the understandings that "human beings are not a single element of the global echo-system that may simply co-exist in a commonsense term with other natural living beings" and "they are also an animal group which has to co-exist with other living things on a unique standing space with excessively high energy and resource consumption rates, floating on the sea of various natural echo-systems". He thought that "our urban areas must clearly define and establish the boundaries between human activity area and the natural world, minimizing the environmental load.

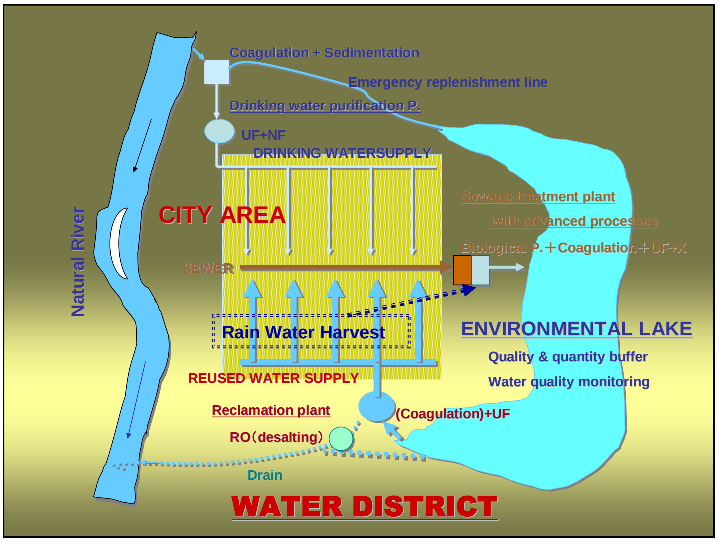
He proposed a new urban water system concept that "we must use materials and energy qualitatively depending on the purpose of uses, and establish a similar genuine structure to those of living things where an appropriate physiological re-use circuit is activated at a minimum energy-consumption rate". On his concept, cities must provide space similar to the animal body system, managed through restricted consumption of low-entropy energy such as electricity and petroleum with tactfully integrated inside reuse system, and running through strictly controlled boundaries with the least amount of energy consumption.

Human dimensions used the natural hydrological cycle as an animal and add special technological application to the cycle. He said that "human beings are super dominant animals on the earth; hence in keeping natural diversity and sustainability in mind, human dwellings should enclose their boundary by themselves in order to give freehand to natural living things as possible as man can".

Tambo's Water District Concept:

Professor Tambo advocated a new paradigm of water system for the 21st century post modern world that " the urban/regional water metabolic system of the next era will be designed to supply optimum quality of water for specific usages with necessary amount for the use through appropriate integrated systematic use and recycle of water resources at minimum cost (energy-consumption rate) with the technological and managerial goal that "the cities and regions involved in water usage and drainage (urban water metabolism) should take direct and proper responsibilities over the water environment". He suggested an importance to graduate from the rather rude conventional/modern water system to supply top quality water en bloc for every purpose (modern water supply system), and then to dispose the used water again en bloc as "sewage" (modern sewage work system). He thought that the conventional modern water and wastewater systems are possible to sustain only when ample regional water resources exist. He proposed the new post modern paradigm as early as 1970's for the 21st century and assumed that at least half century might be needed to materialize his concept in real city plan (1976、1994、2002). On that means he felt his great satisfaction and respect for the progress of Singapore water project of the recent years. It was hearsay that the city of Seoul refereed

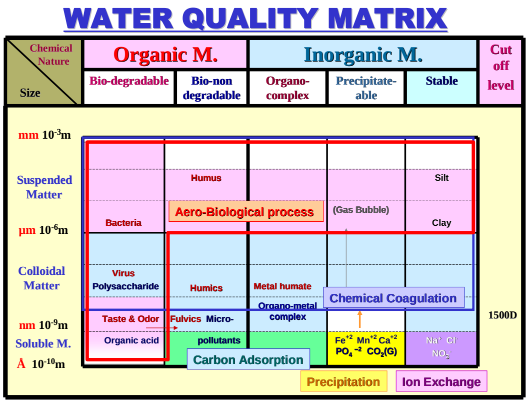
Tambo's concept in discussing the master water plan in early 1980's (Professor Emeritus Park Chung-Hyun, Seoul National University).

