

The volume of the pool is 605T. The temperature is maintained at 30 degrees C.

Meanwhile, as addendum of the last paragraph, we wish to comment that the yearly numbers of the pool-bathers before installation of mixed oxidant solution was 75,000 at average, while after mixed oxidant solution, it can be said at 92,000 at average. Therefore the difference of before and after will be 23% increase (92,000/75,000). Monetary wisely, for the admission fee, the revenue has been increased by about 40%.

- Full Article Translated -

“Improvement of Water Quality of Tachikawa Citizen Swimming Pool – Surprising Effectiveness and Performance of Mixed Oxidant Generator Made in USA”

Hideyuki Sanmiya, Directing Manager of Tachikawa Gymnasium

November 2005

1. Preface

The new type of disinfection equipment installed in October 2001 at Tachikawa Citizen Swimming Pool locating at Tachikawa city being of US made. Two years have already passed since this mixed oxidant generator has been introduced in this Journal as the one of best sample which has been completely met a localization in compliance with the Japanese environmental requirement and the Japanese end-user's application method.

Four years, as of October, have passed since installation of first equipment by the Municipal corporation and it seems that the thinking way of the disinfectant to be used for the swimming pool has greatly changed at 23 Tokyo metropolitan districts and Tama area. The neighbouring cities to Tachikawa city having indoor swimming pool at Tama area has started their study to the disinfection equipment for the swimming pool for replacement with the existing chlorine system (sodium hypochlorite) from 2004 through 2005.

Some of the city has introduced and completed the installation of the mixed oxidant solution generator on the basis of taking due consideration of the first priority on the health of pool-bathers.

On the other hand, some sport clubs and a famous university locating at the vicinity of KITA district one of the 23 Tokyo metropolitan districts have installed the mixed oxidant solution generator for their indoor swimming pool in 2004.

The said university has decided to introduce and install the mixed oxidant solution generator just two weeks before their inspection visit to Tachikawa Citizen Swimming Pool because one of the members, who being the professor of the some university, of new type of disinfection equipment introduction committee has already known to hear the popularity in USA of the mixed oxidant solution generator having a great deal of superior advantages in respect of the disinfection effectiveness.

It has been correct selection to have introduced the mixed oxidant solution generator to our Tachikawa Citizen Swimming Pool, based on the first priority paid due consideration to the pool-bather's health aspect as well as the countermeasure against legionella pneumophila which being the common subject to the pool-bathers in the indoor hot water swimming pool.

2. Summary of Mixed Oxidant Solution Generator

Mixed oxidant solution generator system is potable water disinfection equipment developed through Los Alamos Technical Associates (LATA) in 1985 in response to the US Army's solicitation for alternative water purification system and afterwards commercialized. The technology is of disinfection system of the untreated water where the brine water is electrolyzed at electrolytic cell, and the solution produced at the both of anode and cathodic cell is being mixed up by which application as the mixed oxidant solution the disinfection is made. The compound of the mixed oxidant solution is the plural complex of the oxidant solution which being produced by electrolyzing the brine water.

By the synergy effectiveness of those compound, the action and oxidizing mechanism never experienced hitherto, occurs and forms the big flock in oxidizing and flocculating the organic as well as inorganic particles. With this effectiveness, the filtering power is continued for a lengthy time, resulting in removing the application of cleaning water for the filter materials possibly required. The disinfectant (mixed oxidant solution) produced by this system also has none of bad effect the chlorine causes individually and maintains FAC for a lengthy time. In Japan, the introduction of this equipment has been started in 1999, and the disinfection and odor countermeasure test at the field of the sewage facility, poultry shop was conducted, which effectiveness was practically demonstrated.

For the water supply of potable water, the system has been approved in February 2000 by the Ministry of Labour, Health and Welfare as an electrolytic equipment producing hypochlorous acid solution.

