

SPEX CertiPrep App Note

Mercury Poisoning “The Minamata Poisoning”

Many of the elements we recognize as toxic elements or heavy metals have been around and in use for thousands of years. One of the most common heavy metals in use after lead was mercury. Mercury was well known by ancient peoples who used mercury as cosmetics, paints, medicines, and in alloys. Cinnabar (HgS), the most common form of mercury, was found adorning homes and tombs as beads, sculpture and ground into paint. Historically, mercury was used in the metals industry and a byproduct of the purification of other more precious metals including gold, silver, zinc, and cadmium. The intentional combination of these elements with mercury created amalgams which were used up until the late 19th century as dental fillings.

By the late 1800's, mercury use increased from amalgams and refining of metals to include many other industries. Mercury fulminate was developed as a detonator for explosives. The nascent plastics industry began and PVC was first produced using a mercury catalyst. Light bulbs were invented and contained mercury which still persists in fluorescent light bulbs. The element was also widely used to make scientific equipment and in the process of felt making. The felt was used for the creation of hats and repeated exposure of hat makers often would lead to signs of mercury poisoning manifesting as dementia. This phenomenon was immortalized by Lewis Carrol in Alice in Wonderland in the persona of the Mad Hatter.

Mercury was often used as medication and disinfectant. It was often believed to be an effective treatment for venereal disease and other infectious diseases. By the mid-twentieth century most of the uses of mercury was industrial - the production of chlorine, caustic soda and other industrial chemicals. It has been suggested that over the last 4,000 years there have been over 350,000 tons of mercury released into the atmosphere, water and land. Behind lead, mercury has become a threat of industrial poisoning of the environment and threat to human health. One of the most serious cases of industrial mercury poisoning became a cautionary tale to the world on the dangers of environmental pollution. This case became known as the Minamata poisoning.

On the western coast of the southern Japanese island of Kyushu, Minamata Village was officially designated by the Japanese government in 1889 with just over 12,000 residents. Less than 20 years later, in 1908, the Nippon Nitrogen Fertilizer Company (later the Chisso Corporation) built its factory in Minamata. The plant began manufacturing acetaldehyde in 1932 using mercury sulfate as a catalyst. By the end of World War II in 1949, Minamata Village had grown into a city of over 40,000 people. A large part of the economy of the city (over half of its tax revenue) was the chemical factory and its acetaldehyde product which was an important component in the manufacture of plastics. The plastic boom saw the increase of acetaldehyde product grow from over 200 tons to more than 45,000 tons by 1960.

During this post WWII plastic production boom, a curious phenomenon was observed in Minamata. Cats began to display odd behavior which resulted in them falling into the water and dying. The locals dubbed the curious disease 'cat suicides' or 'dancing cat fever'. Less than a decade later, in the 1950's, a strange disease of unknown cause started plaguing the city inhabitants. Just like the cats, people, especially children, would start to stumble or have trouble controlling fine motor skills. In April 1956, a five-year old girl was hospitalized at the Chisso Minamata Plant Hospital. She complained of numbness in her limbs and inability to speak or eat. In May of 1956, four patients were admitted to the local hospital all suffering from the same disease characterized by very high fevers, convulsions, psychosis, unconsciousness, coma, and then finally death. The disease was believed to be infectious and patients were quarantined and disinfected. Families were ostracized in fear of the disease which was called the Minamata disease.

By 1957, the medical and scientific community was starting to believe that the disease was not an infectious agent, but a result of poisoning. The main culprit was believed to be seafood caught in the Minamata bay. The local fishermen voluntarily stopped fishing the bay and the government banned fishing in the bay. During this time in the fall of 1958, the corporation changed its discharge system for plant effluent. Prior to this change, the plant effluent was directly discharged into the Minamata Bay. The new system stored the effluent in a pool near the Minamata River where it was later discharged. Suddenly, new cases of Minamata disease were identified near the river. During the course of the effluent discharges from the plant, over 60 tons of methylmercury were released into the waterways.

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Almost three years after the start of the outbreak of the disease, the majority of the university researchers were able to conclude that the origin of the disease was most likely an organomercury compound. Researchers investigated the mercury distribution in Minamata Bay in February 1959 and discovered that the concentrations of mercury at the mouth of the plant's wastewater canal were shockingly high. Levels were detected in the sediment of 2 kg/ton which would be a concentration considered high enough to mine or refine. The company later created a division to reclaim and sell the mercury recovered from the sludge.

In November of 1959, a researcher from the University of Kumamoto reported his belief that the plant effluent was the cause of the poisonings. Citing lack of proof, the investigating council ruled the poisoning was probably due to an unknown source or organomercury pollutants. The findings of the University of Kumamoto created public protests by patients and fishermen in Minamata calling for compensation and for plant effluent treatment systems to be installed at the plant. By the end of 1959, agreements had been reached for sympathy compensation. Living patients who were certified to have Minamata disease were given between the equivalents of approximately \$275 to \$925 per year. Family of patients who died from the disease were given a one-time payment of about \$3,000. Minamata disease started to fade from the public consciousness until a similar outbreak of the disease occurred in 1965 in the Niigata Prefecture along the banks of the Agano River.

A different chemical factory used a similar mercury catalyst that was thought to be responsible for the previous illness. From the fall of 1964 to the spring of 1965, cats in Niigata were observed experiencing 'dancing cat fever'. Shortly afterwards, patients living along the Shiranui Sea began to appear with symptoms of Minamata disease. As the result of the events in Minamata, lawsuits were quickly filed against the company and reopened investigations into Minamata's pollution. In 1968, twelve years after the discovery of Minamata disease and four months after the discontinuation of the production of acetaldehyde using its mercury catalyst, the government issued its final conclusions: "Minamata disease is a disease of the central nervous system, a poisoning cause by long-term consumption, in large amounts, of fish and shellfish from Minamata Bay. The causative agent is methylmercury. Methylmercury produced in the acetaldehyde acetic acid facility of Shin Nihon Chisso's Minamata factory was discharged in factory wastewater..."

In light of the government's findings, patient advocate societies asked for new compensation agreements with the company. Meetings and arbitrations were negotiated but in the end many sought to bring their grievances to trial. During those trials, dramatic testimony was given by plant employees and managers who testified to the falsification of safety studies done by the plant during the outbreaks. Many employees admitted the company put profit ahead of safety. As of 2001, 2265 victims were officially certified, 10,000 people received compensation from the company, and 1,784 patients had died. During the course of certification, over 17,000 people applied for certification with the council. Enormous social and economic pressure was put on citizens not to declare their symptoms and apply for compensation. The certification council was pressured to reject claimants and minimize the economic impact on the company.

Minamata disease is an important issue to this day in Japan. Lawsuits still continue. Most of the congenital patients exposed to the Minamata pollution during the 1950's and 1960's are now in their fifties or older and are reporting severe challenges to their health. Also in Japan, it has been found that high levels of mercury were migrating into the food chain with high levels of mercury in seafood and whale meat. For most of the world, the continued exposure of mercury comes from food, in particular, seafood where mercury accumulates from run off from the land and builds through bioaccumulation in the tissues of fish and other higher sea order creatures.

Heavy metals testing becomes essential in both the protection of the environment and human health since humanity has spent thousands of years exposing the world to large quantities of heavy metals which are often highly persistent in the environment and can cause damage and health issues for decades after their deposition.

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