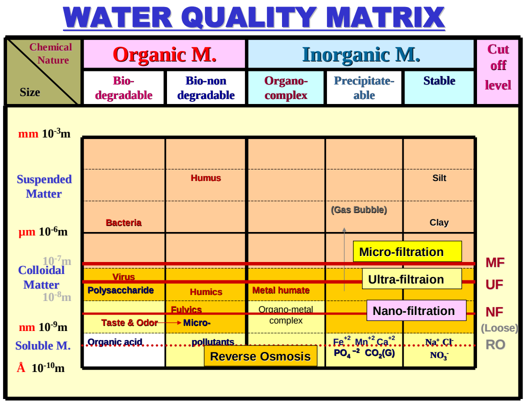


Here is an example of the possible structure to clarify the sustainability of cities within the echo-system chain by establishing a water district (a water metabolic space where cities take autonomous responsibility within the hydrological cycle) with a clear boundary drawn between the conservation area (natural system) and the controlled area (urban system) in the basin of high degree of activity, and high population density. The objectives for developing such a new system are considered to be 1) to draw a clear distinction between the water environment that should be conserved and those utilized, as well as to ensure clean/healthy life mode in the cities, 2) to enforce control only at the borders and/or only inside the urban controllable area, 3) to have a clear awareness with in the controlled area (inside the cities: citizens) of the fact that essential factor behind water utilization is water quality consumption, to device multi-stage (cascaded) water utilization, to minimize recycle of water that require additional energy consumption, 4) to limit controlled area as small as possible in order to stop unlimited spreading of water metabolism, keeping the metabolic structure within the boundaries that cities (citizens) are directly responsible for, and 5) to not let the increasing activity within the boundary affect the external environment.

Tambo's Water Quality (Treatability) Matrix :

For integrated engineering control and design of regional water and wastewater systems, sufficient information for evaluating quality change and material balance before and after the treatment that is essential. Moreover for the control of water quality in regions densely populated and/or highly industrialized, advanced wastewater treatments which do not depend upon natural assimilation capacities are required. Thus, an establishment of comprehensive method of treatability evaluation with respect to individual or combined water and wastewater treatment processes which is enable to describe whole treatment process trains on the same evaluation plane should be developed.





On that concept, Tambo's "Water Quality Conversion Matrix "was proposed and has been used widely for integrated/complex water system designs and has been used also as the stand point (bench mark) to discuss individual water and wastewater treatment process in integrated water system design (1978, 1980, 1989, 1992, 1998). Schematic two-dimensional water quality conversion matrix developed by Tambo et al. in the department of environmental and sanitary engineering in Hokkaido University is shown as the figures.

The size of impurities is the first parameter to characterize treatability in connection with the second parameter of the chemical nature. By introducing size parameter into quality/treatability evaluation, the use of simple chemical parameters can show much deeper meaning. Tambo et al. proposed the use of molecular size distribution in connection with DOC (dissolved organic carbon concentration) and E260 (ultraviolet adsorption at 260nm) to evaluate treatability of colloidal and soluble organics by coagulation, biological treatment, activated carbon adsorption etc. on the two dimensional matrix. In this discussion major organic substances on a regional water cycle are classified into two groups such as biodegradable (BOD) substances and biologically non-degradable (COD-BOD) substances. This pseudo-binary classification of organics is characterized by separating the total dissolved organic carbon (DOC) into biologically degradable DOC which is insensitive to E260 and biologically non-degradable DOC which is sensitive to E260. The latter part of organics in the natural water is mainly humic substances and can be characterized as two groups of biologically non-degradable colored organics separated into two parts by the molecular size around 1500Dalton (1989). The higher molecular weight humic substances, i.e. humic acid etc. having MW larger than 1500 Dalton, are characterized as such substances showing the ratio $DOC_{(mg/l)}/E260_{(1cm)}$ =20-30 , and the lower molecular weight humic substances, i.e. fulvic acid etc, showing a little higher DOC/E260 ratio as 50. Introduction of molecular weight analysis revealed an effectiveness of chemical coagulation for higher weight humics, other organics and turbidity which are E260 sensitive, and ineffectiveness for lower molecular weight fumics.

Lower molecular weight fumics (lees than1500 Dolton) which is E260 sensitive should be removed by activated carbon adsorption. Lower molecular weight E260 insensitive DOC can not be removed by carbon adsorption but is removed easily by aerobic biological processes and so on. As a main physico-chemical classification method Tambo et al. have used gel-chromatography to evaluate molecular weight distribution.