3. Characteristics of The Mixed Oxidant Solution

(1) Characteristics of the mixed oxidant solution

When the ammonia presents in the water, the conventional chlorine disinfection solution produces the combined chlorine (dichloramine, monochloramine and trichloramine) changing its formation at three steps. Those dichloramine, monochloramine and trichloramine have strong stimulant and presents the stimulant odor the chlorine causes individually. The burning of eye (conjunctivitis), itchy skin (especially pool-bather suffering from skin inflammation) and feeling of the dry hair of the pool-bather are attributed to those substances. The combined chlorine is detected as total chlorine residual, which however is primarily combined chlorine residual, and its disinfection power will be very weak and ineffective for the disinfection of the pool water in comparison with the FAC residual. However, it should be noted that the invasion of ammonia to the swimming pool is not completely prevented because the ammonia is secreted from the sweat or urine of the pool-bathers

In the contrast, when any of the ammonia compound present in the water, at the application of the mixed oxidant solution, hydrogen peroxide will convert ammonia to nitrogen(N_2) at the earlier stage than the timing of combining of hypochlorous acid compound and ammonia existing in the mixed oxidant solution. This reaction will cause none of combination of hypochlorous acid compound and ammonia, thus disappearing any of ammonia compound in the pool, and resulting in having left the oxidizing process of residing the FAC only. Hence, the pool water will cause none of feeling of stimulant odor, burning of eye and itchy skin on the pool-bather because it dose not contain any stimulant substance therein.

(2) The disinfection effectiveness of mixed oxidant solution and its characteristics

The mixed oxidant solution has disinfection power to root out the biofilm, which is a host for breeding legionella pneumophila. While this biofilm inhabits in filter water circulating pipe, it repeats the breeding at the inside of the piping and filter sump, in an amoeba appearance living in and breeds by reiteratively settling or peeling off there subject to the change of water flow. It will be not always stable to detect the legionella pneumophila In order to prevent occurrence of those phenomena well in advance, there will be no way except destroying the biofilm and completely eradicating the legionella pathogen. The biofilm has some extent of resistant power against the hypochlorous acid and never been killed at the lower concentration chlorine residual, hence being unable to be eliminated. However, it has been demonstrated at the actual test of application of the mixed oxidant solution that the mixed oxidant solution has such disinfection power that the biofilm has been completely destroyed and the legionella pneumophila has been eradicated only in around 3 weeks.

It will be supposed that at the time of mixing up of hydrogen peroxide produced at the anode cell and sodium hydroxide produced at the cathode cell, the solution will rapidly become alkaline, and the reaction will make sudden progress, having resulted in changing to superoxidant or OH radical, thus disinfecting the water by oxidizing and resolving the biofilm However, it is true that at the present those mechanism has not been yet cleared up.

Meanwhile, the chlorine residual concentration can be measured as ever experienced, because the main compound of the mixed oxidant solution is sodium hypochlorite. In other words, it will be possible that the dose of mixed oxidant solution will be made by automatic control of injection and at the lower concentration by using the conventional chlorine residual measurer.

However, in the case of using the conventional chlorine measurer for the purpose of automatic injection of the mixed oxidant solution, it should be noted that the characteristics of the make'r measurer must be checked because the hydrogen ion concentration shows before or after 8, when the mixed oxidant solution is applied to the swimming pool for disinfection.

(3) Strengthening of safety in the maintenance aspect

At the previous Tachikawa citizen swimming pool facility before introduction of the mixed oxidant solution, the chlorine's strong individual odour was felt even at only walking in the passage way just in front of the pool reception desk. Furthermore, many complaints from the pool-bather's of the chlorine gas odour in the air as well as of the locker's room heated up with high humidity which was caused by corrosion of air-conditioning duct located at the inside of the ceiling were frequently alleged to the management staff. In addition, it was a serious trouble required for the management and maintenance of quality of the swimming pool water because of the slime occurred at the floor of bottom of the pool incurred by the shortage of chlorine disinfectant and un-homogeneous FAC concentration residual happened. Furthermore, it was also observed that the heat exchange efficiency of the boilers was degenerating year by year, thus having resulted in bringing about a great deal of energy loss since sodium hypochlorite disinfection system did not have such characteristics to oxidize and dissolve the scale attaching to the piping or heat exchange area. However, all of those problem has been completely and simultaneously cleared up by the compound contained in the mixed oxidant solution.

