Environmental Diplomatic Leader
Special Coordination Funds for Promoting Science and Technology
Strategic Program for Fostering Environmental Leaders

振興調整費

DOMESTIC INTERNSHIP IN MINAMATA CITY AND MINAMI-ASO VILLAGE OF KUMAMOTO PROFECTURE

2nd – 4th December 2010

Program Organizer

Master's Program in Environmental Sciences
Doctoral Program in Sustainable Environmental Studies
Graduate School of Life and Environmental Sciences
University of Tsukuba

Participants of The Internship

Professors:	Prof. Naomi Wakasugi
	Dr. Takahiro EndoMaki
	Dr. Sun Xiaogang
Students:	Turdumatova Nazgul (Kyrgyzstan)
	Zagdragchaa Otgonbaya (Mongolia)
	Nguyen Trung Thuan (Vietnam)
	Zhu Aijun (China)
	Ni BingBin (China)
	Xiang Nan (China)
	Zhao Yingxin (China)
	Fang Hao (China)
	Yang Shengjiong (China)
	Gantulga Gonchig (Mongolia)
	Natsagdorj Natsagsuren (Mongolia)
	Khishigsuren Nyamsambuu (Mongolia)
	Pham Tien Dat (Vietnam)
	Hoang Thanh Tung (Vietnam)
	Fakir Muhammad Munawar Hossain (Bangladesh)

Visiting National Institute for Minamata Disease

Taking a lecture by profossor Yamaguchi on the experiment of mercury content in hair

Visiting memorial site of Minamata Disease

At Minamata memorial square

Visiting Bukeiyashiki (Samurai's house) in Izumi city

Taking a lecture by Mr. Kajihara (Director of Aso Tanibito Ecomusee) on the interaction between human activities and Aso grassland.

Joining in a local festival and making rice-cake at Minami-Aso village

Visiting a local farmer's house

EDL Minamata Internship Program

Date of Internship: December 2nd (Thu.) ~ 4th (Sat.) 2010

Place: Minamata City and Minami-Aso Village of Kumamoto Prefecture

Main Subject: (1) Minamata Disease and public health: the past, the present, and the future
(2) Co-existence between human and nature (rural lifestyle, nature and culture in Aso region)

Schedule:

Date	Time	Place	Aim
Dec. 2nd	08:10 - 10:05 10:30 - 12:30	Haneda – Kumamoto (flight) Kumamoto – Minamata city (by bus)	
	13:30 – 17:30	National Institute for Minamata Disease http://www.nimd.go.jp/english/index.html	Conduct an experiment on mercury content in hair
Dec. 3rd			
	09:00 – 11:00	Minamata Disease Municipal Museum http://www.minamata195651.jp/guide_en.html	Take an oral historian's (patient of Minamata disease) lecture.
	11:00 – 12:00	Minamata Disease Archives http://www.nimd.go.jp/archives/english/index.html	Watch exhibition on researches of Minamata Disease
	12:00 – 14:00	Minamata city – Izumi city (by bus)	
	14:00 – 16:00 16:00 – 18:30	Crane Park Izumi and Izumi Bukeyashiki Kumamoto city – Minami-Aso village (by bus)	Learn Japanese traditional culture and conservation of crane species
Dec. 4th	09:00 – 16:00	Aso Tanibito Ecomusee, field trip at Aso valley http://www.tanibito.com/indexen.html	Experience traditional rural lifestyle in Aso valley; think about the co-existence between nature and culture.
	16:00 – 17:30	Minami-Aso – Kumamoto Airport	
	18:25 – 19:55	Kumamoto -- Haneda	

Report on Minamata Internship (1)

XIANG Nan, ZHAO Yingxin, YANG Shengjiong, FANG Hao, NI Bingbing, ZHU Aijun

Contents

1. Introduction

Minamata disease (水俣病) is a neurological syndrome which affected in in the central nervous system. It is a form of poisoning caused by severe mercury assembled in human's body.

The symptoms of Minamata Disease include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech. In extreme cases, insanity, paralysis, coma and death follow within weeks of the onset of symptoms. A congenital form of the disease can also affect fetuses in the womb.

Minamata Disease was first discovered in Minamata city in Kumamoto prefecture, Japan in 1956. It was caused by the release of methylmercury in the industrial wastewater from the Chisso (チッソ) Corporation's chemical factory, which continued from 1932 to 1968. This highly toxic chemical bioaccumulated in shellfish and fish in Minamata Bay and the Shiranui Sea, which when eaten by the local populace resulted in mercury poisoning. While cat, dog, pig, and human deaths continued over more than 30 years, the government and company didn't take immediate measures to rescue local victims and prevent the pollution.

2. Lessons from National Institute for Minamata Disease

2.1 The Introduction of National Institute for Minamata Disease

The National Institute for Minamata Disease (NIMD) was established in October of 1978 in Minamata City, with the purpose of conducting comprehensive medical research to improve medical treatment for victims of Minamata Disease. Also, it can give balanced consideration to its deep historical background and social importance.

The red point is the location of National Institute for Minamata Disease in Minamata city.

NIMD is built on top of a mountain which can overlook the Minamata Bay as the following figure.

Figure2-1 National Institute for Minamata Disease

Its location is convenient for its research on Minamata disease. Although the mercury in Minamata Bay has been cleaned in the last century, there are still important meanings to continue research to prevent this kind of diseases happen again. Also, it was built to implement international, social and natural scientific research and to collect, manage and provide international and domestic information with regard to Minamata Disease.

Mercury was used as a catalyst in the production of acetaldehyde. The presence of mercury allowed effective generation of acetaldehyde in the manufacturing process.

Although a catalyst itself generally does not change during the chemical reaction, a reaction other than the targeted one is assumed to have occurred in the Minamata factory, and produced methylmercury that flowed out into the sea mixed with the wastewater of the factory.

Very high levels (more than 10 ppm) of mercury used to be found in the fish from Minamata Bay. The total amount of mercury used at Chisso Corp. is estimated between 380 and 455 tons, and more than half of it is considered to have been flowed out into the bay or been released into the air. Most of the mercury in the bottom sediment that was removed from the bay by dredging was considered to be an inert form of inorganic mercury (mercury sulfide).

However, no fish have a mercury content that exceeds the provisional standards set by the national government (total mercury 0.4 ppm; methylmercury 0.3 ppm) at present, according to the monitoring done by Kumamoto Prefectural Government. Therefore, the Governor of Kumamoto declared that the fish were safe in July 1997, and fishermen resumed fishing operations in Minamata Bay.

From the lecture, we can know that Minamata disease not only destroyed people's health, but also had other impacts such as adverse economic effects and anxiety regarding health.

Furthermore, local people in Minamata have suffering discrimination or prejudice for their diseases. The community was also damaged.

Minamata Disease have significant meaning to warning developing countries now, we should avoid the repetition of the “Treatment after Pollution”. However, it is still a common phenomenon that the developing countries give priority of economic growth without considering the expense of the human’s health and environmental pollution. Not only should we learn how to avoid environmental problems, but also how to take responsible when these problems happens. The relief of patients, administrative measures, and other lessons of Minamata disaster are valuable Heritage.

2.2 Experiments on Mercury Content in Hair

Hair is clearly the most suitable material for estimation of methylmercury exposure. Methylmercury is found to contaminate in fishes and other marine creatures at trace concentrations through an aquatic food web. Methylmercury is readily absorbed from the digestive tract after ingestion of the contaminated foods such as fishes, and thereafter concentrates in hair.

According to WHO, low dose exposure to Methylmercury will not threaten people' life, there is no health effect for adults with hair Hg level up to 50ppm. For pregnant women, any fetal effect will be impossible with hair Hg level below 14 ppm. However, if the hair Hg level is above these standards, the disease mortality is high. And so far there is no effective treatment for Hg poisoning, even if the patient is survived, they often come to the aftermath of nervous system disorders, resulting in permanent disability.

At the National Institute for Minamata Disease, we conducted an experiment on mercury content in hair with the instruction of researchers in NIMD. In our group, XIiang Nan and Ni bingbing did this experiment.

This experiment use the developed devices, the raw materials are hair(2mg) and chemical reagents. Firstly, we should cut scrap hairs with scissors at close site to hair root. A minimum amount requirement is twenty strands of hair each with about10 cm in a length. The shorter the length is, the more strands are required. After weighting the hair, we buried the hair in chemical reagents, put into the device with high temperature to text the Hg amount in Hair. The experiment result is that the Hg contents in Chinese is pretty low, less than 1 ppm. The amount of Hg in our hair is very safe.