In natural water and wastewater in cities there are two kinds of organics of biologically degradable and non-degradable as mentioned above. The amount of biologically degradable organics (by biological wastewater plant and natural purification) can be calculated accurately using the ratio DOC/E260 of the sample on the base of biologically non-degradable organics having the ratio DOC/E260=20-30 or 50 for lower and higher molecular weight group respectively (1980,1992). After his information (1980, 1989), a rough index of natural organic matter (NOM) was proposed by American without molecular size consideration. Coagulation, carbon adsorption, precipitation as well as biological processes has been discussed from the viewpoint of kinetics and, sometimes, dynamics to fit the result on the matrix.

Since the late 1990's his work has step into membrane separation and he triggered the first Japanese national membrane project Mac 21 as the chair person. A new water quality conversion matrix of membrane separation and reactor design on the same manner developed as in conventional system has been established by him and his successors in Hokkaido University. Regardless to say, various prominent features of membrane separation may materialize his water district concept much more easily and clearly with much higher performance. He enjoyed the progress of the technology which accelerates his philosophy forward, but at the same time he feels some sorrow ness that he can not stand on the practical grand job line.

Tambo's research works from the very fundamental bottom:

Since he started his carrier of water research after receiving MS in Civil engineering from Hokkaido University in 1957, he has expanded his research activities. His works can be roughly classified into three categories: 1) Philosophical and strategic works such as on sustainability and urban metabolic system configuration. 2) System design and evaluation as water quality /treatability evaluation for system design and/or treatment process train design. 3) Kinetic analysis and treatise of various water treatment processes.

Tambo has been evaluated as the author of top ten papers of IWA Water Research Journal this year with Professor Watanabe, his successor of his chair at Hokkaido University, by the paper entitled "Physical Characteristic of Flocs (1) The Floc density Function and Aluminum Floc " (Vol.13,No5,pp409-417) published in 1979.(Japanese version was as early as in 1967 on J. Japan Water Works Association). A series of his works for coagulation and flocculation were evaluated as outstanding one, the above mentioned paper is only a part of the series, and his flocculation index GCT-Value(C :initial floc volume), instead of Camp's classic GT-vale, is recognized as standard design factor and often named Tambo's Factor (1965, 1979, 1991) Great numbers of papers more than 200 on ground water recharge, natural purification, eutrophication, coagulation, flocculation, sedimentation, flotation, filtration, carbon adsorption, ion exchange, MF/UF/NF membranes and aerobic/anaerobic biological processes with/without membrane etc. have been published for more than half century by Professor Tambo and his associate members. Those results are all included in the above mentioned strategic proposal and matrix evaluation procedures as well as directly used for plant design.

Tambo is a top leader of international water world and an originator of environmental education in Asia and Japan.

He was the first faculty member to establish first Japanese and Asian department of Sanitary (Environmental) Engineering at Hokkaido University as early as in 1957 and had led the department to one of the largest and strongest Environmental Department in the last half century. It is now one of the most powerful leading research group of membrane technology for water among many world institutes. More than 2200 graduates from the department worked all over the world in environmental engineering field. He was the first president of Japanese Environmental Professor's Association in 1998 and the 89^{th} president of Japan Society of Civil Engineers elected as first one from environmental engineering field. He is the vice president of Japan Water Forum organizing many world conferences and forums.

He served as a vice chairperson of the Council of International Water Supply Association and then become a vice president. He has worked for merging of two big water professional associations, i.e. International Water Supply Association and International Association on Water Pollution Research and Control, into amalgamated International Water Association of today as one of the eight merging members from two associations after 2 years difficult works in order to create new water association adoptable to carry integrated water system construction and management. He elected as the first single president of IWA, and was first president from Asia. In due course, he also tried to organize merged Asian water group of water and wastewater after 2 years discussions and trials, then ASPIRE has launched from the first conference at Singapore in 2005 successfully.

He was the first JICA (Japan International Corporation Agency) leader worked in Asian countries to organize professional training in Jakarta 1973-75, helped Asian Institute of Technology (AIT) in Bangkok and Thai training center in 1980's, and lectured to Chinese young professors and engineers in the difficult days just after China's Cultural Revolution was over in 1983 and cooperates until today. He always worked at the first and the most difficult stage of projects as the leader to open new horizon.

He received honorary Professorship, Doctor's degree and membership from many universities, academies and associations in the world by his long years distinguish works.