The mixed oxidant solution generator uses the salt refined with high purity raw material, hence none of handling of the hazardous chemicals as well as storage of dangerous gas

were required at all and consequently avoided extensively possible hazard risk in comparison with the conventional disinfection unit. In addition, because, comparing with the ozone or chlorine dioxide disinfection unit, the handling of the mixed oxidant solution generator remains so far easy, the improvement in aspect of safety has been progressed extensively for the maintenance of the swimming pool. While this equipment is made of compact design and its installation is simply done whether it is newly installed or retrofitted, the operation of the equipment is achieved by full automation where the equipment is automatically started or stopped depending on the increase and decrease of the volume of mixed oxidant solution stored in the tank.

The produced mixed oxidant solution, as the characteristics of the solution, is superior at the point of stability of solubility. The solution has a little volatility and accordingly it can be said that the solution is very excellent disinfectant in way of administration of the building and its peripheral accessory facility due to no damages incurred to the building as well as its accessories by the solution.

Meanwhile, upon replacement of the swimming pool water, it always happens that the concentration of chlorine residual of waste water for discharge is footlighted as a likely problem, however, insofar as the mixed oxidant solution is concerned, such can be discharged at the lower level concentration, since the solution itself stands lower poisonous and also will be injected for disinfection at lower dosing rate even which keeps an excellent disinfection effectiveness.

Furthermore, it can be reported that the administration of the equipment will be done very simply as the composed components of the equipment are enumerated as control panel, cell, power supply, brine tank and mixed oxidant solution tank which is of very simplified configuration.

4. Improvement of sanitary and environmental aspect of the pool-bathers and its present status

(1) Chlorine gas concentration in the air of the inside of swimming pool

The record of comparison of chlorine gas concentration value actually measured in the air of three type of swimming pool facility (disinfection method is different respectively) is detailed in Table 1 below:

Name of Facility	Disinfection method	Before Miox installed	After Miox installed
Tachikawa Pool *1)	Mixed oxidant		0.0060 ppm
A city pool *2)	Sodium Hypo + Ozone	0.0146 ppm	
B city pool *3)	Sodium Hypo	0.030 ppm	0.0095 ppm

*Measurement method: JIS K0106 O-Tolydine

*Maximum level of chlorine ion gas concentration: 0.01 ppm

Note:

- 1) Already explained in the above, Miox was officially installed in October 2001.
- 2) Sodium Hypo + Ozone only is continuously being used.
- 3) Sodium Hypochlorite was being used until Miox was installed just in December 2004. The value of concentration after Miox installed is the value measured just after 2 weeks after Miox installation. Therefore, the value of chlorine gas concentration after Miox installed (0.0095ppm) is found a little bit worse than Tachikawa pool's

Now, comparing the chlorine gas concentration of A city pool with **Tachikawa pools**, it is found that the concentration of chlorine gas in the air of **A city pool** remains 2.4 times higher against Tachikawa pool (0.0146/0.0060ppm). And further, it is shown that the concentration of chlorine gas in the air of **B city Pool** before Miox installed remains 5 times higher than Tachikawa pool. (0.030/0.0060ppm)

The chlorine gas concentration before Miox installation of this **B city** seems at a glance no big difference against the maximum level of chlorine ion gas concentration (0.01ppm), but this substantially shows a higher value of 3 times against it (0.030/0.01ppm).

As **A city pool** is applying sodium hypochlorite together with ozone, the chlorine gas concentration in the air does not appear so higher, however, it should be noted that **B city pool** used sodium hypochlorite only shows the excessive value measured against the maximum level of chlorine gas concentration.