However, we should know the effective treatment when exposed to a large amount of methylmercury. First, methylmercury excretion must be accelerated. There are several antidotes to stimulate methylmercury excretion. When the exposure is identified treatment using them must be carried out immediately. This treatment will minimize the neural damage in later periods.

Through the lectures and experiments we learn from NIMD, we have a better understanding of Minamata Disease, but also recognize the vital importance of environmental protection. Every country, especially developing countries should pay attention to environment, people’s

health in their economic and social development, in order to achieve the sustainable development in the long run.

3. Oral Historians' Lecture of Minamata Disease

3.1 Oral historians Experiences of Minamata Disease

Oral historians have been telling about themselves since October 1994. According to the records given by the museum, now there are thirteen oral historians who discuss various ranges of topics based on their personal experiences, such as fisherman's lifestyle, physical effect of Minamata disease, and discrimination and prejudice from the others.

On the day of Dec.3rd, Ms Shumiko Kaneko told us the consecutive tragedies of Minamata Disease that attacked her family. Ms Shumiko Kaneko was born on Jun. 8th, 1931. She is a Minamata disease patient certified in 1972. She lives in Myojin, Minamata city. She had a happily early life when she got married. Everything began to change after her first son was born. The little child showed some abnormal behavior when he grew a little older. She and her husband brought the son to local hospital and some big hospitals, but the illness was not confirmed. Later her husband also suffered sick. His extremities became disequilibrium and visual field became blurred. In the days later, she gave birth to another two sons. Unfortunately, she lost her husband and her second son from Minamata disease. Her oldest son had symptoms of the Minamata disease since his early childhood. Also, her youngest son is a congenital Minamata disease patient. Thanks to his sons, her illness did not develop serious. The old woman tells us how suffering her life is.

Actually, Oral historians's personal first-hand accounts of valuable experiences could move more eloquent. But it is cruel for them to repeat their own misfortune time and time again. Anyway, they help us to learn more about Minamata disease and realize how important it is to overcome Minamata disease. Their first-hand stories and their hope to the better future have been deeply impressed many visitors, especially, us.

3.2 Minamata Memorial

Minamata memorial square was completed in Oct. 1996, in memorial of the 40th anniversary of the official discovery of Minamata disease. It functions, 1) as a prayer and requiem for those sacrificed to Minamata disease 2) as a pledge, based on the experience of Minamata disease to never allow the repetition of such disease, and 3) to pass on the lessons of Minamata disease to future generations.

Minamata Bay was once a treasure of fish and shellfish, and a place for its citizens to relax. However, it is also the place where industrial pollution caused by heavy metals generated Minamata Disease. Then, more than a thousand precious lives were lost and more than ten thousand people were affected.

The citizens of Minamata who experienced this unprecedented industrial pollution have the responsibility to pray for the victims, to hand down the invaluable lessons learned from

Minamata Disease to future generations, and to warn the world not to repeat this kind of tragedy.

Minamata Memorial was built as a symbol of the heart of the citizens, as an appeal to recognize the preciousness of human lives and the tragedy of the pollution, and as a pledge not to let a manmade disaster happen again.

When deciding on the construction, Minamata Memorial Design Competition was held with the judge, architect Arata Isozaki. 454 designs by architects, artists, designers, and landscape artists from 18 different countries were submitted. From this competition, the Italian architect Giuseppe Barone was awarded the grand prize, and based on his plan, Minamata Memorial was completed in August 1996 on the grounds of Myoujinzaki.

Situated in the Myoujinzaki area overlooking the beautiful Shiranui sea are the Minamata Disease Municipal Museum in which important documents related to Minamata Disease are presented and preserved; the Kumamoto Prefecture Environmental Education and Intelligence Center in which you can learn about environment; and the Reclaimed Land Park of Minamata Bay which once swallowed many lives.

Minamata Memorial, united with these facilities, is the place which the visitors can pause for a while to gather their feelings and thoughts about the past and the future, to communicate with each other from the bottom of their hearts, and pray for a fresh start for tomorrow.

Here we pray and pledge…we shall never cause an accident like Minamata Disease, never let it happen again, and never forget Minamata Disease.

Spread all around the surface, there are 108 stainless-steel spheres. The incision made around the diameter of the spheres allows a dynamic perception of their firmness. In fact we can have a twofold sensation that they are rolling down toward the sea ‘a symbol of the pollution that happened in the fifties’ or vice versa that they are the victims’ souls gathering in silent warning.

The symbol of life-earth, fire, and water-is completed by the realization of a high crystal wall with a fine stream of water running over its surfaces. This vacuous picture turned entirely towards the sea, becomes a ‘Kaleidoscope’ of ancient feelings which bind man and the sea, and the past torments and the future expectations are recalled. A perfect system of artificial lighting assures the enjoyment of the work all day long; its nightly image appears like the reflection of the Shiranui’s seaman’s lights and of their ancestors’ souls.

The intention is to realize a ‘monument’ that does not crush man, but is a reflection of the way he feels.

4. Hyakken Drainage Outlet and Minamata Disease Municipal Museum

4.1 Hyakken Drainage Outlet

In the morning of 3rd,Dec, we arrived at the Hyakken drainage outlet, which was the originating point of Minamata Disease (Figure 4-1). From 1932 to 1968, methyl mercury was produced as a by-product in the process of manufacturing acetaldehyde and acetic acid at the Chisso company's Minamata factory. It was discharged into the sea (also into Minamata River) along with waste water from the factory, and polluted Minamata Bay. As a result, Minamata Disease occurred all around the Yatsushiro Sea area. It is said that between 70 and 150 tons of mercury have been discharged into Minamata Bay, resulting in an accumulation of mercury-containing sludge that reached up to 4 meters thick around the Hyakken drainage outlet. In 1977, Kumamoto Prefecture began pollution prevention work to remove the sludge, and after 14 years and approximately 48.5 billion yen, both the task of dredging accumulated mercury-containing sludge in Minamata Bay, and that of reclaiming the land, were completed in 1990. At present, treated factory waste water as well as household waste water flow from the Hyakken drainage outlet. Monitoring has been carried out to confirm the safety of fish and shellfish in Minamata Bay. No matter how great an amount of money or effort is spent, it is impossible to return a once-polluted and all but destroyed environment to its original state. We must recognize this as a lesson to the human race.

Figure4-1 The Hyakken drainage outlet

After watching the Hyakken drainage outlet, we went to visit Minamata Disease Municipa1 Museum (Figure 4-2) and Minamata Disease Archives. Minamata Disease Museum is established in order to preserve the valuable resources related to Minamata disease, dubbed the "origin of pollution". Moreover, in a hope that such a terrible case of pollution may never occur again in the world. The museum tells the peril of Minamata disease from the perspective

of the victims. Their experience of suffering from pain and discrimination is expressed through visual displays, as well as by oral historians who give personal and first-hand accounts of their experience. Information is presented to enable visitors to clearly understand the issues surrounding Minamata disease. The museum has become a place for learning human rights education.

4.2 Minamata Disease Municipal Museum

Figure4-2 Minamata Disease Municipal Museum

The museum shows the history of Minamata disease by using panels, photographs, screening room and video monitors for easier understanding. The first sight of the museum is a fishing boat (Figure 4-3), the instruction of which said: The sea has lived up to people's enthusiasm, efforts and prayers. In the display room, the model map (figure 4-4) showed the victims who were confirmed by official government. In fact, the number of victims who suffered the Minamata Disease is far more than the official confirmation. On a wall of the display room is the introduction of original Shiranui Sea (figure 4-5): As Minamata Bay was a spawning place for fishes, it was once one of the most abundant areas in the Shiranui Sea. People called it "Welling sea" because there welled up many fish one after another there. They got a large catch of fishes and spend a rich and peaceful life around the Minamata Bay. However the discharge with poisonous mercury from Chisso polluted the sea and fishes. People did not know what had been happening in the sea yet, and kept on eating the fishes. Eventually they began ill to have disease gradually and their peaceful life was taken away. We also learned the history and scientific research of Minamata Disease (figure 4-6 and 4-7).