In the meantime, as far as the measurement data as above is reviewed, it can be judged that the disinfection of swimming pool by the mixed oxidant solution will maintain the normal air concentration level without giving any influence to the air above the swimming pool water. By the result of this measurement of chlorine gas concentration conducted this time, it is considered that the chlorine gas ion will not give the bad influences to building including its accessory facility but also cause sanitary and environmental problem to the people using the pool facility.

(2) Homogeneous chlorine gas concentration in the air at the inside of swimming pool

The mixed oxidant solution will not be subjected to the chlorine itself for its disinfection, and accordingly, has such characteristics as to provide disinfection effectiveness homogeneously to the any of water quality without incurring any change of disinfection effectiveness, whether the hydrogen ion will be apt to alkaline or acid or not. While the mixed oxidant solution contains very low level chlorine concentration of 0.3-0.45%, its spreadability will remain very high, hence, the homogeneous FAC concentration can be detected at any spot at the inside the swimming pool water.

In contrast, the chlorine concentration of the sodium hypochlorite, which being a liquid chlorine, and electrolyzed sodium hypochlorite will stand at around 12% and 1-6% respectively, which are found very higher, compared with the mixed oxidant solution. The chlorine containing ratio of the mixed oxidant solution will be quoted 1/35 and 1/3-1/13 times against the sodium hypochlorite and electrolyzed sodium hypochlorite respectively.

Even though the chlorine containing ratio of the mixed oxidant solution remains lower, the mixed oxidant solution will never form any stimulant presented by the conversion of the sodium hypochlorite as it will disinfect by the other oxidant (such as hydrogen peroxide, chlorine dioxide and ozone) without subjecting to the chlorine for its disinfection, hence the chlorine itself will remain stable.

As the oxidization speed of the mixed oxidant solution is 3,500-5,000 times which being very rapid comparing with the chlorine, and the chlorine remains in the solution as stable conditioned FAC residual, the solution is able to follow up, even if sudden load change happens, and does not form chlorine combination, which being one of the bad effect of the chlorine nor present the corrosive gas. Subsequently, the mixed oxidant solution is able to

maintain a stable disinfection effectiveness and keep homogeneous air filled with lower concentration of the chlorine gas at the inside of the swimming pool.

(3) Improvement of utilization circumstance of the building and its equipment

The facility in the building of Tachikawa Citizen Swimming pool was opened on February 1, 1993. Upon entering the side passage for the staff only then, a strong odour, which the chlorine causes individually was felt. In addition, while the chlorine odour and humid heat was presented in the man and women changing room which was caused by the corrosion of air-conditioning duct located at the inside of ceiling, the corrosion was spread over whole building of steel construction but the sashes remained in good condition as they were of the stainless made or special ordered aluminum made.

At the first stage, such disinfection method as the sodium hypochlorite being used together with ozone generator was employed for the disinfection of the swimming pool water. But the application of ozone generator bearing the running cost was suspended after 6 years passed and afterwards, instead, the supplementary disinfectant was being added.

However, in view of taking due consideration of aging of the building as well as likely worse influence to the pool-bathers causing by corrosive gas, an investigation and study started in 2001 for such unit as completely covering the safety and the mixed oxidant solution generator was introduced in October of the year.

In order to demonstrate the extent degree of the improvement of utilization circumstance of the building and its equipment, the measurement of chlorine concentration in the air of the inside of the swimming pool was taken, and as the result thereof, insofar as the data reviewed, it was judged that the air inside was not almost influenced and was kept same level of the normal air at the facility using the mixed oxidant solution.

Under such result, it was found that the mixed oxidant solution would be usable for disinfection of the swimming pool water and the standards sashes would be acceptable without using any corrosion-proof or special ones. This findings was a kind of big revolution greatly saving the building cost, by which it can be said that the condition of the circumstance letting the pool-bathers use comfortably and with peace of mind was provided

(4) Improvement of clarity of swimming pool water

The mixed oxidant solution has such characteristics as inducing the microflocculation so as to flocculate the very small particles suspending in the water. This action was hitherto considered as an individual phenomenon occurring in the treatment by ozone only, however, the mixed oxidant solution has destroyed that concept. The main compound of the mixed oxidant solution produced remains sodium hypochlorite, simultaneously generating complex oxidant solution containing ozone, chlorine dioxide, hydrogen peroxide, oxygen and oxygen.

It is assumed that the synergy effectiveness of the solution will promote the microflocculation action. At this Tachikawa Citizen swimming pool, after the disinfectant has been switched to the mixed oxidant solution, such result has been presented as the clarity degree going from around 8m thru 28m and the previous pool water has been changed to softened pool water having glittering.

(5) Disappearance of slime in the pool

The Tachikwa's pool is constructed of tile finish at the floor and side wall and such complaint as the floor being slippery at the time of application of sodium hypochlorite, however, since the mixed oxidant solution has been introduced, such complaints of slippery floor or slime has disappeared. Any slime or slippage on the tile of floor and side wall should be a phenomenon attributed to growth of the pathogen there which therefore will never occur, if the pool water is disinfected homogeneously.

The disappearance of occurrence of slime or white turbidity (this represents breeding of the pathogen) should be due to the mixed oxidant solution's characteristics of disinfecting the pathogen so rapidly which is cause of the slime and white turbidity, as the mixed oxidant solution is very high at the spreadability and so speedy oxidization of 3,500 thru 5,000 times to the chlorine.

(6) Safety of refined salt (NaCl) of raw material applicable to electrolysis

Recently it has been picked up as possible social problem that if the bromine ion is contained in the refined salt which is used for sodium hypochlorite generator etc., this bromine ion will convert the bromic acid (BrO_3) and give harm to the human being which being the substance for inducing the cancer by the bromine ion being oxidized in the electrolysis. Normally, the concentration of bromine ion in the refined salt manufactured from the seawater by ion exchange will remain very high extent to 300-500 mg/L and even the lower bromine concentration salt, which is applied to the water supply will contain about 50mg/L. At the compound table of the refined salt for electrolysis submitted for securing the pool-bather's safety, the purity of the said salt has been found more than 99% with bromine ion contained less 1 mg/L, which has been confirmed that it is such value as sufficiently securing the safety.

5. The proper management of the swimming pool facility and the mixed oxidant generator

(1) The installation condition of the mixed oxidant solution generator

While the heating spot such as cylinder is self-contained in the generator, it will make an emergency stop for the protection of the generator in letting the safety apparatus operate when the temperature at inside of room where the generator is installed will increase up to some extent temperature. Further, the installation of ventilation system will be inevitable in the aspect of safety because the small amount of the hydrogen gas is produced at the cathodic cell in the course of the production of the mixed oxidant solution. And taking consideration of the solution splashed to the other equipment by mis-handling of the solution, if the case, the washing station is required to locate at its vicinity.

Needless to say, such normal maintenance as same as the other equipment required will be also needed. Tachikawa has a contract with the maker for the maintenance of the generator.

(2) Optimization of the amount of new replenishment pool water

As the common subject for the maintenance of the swimming pool facility, the water quality control will raised, and one of the most important matter in that point should be new replenishment amount of the pool water In the normal case, the new replenishment water amount per day will be possible indication of 5-10% to the swimming pool capacity and will be adjusted depending upon the situation of the pool-bather's numbers. Meanwhile the

commentary literature (entitled as "The sanitary management of Swimming Pool") based on the "Tokyo Metropolitan Pool Regulatory" recommend that the new replenishment water amount should be precisely held by water amount measurer. The replenishment of Tachikawa's pool, accordingly, has been conducting for long years in compliance with the said commentary literature, however, since the conventional disinfectant has been switched to the mixed oxidant solution in 2001, the water quality control is being now done by making the new replenishment water amount per day 4-5% to the swimming pool capacity for the benefit of the characteristics of the solution.