Figure4-3 Utase fishing boat

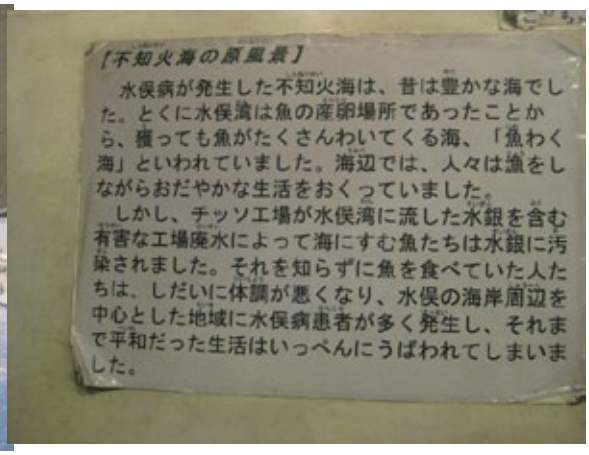


Figure4-5 The introduction of original Shiranui Sea

Figure4-4 The number of official confirmed victims of Minamata Disease

Figure4-6 The history of Minamata disease

Figure4-7 The scientific research of Minamata disease

From this study, we have learned the circulation of mercury in the body. Most of the mercury entering the body is absorbed by the intestines. Mercury circulates throughout the body and accumulates in great quantities particularly in the liver and kidneys. It gradually accumulates in the brain and causes destruction of the cerebral nerve cells. In the photo gallery, it showed the Minamata Bay contaminated sludge disposal project (figure 4-8). The Kumamoto prefectural government removed sludge from Minamata Bay to inside of Shinsui shore (Eco Park), and restored. And the restoring construction of Minamata Bay took 14 years and cost 485,000,000 yen. In 1990 the restoration was finished and there appeared a reclaim land, the spread of 58.2 hectare. It is 13.5 times spreads of Tokyo Dome, and called Eco Park Minamata. The park is abundant with green trees, symbolizing preservation of environment and good health.

Figure4-8 Minamata Bay contaminated sludge disposal project

Near the Minamata Disease Municipal Museum is Minamata Disease Archives (figure 4-9). In June 2001 the Minamata Disease Archives opened adjacent to the Minamata Disease Municipal Museum and the Kumamoto Prefectural Environment Center, as part of the National Institute for Minamata Disease.

Figure4-9 Minamata Disease Archives

The functions of the institution are: (1) To collect, organize, store information relating to Minamata disease and conduct research activities on Minamata disease; (2) To disseminate information on Minamata disease to researchers and citizens through exhibition and information network; (3) To provide opportunities to enhance academic exchange on Minamata disease. It aims to contribute to enhance further understanding of Minamata disease, to transmit the lessons learned from the experiences of Minamata disease, and to advance research activities on Minamata disease and mercury in general.

The exhibition in Minamata Disease Archives showed outline of Minamata disease including cause, mechanism, health effects; Investigation of the cause of Minamata disease; Knowledge on mercury; Mercury pollution problems in the world. From “the mercury pollution in the world” exhibition (figure 4-10) we learned there are several possible sources of mercury pollution. Pollution caused by factory drainage or organo-mercurial pesticide has been decreasing though it still continues to occur mainly in developing countries.

Figure4-10 The mercury pollution in the world

On the contrary, mercury pollution caused by small-scale gold mining activities or mercury from closed mines, as well as mercury polluted soil in the sites of demolished chemical factories, have become serious recently. It is urgent to take measures for mercury pollution and to study its health effect in pollution-ridden areas. We also learned the development in mercury analysis (figure4- 11).

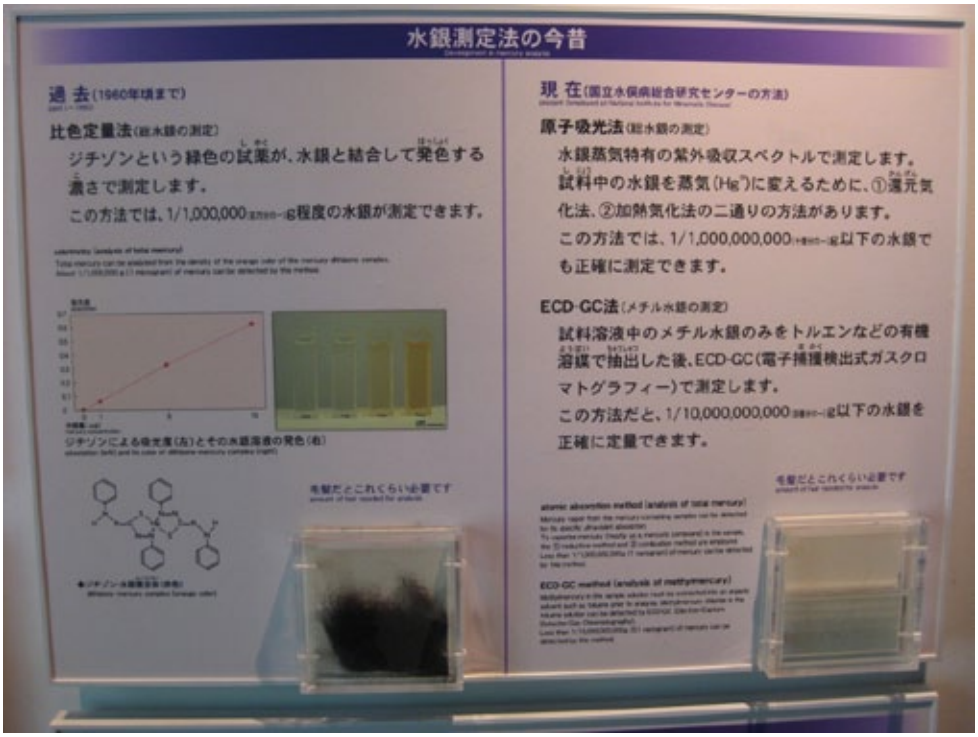


Figure4-11 Development in mercury analysis

Before 1960, colorimetry was used and total mercury can be analyzed from the density of the orange color of the mercury-dithizone complex. About 1/1,000,000 g (1 microgram) of mercury can be detected by this method. At present, atomic absorption method and ECD-GC method are used to analyze total mercury and methyl mercury, respectively. Besides, we saw a model of an acetaldehyde plant (figure 12). It is used when methyl mercury was supposed to be generated in the largest volume as a by-product. When acetaldehyde was made from acetylene and water, methyl mercury was supposed to be produced in the reactor vessel. Methyl mercury contaminated the vacuumed evaporator, the rectifiers and was then discharged via the drain. On the first floor of Minamata Disease Archives, there was an aerial view of Shiranui Sea area (figure 13), which described a beautiful outline of the area near Minamata. From this view we deeply felt that “The purpose of industrial activity is not merely to seek profit, but to support a truly abundant life”.