(3) Proper control of the filtering equipment

As already mentioned above, the mixed oxidant solution has such characteristics as forming the big floc in rapidly flocculating after oxidization of the organic as well as inorganic particles in the swimming pool which is caused by its strong power of disinfection and microflocculation.

Due to this characteristic, the particles will be accumulated very easily and even if those accumulation is made up in the several layers on the filtering materials, the water passage will be very smooth with a little water resistance (loss of pressure) by the particles accumulated on the filtering materials, which therefore has caused the backwash frequencies decreased around one thirds hitherto conducted.

In this respect, however, it should be noted that the due importance is paid to the proper management (compliance with the backwash hours) of backwash as the flocculated particles are found more at the filtering materials than the conventional disinfection

Meanwhile, if the maintenance management of the disinfection by mixed oxidant is incorrectly done, the maintenance of the filtering unit must properly be conducted, because the pathogen's breeding phenomenon (white turbidity) occurs by the reason of the rapid increase of the pool-bathers as well as the shortage of disinfection concerned.

Letting introduce the actual sample of Tachikawa's pool for reference, backwashing, settling and normal washing are 15 minutes, 10 minutes and 15 minutes respectively, and conducting cycle of the backwashing is done by the timer of automatic setting, subject to the season and the number of pool-bathers. Further, one more example is here introduced for the new application method of the mixed oxidant solution. Tachikawa's pool is using the sand filtering unit where the sand is utilized for filtering. Normally, the average replacing cycle of the filtering material is reported 3-4 years, depending on the water quality. The Tachikawa's pool is still using the filtering materials which was replaced in April 1996. The 2000 years examination report of the filtering unit said that the said unit reached already the limitation of filtering ability. However, as the mixed oxidant solution was employed from July 2001, in 2003 years examination report (January), it was recommended that the filtering ability is acceptable for another several years. The reason why such happened is attributable to the fact that the treatment ability of the filtering material has been recovered because it has been activated by immersing in the mixed oxidant solution for the night at the end of 2001.

(4) The another advantage of the mixed oxidant solution

In 2004, the throat inflammation has extensively spread among the infants or school children, which used to be incurred by the contagion of adeno-virus in summer time through fall every year. The main symptom this disease represents is having temperature before and after 39°

C, and induces the symptom of throat inflammation and conjunctivitis such as ache and swell of throat and lymph gland swell. It is reported that those virus will be possible to be inactivated at FAC residual of 0.4-0.5mg/L will in the not so contaminated swimming pool.

The swimming training lesson for the school children is held 2-3 times every week in Tachikawa's pool sponsored by the Swimming Association. However none of any report or claims ever heard or received to the effect that the above disease occurred in inside of Tachikawa's swimming pool

In January through March this year, many of the people from Tokyo Metropolitan Tama Handicapped Center used this Tachikawa pool due to the repair works of their swimming pool, who to our great impression, has expressed their warm thanks to Tachikwa's pool's staff for the disinfecting condition of the pool being homogeneously kept and the swimming circumstances being fully satisfied.

(5) Improvement of the heat exchange ratio

At the period when the swimming pool water replacement was achieved on the end of December every year where the sodium hypochlorite disinfectant was used, around 10 hours was required for increasing the water temperature by about 3°C. However, to surprise, 5°C has been increased under the quite same condition after switched to the mixed oxidant solution. Consequently, it has been demonstrated that the mixed oxidant solution will dissolve by oxidization attached particles (like scale) at the inside of heat exchanger and hence increase the heat exchange effectiveness. In addition, energy reduction ratio has been conducted by 26% in comparison with the conventional unit. In other words, the energy reduction effectiveness will be remarkably materialized in the hot water swimming pool passed for years since its installation, if the disinfection method is switched to the mixed oxidant solution.