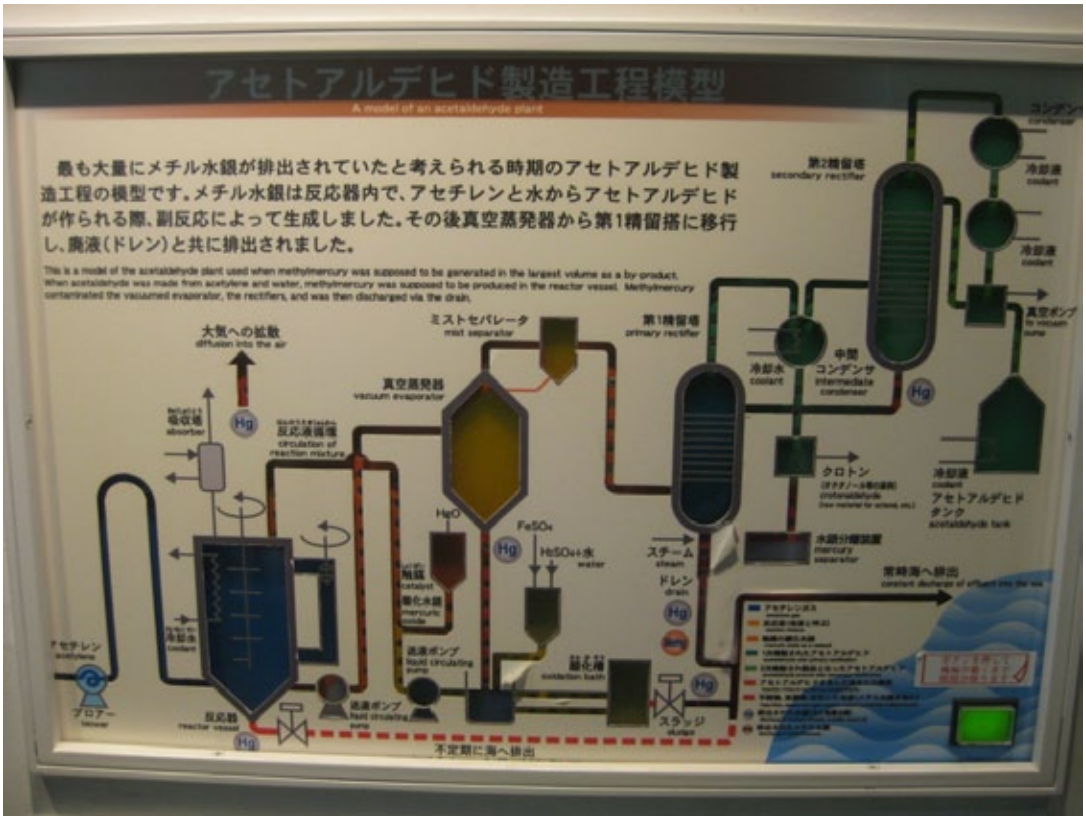


Figure4-12 A model of an acetaldehyde plant

Figure4-13 An aerial view of Shiranui Sea area

5. Tour in Kumamoto City

5.1 The landscape on the way

The national area of Japan is 377.7 thousand kilometer square and approximately 70% of area is covered by forest. Japan is a country of ‘green’, and Kumamoto located at western of central of Kyushu, landarea is 7.402 thousand kilometer square, the landform of Kumamoto is surrounded by Mild Mountain with average altitude of 1000 meter at northern, eastern and southern area of Kumamoto respectively.

Figure 5-1 The map of Kumamoto city

Many beautiful landscapes exhibited there by natural, such as Aso volcano and Suizenji.

Figure 5-2 Aso volcano（阿蘇山）

Figure 5-3 Suizenji(水前寺)

Aso volcano located at northeast of Kumamoto and this is a overlapping active volcano. It erupted and collapsed for times and formed a natural volcano museum. Various scenes of volcano were exhibited there.

Figure 5-4 The grassland on Aso Mountain

5.2 About Samurai

Samurai generated at epoch of Heian (The 9th century), accepted by government after a long time development, and became to dominant rank in society last to Meiji reformation, they were similar with feudal lords and knights in Europe.

Figure 5-5 The abiding house of Samurai

Figure 5-6 The famous samurai in history of Japan named Hatori Hanzo (kensen) was buried in Kumamoto.

5.3 The Natural Park and Farm

As we mentioned before, Japan is a country of ‘green’, although the time of internship was almost winter, but still no influence on sight because of climate. Many tourists stopped here and drunk the water of spring which was the symptom of happiness and good fortune.

Figure5-7 The Natural Park

We still have been to a village in Kumamoto to making the sense on aura and sentiment of life, also walking in the peacefulness and quiet.

Figure 5-8 The farm in Kumamoto

6. Conclusion and Enlightenments

After internship in Minamata city, and depth understanding of Minamata Disease, we have profound understanding of the relationship between economic development and environment, health influences. Through Experiences and lessons of Minamata Disease, we should realize that if manufactories, governments only focus on short-term economic interests, there will be even more serious losses in our society.

In Minamata internship, we got a lot of knowledge and also knew a lot of sense; human beings should pay much more attention to the nature when we change it. Sustainable development should be performed along with the development of human society. Human should pay attention on environment pollution, the Minamata Disease was just a bell which given to us by nature. There is only one earth in our space and we should protect it as we take care of our baby. Only in this way, can we have a bright future.

As research students in life and environment sciences, we should always put human's life at first. Also, every country, especially developing countries should pay attention to environment, people's health in their economic and social development, in order to achieve the sustainable development in the long run.

Report on Minamata Internship (2)

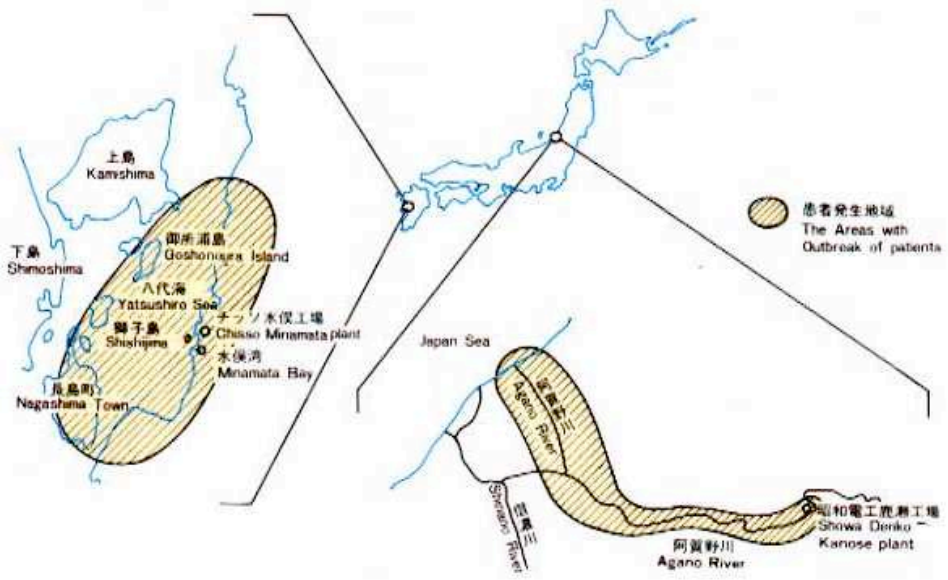
Nguyen Trung Thuan, Hoang Thanh Tung, Pham Tien Dat, Fakir Muhammad Munawar Hossain

1. Introduction

1.1. Background

Minamata disease is the best know health disaster caused by environmental pollution. It is reported for the first time in history. Minamata disease that led to such tragedies is one of the most serious environmental pollution in the world as well as in Japan. This disease struck at the small coastal town of Minamata, Japan in 1956. This was the first outbreaks of Minamata disease. In fact, it was confirmed that there were 54 patients had Minamata disease and 17 of the patients died in the areas around Minamata Bay in Kumamoto Prefecture. Wastewater from the process of acetaldehyde production by the Shin Nippon Chisso Fertilizer Co., Ltd, which was a causative factor for Minamata disease in Kumamoto Prefecture, completely stopped by the cessation of operation of production facilities in May 1956 (NIMD, 2001). The present name of the company is Chisso Corporation, which hereafter called Chisso (MDMM, 2007).

After 12 years, in May 1965 this disease also occurred in the Agano River in Niigata Prefecture. In July 1965, it was confirmed that 26 patients had Minamata disease and 5 patients died Operation of the process of acetaldehyde production by Showa Denko, which was a causative factor for Minamata disease in Niigata Prefecture, was ceased in January 1965 (NIMD, 2001; MDMM, 2007) (See fig 1).



Source: MOE, Japan 2002

Fig 1: Map of the areas with outbreak of Minamata Disease

It was estimated about 200,000 affected by Minamata disease and about 20,000 patients of this disaster. Approximately 10,000 people are not yet identified as having Minamata disease. People were seriously affected by methylmercury poisoning. This kind of poisoning affects the nervous system (brain) and liver (MDMM, 2007).