(6) Safety strengthening in the aspect of maintenance of the disinfection equipment

As the result of full and extensive study on the safety, upon the introduction of the new disinfection equipment on October 2001, which should be most important to the maintenance of the disinfection equipment, the following conditions have been focused:

- I. the equipment to be more simple.
- II. the chlorine concentration contained to be lower.
- III. any spot or area possibly touching the human body to be the lower voltage.

It has been the mixed oxidant solution generator that has completely satisfied the above-mentioned conditions. The chlorine concentration contained in the solution produced by the mixed oxidant solution generator will remain 4,500mg/l (0.45%) at maximum, which being judged very lower level and caused none of the damages on the skin or discolor or change of the color of any clothes, even though the solution has been splashed there. Also, the said equipment can be said very safe and give peace of mind

To the worker as the electrolytic voltage of the cell will remain very low of 9-12V at the direct current, hence, any possible hazard will be envisaged, even if it has been touched during working. The four years have passed since the mixed oxidant solution generator have been installed, it can be admitted that the selection has been quite correct and right even at the present.

(7) Actual operation status of the mixed oxidant solution generator

Here, the actual operation hours of the equipment so far made and its relation with its outer circumstances surrounded is introduced as per below:

Year	No.'s of Pool-bather	Quantity of Salt used (kg)		Operation Hours of Miox (H)	
		Per Hour	Per Day	Per Day	Per Year
2001	78,492	2.2	7.7	3.5	575
2002	82,923	2.5	6.5	2.6	953
2003	98,412	2.6	10.9	4.2	1,523
2004	92,114	2.6	13.0	5.0	1,793

Note:

(1) The swimming pool is open for year, which operation hours is 3,500.

(2) The Miox was installed in July 2001. Accordingly all of the numbers and operational hours described for this year stands for 6 months only.

Comparing 2002 with 2003 in the above, the numbers of pool-bathers and operation hours in 2004 have been increased by about 15,500 and about 570 respectively. Further, comparing 2003 with 2004, the numbers of pool-bathers have decreased by about 6,300 in 2004, while the operation hours have been increased by about 270 hours.

However, it will a fact that the amount of the refined salt, which being the raw material for the mixed oxidant solution generator, used per hours for all of 4 years has been almost constant. Namely, it can be judged that there will not be found any proportional relationship between the increase and decrease of the pool-bathers and the amount used of the mixed oxidant solution, as the other disinfectant dose, because the mixed oxidant solution does never disinfect by the chlorine.

Tachikawa's pool is frequently taking in the outside air from the outside of the pool building by opening the roof, when the outside and inside temperature of the swimming pool building. On that occasion, the amount of the mixed oxidant solution will increase as the ultra-violet ray comes together, for which it can be said the solution will consumed by the UV ray as the other disinfectant dose.

As conclusion, the mixed oxidant solution will consumed by the UV ray similarly as the other disinfectant dose. However, it will give strong and constant disinfection effectiveness to the rapid increase of the pool-bathers together with possibility of to a great deal of saving expected.

6. Ending

As of October this year, four years have gone since the mixed oxidant solution has been installed at Tachikawa citizen swimming pool. Tachikawa city is now conducting "Health Forming Works" based on the utilization of the swimming pool as the swimming pool does not bring any load to the human body. In addition, the underwater walking training as well as swimming training lesson together with the underwater exercise is being held, which is receiving a very good reputation from the pool-bathers. On the other hand, as for the swimming pool facility itself, Tachikawa swimming pool has received for this 4 years such high evaluation and reliability that even people suffering from the frail skin can use with peace

of mind Tachikawa citizen swimming pool thru the year as they don't feel any itchy or stimulant in the pool.

In conclusion, the first priority factor to be conceived for the swimming pool maintenance should be in selecting and using such disinfectant as the swimming pool remains very friendly to the human being body and its environment and provide the comfortable, safe and peace of mind swimming circumstances.