1.2. Mechanisms of Minamata disease

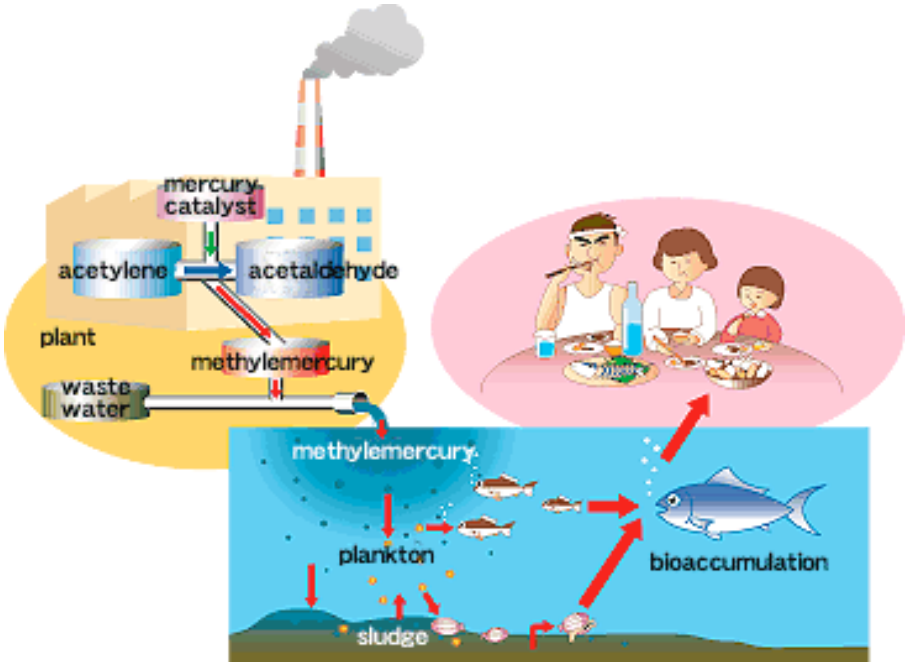
The methylmercury compounds cause Minamata disease. These compounds are expressed using the CH_3HgX chemical formula and molecular weights vary depending on X. Compounds with chlorine are called chloromethyl mercury (methylmercuric chloride). When X is a halogen the vapor pressure is high. In particular, when X is chlorine or bromine, the vapor saturation concentration at 20°C is very high at 94 mg/m^3. However, halogen compounds do not dissolve easily in water but are soluble in organic solvents. Other compounds of this type include ethyl mercury (C_2H_5HgX) and propyl mercury (C_3H_7HgX) with the methyl group substituted by some other alkyl groups (JPHA, 2001). Methylmercury is taken into the hair in concentrations that are 250 to 300 times the blood concentration. In addition, the mercury concentration in hair reflects the blood concentration at the time that part of the hair was formed. If the hair is divided in the length direction and each segment is analyzed, the exposure history can be elucidated. Mercury does not accumulate in the hair in exposures to mercury compounds other than alkyl mercury. If high concentrations of mercury are detected from the hair in these other types of exposures, the mercury is probably adhering to the external part of the hair. Hair samples should include 20 or more strands of hair (1 cm long, 10 mg), cut from the base, located behind the ear. Collect the strands so the base can be confirmed (tie bases together with thread, affix to adhesive tape, etc.). Place the sample in a polyethylene bag, close the opening, and store at room temperature. Since methylmercury is easily taken into the red blood cells, the mercury concentration in red blood cells is higher than the concentration in serum (plasma) (JPHA, 2001).

(Source: NIMD, 2010)

Fig 2: Machine to determine Methylmercury in hair

1.3 Pathway of Methylmercury from factory to human

The source of the methylmercury was a chemical production factory that utilized mercury as a catalyst in one of its processes. Surplus mercury was discharged via spill-water into a close bay, and this mercury accumulated in bottom sediments. Microbes in the sediments converted the mercury to methylmercury that eventually entered the food chain of fish and resulted in very high methylmercury levels in the local fish. Methylmercury in fish is absorbed in intestine and distributed through blood stream. Minamata had a substantial population of small family fisheries, and these families were the most affected (JPHA, 2001).



Source: NIMD, 2010

Fig 3: Illustration of pathway of Methylmercury from factory to human

1.4. Signs and symptoms of Minamata Disease

1.4.1 The process of onset of Minamata Disease

There is the possibility of occurrence of Minamata Disease, like the poisoning by other substances, when the quantity of methylmercury (the causal substance) accumulated within the body reaches the threshold value for the onset. Because methylmercury taken into the body is discharged outside of the body at the same time, on the condition to continue that a certain amount of the substance is taken into the body methylmercury will not be accumulated in the body in excess of the limit accumulative amount correspond to the amount of continuous intake.

And the knowledge is supported by "IPCS Environmental Health Criteria 101 Methylmercury" issued by WHO in 1990.

1.4.2. Diagnosis of Minamata Disease

Because each neurological sign and symptom of Minamata Disease can be caused by other diseases as well, diagnosis of Minamata Disease is carried out for people who have been exposed to methylmercury on the basis of the diagnostic criteria which is composed of combinations of signs and symptoms in order to raise probability of decision. While diagnosis is easy for typical patients who have all major signs and symptoms, in the case of incomplete type or mild type of the disease, it may be difficult to distinguish it from other diseases.

There is a variety of symptoms ranging from slight numbness of fingers to loss of ability to talk and walk. The persons with particularly serious ones of these symptoms lost consciousness, moved the extremities and the body terribly, cried by day and night, or scratched off the wall. After that, they died around one month after the onset (NIMD, 2001).

Table 1: Various Indices showing the Threshold Value for Onset of Symptoms in Human Body[1]

Average daily intake	3-7 μg/kg
Body burden	15-35mg（50kg weight)
Total mercury concentration in blood	20-50μg/100ml
Total mercury concentration in hair	50-125μg/g

(Source: "IPCS Environmental Health Criteria No.101 Methylmercury",etc.)

2. Lessons From Minamata Disease

2.1. What can developing countries learn from "Minamata disease"?

Minamata disease was considered a disaster for the human who living in Minamata bay during 1950s. That identifying the roots of problems responsible for disease is a greatly precious lesson for any single country in the world, especially in developing countries, where the governments try to make a great effort to achieve economic growth while abandoning or paying less attention to environmental protection.

Economic growth versus environmental protection

- ❖ Industrial activities benefit economic growth but damaging environment and public health

Presently, many developing countries pay concentration on economic growth as high as possible. The government even adapts with the fact that they have to trade-off between

[1] Level at which neurological symptoms would appear in the most sensitive adults

economic growth and environmental protection. This situation induces lack of effective regulations to manage and protect environments. As a result, many terrible environmental problems occurred in both urban and rural area, which seriously impact public health and sustainable development.

Wastewater is directly disposed to the river without treatment

The river is seriously polluted

Many fishes and creatures died of pollution

Fig 4: Many factories are the cause of river water pollution in Vietnam

Community is surrounded by industrial zone, a lot amount of wastewater, which is not treated, directly disposed to the river or sea. Actually, many people have to afford with strange disease. Many areas are namely as "cancer villages" because the people living there have to use polluted water for decades, and the rate of people infected cancer is by far higher than that of other area. For example, in the case of Thach Son cancer village'', one commune of northern province of Phu Tho (Vietnam), each year there are at least 3 people die of cancer because this area is severely polluted caused by chemical industrial factory based on the upstream of river (MONRE, 2009). This situation popularly occurred in many developed countries in industrialized period, and still being a pressing problem until present. Therefore, the lesson learnt from Minamata disease is very precious at the point that the economic growth must be associated with environmental protections. The developing countries should not easily trade-off between economic growth and environmental protection. Accordingly, the central government should establish effectual policy and regulations for ensure environment. The policies should also pay special attention to manufactories producing or using much chemical substance. In which, it is very essential for building the monitoring systems aiming to make sure the waste that has to be standardly treated before disposing.

❖ Gold mining - the emerging threat for human life in developing countries

Mercury is an indispensable catalyst in gold industry, it become dangerously if there isn't measure to treat mercury after using it. Gold mining occurred in many developing countries. Whatever is it legal or illegal activity, this is the hazard for environmental pollution because seriously pollution in gold mining area that adversely affects human health. Gold mining is the second largest source of mercury pollution to the environment behind burning fossil fuel. The US environmental program agencies (2010) report that gold mining is responsible for the

largest release mercury to the environment, especially this industry discharge about 400 metric tons of airborne elemental mercury annually.

In Nigeria, the result of environmental check in Zamfara, where gold mining happen illegally, the phosphorus is severely infected everywhere such as soil, food and vegetable that caused by additives used in this industries. According to the report of survey United Nation (2010), the mercury concentration in the air is 100 times higher than acceptable standard; this is causing a lot of diseases for people and abruptly deaths in this region.

In Mongolia, where is considered one of the largest gold mining storage in the world, the gold mining occurred prevalently. JICA (2007) reported that in only 5 year, in Selenge River, the worker here discharged about 2.4 tons mercury, in which 54% is disposed to the air and the rest is buried in the land. WHO also alarm that the mercury pollution in many area of Mongolia is 230 times exceeding acceptable level. Many livestock died of drinking water in the river, and a lot of people infected mercury born disease. The situation become more and more serious, even it cannot be restored if the government does not have policy judiciously. These are only two case of gold mining affecting to environment and public health. Actually, there are many mercury pollution cases happened throughout the world that require the government to have specific measures to solve these problems as soon as possible.

2.2. What should the governments do?

After realizing the severely impact of mercury pollution in general and environment pollution in particular on public health, many governments have policies aiming to solve environmental problems, in which the policies for managing enterprises potentially causing environmental pollution play decisive roles. We are all accepted that the enterprises play a pivotal role in economic growth of each country. However, they are also the threat for environment if they are not interested in environment in their activities. Minamata disease also raises the social responsibility of enterprise and awareness of the people for environmental protection. It also implies the solution that the prevention is better than cure. It is too late if the serious disease happens like the cancer disease or Minamata disease; once the victims become the final stages, we cannot cure it even if we have more advanced technology equipment. For example, there are also many treatments by using medicines aiming to force methyl mercury to be evacuated from body in initial periods, but the result is not achieved as expectations. The only treatment is just engaged the temporary of symptoms and rehabilitation. Thus it is essential to strongly emphasize that actions for environmental protection should be conducted as soon as possible; it will be too cost to treat and recovery. It is enterprise that has social responsibility for producing commodity to meet the human's demand associated with protect human's health from environmental degradation.

Globally, the Minamata disease is also the warn for the world in the context of climate change and global warming today. Climate shock happened everywhere, the environment is polluted due to the untreated wastes disposed by human activities and industrial factory, and green house gas concentration is increasing daily, forcing human beings to live in a world of

diversified pollution. It is time to have global actions by cooperation between both developed and developing countries to protect environment and keep the world cleaner that ensures sustainable development.

2.3. Other lesson from Minamata disease

Other lesson we learn from Minamata disease is the action of insiders and reaction of government in environmental and health problems. As we already knew, in 1959, the Minamata disease research group of Kumamoto University announced that organic mercury is the cause of the disease that affects the central nervous system. Later the same year, the Food Sanitation Investigation Council (then the Health and Welfare Ministry) determined that "Minamata disease is a poisoning disease that affects mainly the central nervous system and is caused by the consumption of large quantities of fish and shellfish living in Minamata Bay and its surroundings, the major causative agent being some sort of organic mercury compound". However, it was only in 1968 that the central government announced the unified view that a methyl mercury compound released from Chisso's Minamata factory causes Minamata disease. Unbelievably, after that, Chisso Corporation continued to release wastewater containing organic mercury to the environment meaning that they continued afflicting more people.

In this point, we can see the delay of the Government in responding to such disaster which directly affects human life. It took 12 years after the discovery of the disease for the official views to have been offered by the Government. 12 years was too long for such problem, many people died and more severe suffered and much more toxic discharged into the environment. If the Government timely responded to stop the polluter, the damages to people and environment were much less.

Government should pay serious attention in such big health issue. Recently on May 01, 2010, Mr. Yukio Hatoyama (formerly Prime Minister) became the first prime minister to attend an annual memorial event for the Minamata disease victims held in the city and apologized for the government's failure to prevent both the spread of the industrial pollution and the outbreak of the neurological disease. At the same time, the Goverment started accepting applications for new measures to relieve unrecognized Minamata disease sufferers. The new relief measures will pay money (¥2.1 million) and provide a monthly medical allowance (¥12,900 to ¥17,700) for each unrecognized sufferer. The association of plaintiffs will also receive ¥2.95 billion. The measures are expected to cover more than 35,000 sufferers - a great step forward

Fig. 5: Formerly Prime Minister Yukio Hatoyama at 2010 memorial event for the Minamata disease

Source: Cabinet Secretariat, Cabinet Public Relations

in helping Minamata disease sufferers. So, it took 54 years (more than haft of a century) to come up with the new relief measures. The earlier relief measures in 1973 by agreement between Chisso and sufferers failed because it was so strict that many people failed to be recognized as sufferers.

Government must have quick response to minimize pollution as soon as possible in order to protect human life especially vulnerable people such as poor people, pregnant women and babies. To stop the pollution, we need of environmental monitoring. If we well and timely conduct this activity, the pollution could be stopped much earlier meaning that the damages would be reduced, the disease scale would be narrower. This is very meaningful to developing countries where industrial activities are expanding uncontrollable in environment. Monitoring at least provides us current view of industrial affects to environment in order to have active measure managements.

In Minamata disease, we also recognize the discrimination to Minamata patients. Many families had to move to other areas to avoid discrimination from people. The lesson we learn is that the more difficulty we face, the more solidarity we need, as Japanese word Moyai. The discrimination in Minamata disease tells us that we should be sympathy to the victims when they not only need supports but also sympathy from society. Also, the role of media in this case is very important. It is the means which transfer information of the disease to people, directly and quickly. Parallel with media is the role of science. Science should work independently from government so that it could provide precise information reflecting current situation of the disease.

3. Conclusion

Environmental pollution by toxic substances such as methylmercury led to serious damage including health damage and destruction of the living environment. In the case of Minamata Disease, there are many lessons that we could learn form this disease. The citizens of Minamata believe that it is our responsibility to pass on the lessons of this tragedy to all people not only in Japan but also in the world. The lessons of Minamata disease serve as a warning and reminding us those tragic pollution disasters such as Minamata disease must never be allowed to happen again anywhere on the earth. The lessons of Minamata disease have been interpreted from a wide range of perspectives and from different angles. We need to consider the lesson of environmental protection to be the first among these lessons. We would like this first lesson to be shared by all people all over the world as well as commit ourselves to make it known, just how crucial careful consideration of the environment is (MDMM, 2007).

In fact, this disease warns that man-made (industrial development-centered) pollution of environment led to serious results to human beings. Furthermore, vulnerable population including the poor, child, and fetus are the first and severe affected. In fact, they are victims of this disease; nevertheless, they received strong stigma and discrimination from society. Many

scientific fields such as clinical medicine, epidemiology, chemistry, biology, etc… should pay an important role independently from political power and link to solution policy to save people and cease the hazard as soon as possible. Moreover, Media, national and regional government also should be responsible for the issue. This disease reminds that industrial companies have to give their responsibilities for sustainable environment. We should consider environmental monitoring by integrated many effective tools and co-operated many scientific fields.

References

1. Cabinet Secretariat, Cabinet Public Relations Office, Japan, 2010
2. JPHA – Japan Public Health Association, 2001. Preventive Measures against Environmental Mercury pollution and its health effects.
3. NIMD - National Institute for Minamata Disease, 2001. In the hope of avoiding repetition of the Tragedy of Minamata Disease - What we have learned from the experience of Minamata Disease. Report of the social scientific study group on Minamata disease.
4. MDMM – Minamata Disease Municipal Museum, 2007. Minamata disease – Its history and lessons. Published by Minamata city Planning Division.
5. MOE – Ministry of the Environment, 2002. Minamata Disease The History and Measures. Available on the website: http://www.env.go.jp/en/chemi/hs/minamata2002

Report on Minamata Internship (3)

Zagdragchaa Otgonbaya, Khishigsuren Nyamsambuu, Turdumatova Nazgul,
Natsagdorj Natsagsuren, Gantulga Gonchig

As we know the history of Minamata disease, I express very deep sorrow to Japanese.

Unfortunately, we couldn't imagine about infectious disease specially failures based on the methyl mercury before the Global Health class in our course, knowledge from the health effects of methyl mercury in EDL special lecture by Pr.Satoh and the Internship in Minamata arranged by professors who belonging EDL programm.

1. What is "Minamata disease?"

When, where?

The Minamata disease is one of the world first industrial pollution-triggered disease become apparent in Minamata city in 1956 and occurred all around the Yatsushoro sea.

What were the source and causer?

The source of the methyl mercury was a chemical production factory that used mercury is a catalyst in one of its process and acetic acid at the Chiso company's Minamata factory. As well as the municipal government's pay attention was insufficient and there weren't strongly regulations for environmental protection and public health.

How was conducted pollution process?

Surplus mercury was discharged via spill-water into a near by bay, and this mercury accumulated in bottom sediments. After that microbes into sediments converted the mercury to methyl mercury, which eventually entered the food chain of fish and caused very high methyl mercury levels in the local fish.

Who were victims of the Minamata disease?

Hundreds of people were seriously affected by methyl mercury poisoning, and many victims died. Minamata had a substantial population of small family fisheries, and these families were the most affected.

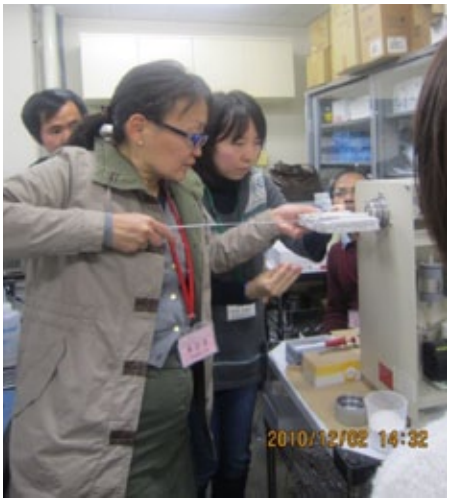
What were the symptoms of Minamata disease?

Early reports and documents describe various symptoms of Minamata disease. Based on these reports and patient's remarks, they can be summarized as follows: Many patients had a sensation that a warm was crawling around their mouths, or pain in tips on their fingers and toes.

Other patients said that they suddenly found themselves being so clumsy that they were unable to use chopsticks and button their shirts (Source from Minamata Disease Municipal Museim). And also this type of poisoning affects the nervous system, with symptoms ranging from slight numbness of fingers to loss of talk and walk.

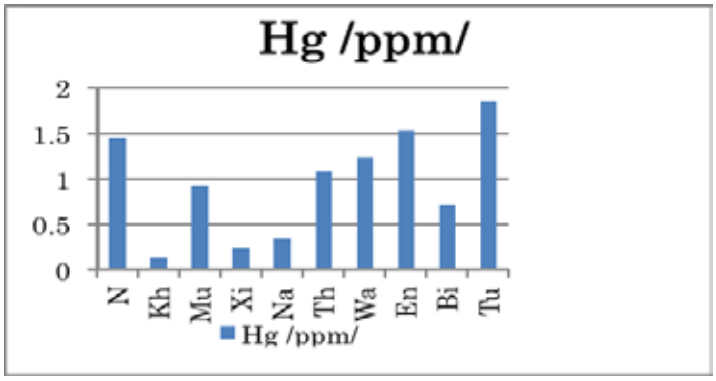
2. Hair mercury is an exposure index

We mainly aimed that focused on mercury content in hair to explain human health effects of low dose exposure of mercury.



Through our Minamata Internship 2th of November, one of purposes of our visit in National Institute for Minamata Disease (NIMD) was analysis and monitoring on mercury content in hair. Totally, 8 interested students and teachers all of us were involved the experiment on mercury content in hair. Time of the laboratory experiment took about 5 hours because of per person spent over 30 minutes. Not only we participated the experiment on mercury content hair, but also we conducted the mercury content analysis in hair by ourselves under the guides from the professor and young researcher of the NIMD. Fortunately, no one have health effect for their with hair Hg level up to 50 ppm according to standard from the WHO.

№	Name	Mass /ng/	Hg /ppm/
1	N	8.720	1.456
2	Kh	0.597	0.139
3	Mu	4.339	0.921
4	Xi	1.246	0.241
5	Na	1.529	0.338
6	Th	3.655	1.078
7	Wa	4.653	1.238
8	En	11.840	1.536
9	Bi	4.128	0.714
10	Tu	11.111	1.858



Because of the analysis result shown that the lowest one who was level of 0.139 ppm mercury content in hair, therefore highest one who was level of 1.858 ppm mercury content in hair from the all of involved people in experiment (Table 1).

According to WHO, there is no health effect for adults with hair Hg level up to 50 ppm. For pregnant woman, any fetal effect will be impossible with hair hg level below 14 ppm. Average hair Hg levels in Japanese are 2.5 and 1.6 ppm for males females, respectively.

3. What can we learn from "Minamata disease"?

Other counties could be learn prevent problems that is caused by the risk of methyl mercury, the government and enterprises of any countries which are threatened by natural resources utilization by water and soil are strongly involved to control pollution's effects on the one hand and to learn and protect their public health situation based on experiences from Minamata disease on the other hand due to failures from the Minamata disease.

3.1 Minamata disease history

Minamata disease (水俣病, Minamata-byō), sometimes referred to as Chisso-Minamata disease (チッソ水俣病, Chisso-Minamata-byō?), is a neurological syndrome caused by severe mercury poisoning. Symptoms include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech. In extreme cases, insanity, paralysis, coma and death follow within weeks of the onset of symptoms. A congenital form of the disease can also affect fetuses in the womb [1].

Minamata disease was first discovered in Minamata city in Kumamoto prefecture (fig.1) [2], Japan in 1956. It was caused by the release of methylmercury in the industrial wastewater from the Chisso Corporation's chemical factory, which continued from 1932 to 1968. This highly toxic chemical bioaccumulated in shellfish and fish in Minamata Bay and the Shiranui Sea, which when eaten by the local populace resulted in mercury poisoning. Since the victims lived near the Bay, this neurological disorder was named Minamata disease (MD). After official recognition, people were afraid of this strange disease, as they thought it might be infectious. As the investigation into the cause took a long time, the outbreak of Minamata disease continued and expanded along the Yatsushiro Sea coast. Along the clinical observation and autopsies Kumomoto Medical School with other Study Group member reported that the disease was not an infectious disease as had earlier been suspected, but a kind of heavy metal poisoning, and that the poison had entered the human body through consumption of fish and shellfish caught in the area.

That time the physicians were shocked at the high mortality rate for the new illness: it was found that thirteen other people, including those from small fishing villages near Minamata had died with the same symptoms, as well as local domestic animals and birds. It was found that a common factor of all the victims is that they all ate large quantities of fish from

Minamata Bay. It became clear that the poisonings were linked to a production facility in Minamata making ethanol and PVC, a type of plastic, owned by the Chisso Corporation, a hydro-electric power company that produced chemical fertilizers. Eventually, the medical research team reached the tentative conclusion that the deaths were caused by mercury poisoning through the consumption of contaminated fish and shellfish; mercury was being used by the Chisso complex as a reaction catalyst.

MeHg chloride, which was produced as a by-product in the acetaldehyde plant of the chemical factory located there, was detected in the wastewater from the acetaldehyde plant, but not from its vinyl chloride plant. Initially, this contaminant had been released into Minamata Bay for more than a decade causing severe acute poisoning cases in the vicinity. Acetaldehyde is an intermediate by-product in the manufacture of plastics and its production had expanded steadily to meet the growing demands for plastics at that time. In order to increase production, the factory had expanded the manufacturing plants and changed the drainage site from Minamata Bay to the mouth of the Minamata River [3]. This resulted in further dissemination of the pollution into the surrounding waters of the Shiranui Sea. The factory continued the production of acetaldehyde and the release of MeHg into the sea waters until 1968. Because fishing in that part of the Shiranui Sea was never restricted, people living in coastal areas–many of whom depended on the sea for a large part of their food supply–were exposed to MeHg by ingestion of polluted fish [4] resulting in chronic MeHg poisoning.

From 1932, for approximately 40years, the Chisso Minamata factory used mercury as a catalyst in the process of manufacturing acetaldehyde and vinyl chloride. During that period about 70-150 tons or more of mercury, mixed in with effluent from the factory, was discharged into Minamata Bay. Sedimentary sludge, which settled on the floor of the ocean, containing more than 25ppt total mercury, had an approximate total volume of more than 1.51 million m3 and an area exceeding about 2.09 million m2. There were also areas in the depths of the bay, where the thickness of this sludge reached 4 m.

Even after the Chisso Minamata factory stopped manufacturing acetaldehyde in 1968, fish and shellfish containing levels of mercury exceeding the provisional regulatory standards on the level of mercury. Many local residents left in anxiety and fishing industry also was severely hindered therefore on October 1, 1977, the Minamata Bay Pollution Prevention Project was initiated to dispose the sedimentary sludge contacting over 25ppm of mercury (the standard calculated based on the regulatory standards for the removal of bottom sedimentary sludge, established by the Environmental Agency).

References.

[1] http://en.wikipedia.org/wiki/Minamata_disease

[2] Shigeo Ekino A., Mari Susa B., Tadashi Ninomiya A., Keiko Imamura A., Toshinori Kitamura Minamata disease revisited: An update on the acute and chronic manifestations of methyl mercury poisoning. The Neurological Sciences 262 (2007); 131–144.

[3] Ninomiya T, Ohomori H, Hashimoto K, Tsuruta K, Ekino S. Expansion of methylmercury poisoning outside of Minamata: an epidemiological study on chronic methylmercury poisoning outside of Minamata. Environ Res 1995;70:47–50.

[4] Ninomiya T, Imamura K, Kuwahata M, KindaichiM, Susa M, Ekino S. Reappraisal of somatosensory disorders in methylmercury poisoning. Neurotoxicol Teratol 2005;27:643–53.

3.2 Methylmercury in Water Environment

Natural Methylmercury

Mercury occurs in the nature and chemical conversions take place. Part of mercury is methylated in global cycle. The MeHg is a naturally-occurring organic compound of mercury and is produced from inorganic mercury by some specific microorganisms in the natural environment, and accumulates in seafood via the food chain (also in wheat grains via seed and soil). In the sea elemental mercury is originated from volcanic activity at first. Most MeHg in natural environments is originated from Hg2+ and Hg0. The Hg0 oxidation is occurs in natural aquatic ecosystems and the Hg2+ thus formed would subsequently be methylated by various environmental processes.

The study conducted by Dr. Megumi Yamamoto says that oxidation rate of Hg0 in natural sea water was significantly higher than that in distilled water or natural fresh water (including river water) and these results indicate that the Hg0 oxidation actually occur in natural aquatic environments, and chloride ion (main part of ocean salinity) would play an important role in the cycling of mercury there.

In aquatic ecosystems, the MeHg is bioaccumulated and bioconcentrated as it passes up the aquatic food chain. MeHg thus generated undergoes biological concentration and accumulates in carnivore fish and marine mammals. The accumulation of mercury in pelagic fish due to natural origin has also been a problem.

In recent years, there has been increasing recognition that MeHg affects fish and wildlife health, both in acutely polluted ecosystems and ecosystems with modest MeHg levels. Two reviews document numerous studies of diminished reproductive success of both of fish, fish-eating birds, and mammals due to MeHg contamination in aquatic ecosystems. A study by U.S. researcher Peter Frederick suggests MeHg may increase male homosexuality in birds: Except a control group, all of 160 captured young ibises were given small amounts of MeHg with their food. The reproductive behavior of these coastal wading birds changed in such a way, that the more MeHg was ingested the more male birds choose to build nests with other males, and snub females.

Anthropogenic Methylmercury

Anthropogenic MeHg input into aquatic ecosystem is very rare action. But big danger is its concentration. The dose-effect and dose response is very important in toxicity in human body and the Minamata disease is the special case of heavy exposure of MeHg, which is arose by anthropogenic activity in first point of food chain.

In the Minamata city case, from 1932, effluent containing MeHg, created in the acetaldehyde manufacturing process of Chisso Minamata factory, was discharged at first into the mouth of Minamata river and then into Minamata bay.

For approximately 40 years, the Chisso Minamata factory used mercury as a catalyst in the process of manufacturing acetaldehyde and vinyl chloride. During this period, approximately 70-150 tons or more of mercury, mixed in with effluent from the factory, was discharged. Sedimentary sludge, which settled on the floor of the ocean, containing more than 25 ppm total mercury, had an about total volume of more than 1.51 million m3.

Whilst imperfect, the refined drain recycling system, thought to be partially effective in extracting mercury, was adopted in August 1960. In 1966, due to the realization of a complete effluent processing sytem, effluent containing MeHg in principle, ceased to be discharged, and in May 1968, the population source disappeared due to the discontinuation of acetaldehyde production.

In 1969, The Economic Planning Agency designated the Minamata ocean expanse as an appointed water expanse under the Water Quality Control Law, also establishing a standard on water quality, and initiating regulation of MeHg under the Factory Effluent Control Law. In December 1970, the Water Pollution Control Law was enacted, followed by nationwide uniform regulation of the discharge of toxic substances such as mercury.

Important points for understanding

-As the MeHg occurs in nature, but its concentration is important factor. Only MeHg exposure at high levels (heavy exposure) is the cause of the Minamata disease. And rate of intake dose in fish-eating human body should be under control.

-The MeHg absorption in fish body does not cause effects to fish-itself, therefore even with high intake, a fish still can survive. This causes danger easily to fish eating human populations.

-River and Ocean/sea environments or ecosystems in are different respect with the MeHg. In the case of the Minamata, at first the wastewater discharged to the river and during that period due to some reasons the Minamata disease not arose sharply, I think: 1. a river is open

dynamic aqua system, which could purify itself naturally; 2. Comparing with marine ecosystem, a river has less microorganisms and salt/salinity (chloride) and as a result it was less methylated. 3. Fishes of river accumulates lower biological concentration of MeHg than carnivore fish and marine mammals.

3.3 Nowadays in Minamata

In Minamata city has based on the experience of one of the worst pollution disasters in Japanese history and has been working towards establishing itself as an environmental model city, and in 1999 received ISO certification for its environmental management policies. International countermeasures against the safety of chemical substances were established.

The administration and citizens of Minamata City are currently working together to tackle a range of projects that promote the development of Minamata as a Model City for the Environment. Now in this city efforts are a rigorous garbage classification and recycling program promotion of saving energy and reducing waste, promotion of environmentally friendly farming and fishing, protection of natural resources and the establishment of Minamata as a city for studying environmental problems. Located just outside Minamata's city center, Minamata Eco Town is an industrial park consisting of various recycling related companies.

At present, 100,000 kinds of chemical substances are used as raw materials and materials of products at factories over the world. A considerable proportion of them are considered to have the fixed possibility to exert harmful influence on human health and ecosystem through pathways in environment (environmental risks), although there is difference in extent of the influence. For these enormous chemical substances, the man power or budget, which is required for checking their environmental risks, is not adequate, and the environmental risks of many chemical substances are not yet evaluated adequately under the present situation.

At present, there are also apprehensions about the influence of long-term exposure to low-concentration chemical substances on ecosystem, the spread of pollution through a plurality of environmental media (air, water, soil, etc.), and the complex influence of chemical substances from a viewpoint of earth environmental preservation.

Nowadays, chemical substances are utilized in various forms and are inseparable from the people’s life. However, they have both sides, useful and harmful, and problems with chemical substances are further complicated. With regard to the countermeasures, control alone of drainage and emission is inadequate. Total management from the environmental aspect, which includes the substances used in products and used/abolished as products, is needed. Since the harmful influence of chemical substances remains scientifically unclear in many points, opening of necessary information and individuals’ wise acts based on the information are required from a viewpoint that how the environmental risks of chemical substances should be avoided or the risk should be reduced. When we turn our eyes to various foreign countries including developing countries, there are still a number of areas in which there may be risks of pollution with mercury, use of mercury for gold refining, pollution with mercury in coal,

drainage of mercury from plants. This risk is will be occur very closer with my country. Many gold mining company and even illegal private people processing last recent years and they're all using mercury.

In order to counter such problems with chemical substances inside and outside Japan, so that the failure like Minamata disease will not be repeated, we must learn the experience in the past, particularly the history of many victims.

Concerning Minamata Disease Countermeasures since 1995 provided to Chisso Corporation based on 'About Measures Against Minamata Disease' are based on a policy by the national government, with the cooperation of Kumamoto Prefecture, formed of the view that a complete and final solution to the Minamata disease problem is essential to the rejuvenation and promotion of the Minamata and Ashikita region.

3.4 Environmental Restoration

We had surprised when we visit to Minamata Bay. It looks nice and we heard about all polluted area removed. Historcally, Minamata Bay has been started to pollute by Chisso Minamata factory from 1932. After 27 years on July 22, 1959, the Kumamoto University Study Group made a formal announcement that "Minamata disease a disease of the nervous system which is caused by eating fish and shellfish of the local area (Minamata Bay)". After that mercury has come to attention cause of pollution of the fish and shellfish. During 40 years Chisso company has been distribute about 70-110 tons mercury into Minamata Bay. Environmental restoration has 5 main activities. These include Chisso company stopped production of acetaldehyde, Commencement of the Pollution Prevention Project, Construction of Temporary Close-off Bank, end of the Sludge Dredging Project , end of the Pollution Prevention Project.

Mercury high content and low content polluted area of Minamata Bay (580,000+1,510,000 m^2) ground surface was then treated with a synthetic sheet and loam, and covered with soil from nearby mountain. Just after the completion of dredging, in 1987, measurements at 84 monitoring points revealed that the total amount of mercury in the bottom sediment had fallen to 0.06ppm-12ppm with an average of 4.65ppm, from 0.04ppm-553 ppm as measured at 610 different monitoring points in 1985, before dredging began.

In march 1990, after 13 years and 48.5 billion yen the Minamata Bay Pollution Prevention Project was safely completed, and the environment returned to its original state.

References

Minamata Disease Its History and Lessons ,2007 Minamata City

http://en.wikipedia.org/wiki/Minamata_disease