

## Editorial

# The past and future of industrial hygiene in Japan

Industrial hygiene in Japan is considered a field of study involving the control of hazardous factors, such as harmful airborne chemical substances and physical factors, that workers encounter in their workplace and the prevention of health problems caused by such factors using science and engineering knowledge and techniques. This definition and purpose closely resemble those for industrial hygiene in other countries. However, the Japanese occupational health system has a unique administrative principle called the “three-management strategy”. Considering that industrial hygiene falls under occupational health, it is also required to follow this principle. The “three-management strategy” is the philosophy that workers’ health should be ensured by completing the following three matters:

- Work management: Reducing the load on individual workers by optimizing their work hours, workload, work methods, work cycles, and work posture. Ensuring that workers wear the necessary protective equipment.
- Working environment control: Assessing the risk of harmful substances, such as organic solvents, dust, heavy metals, and several physical factors, in the working environment. Controlling and eliminating them as best as possible using a ventilation system, etc.
- Health care: Preventing health problems of workers by determining their health conditions through health check-ups and implementing appropriate measures and health guidance based on the results of the checkups.

The current Japanese industrial hygiene system is mainly responsible for providing the information and technologies necessary for work management and working environment control. Therefore, regardless of propriety, the Japanese industrial hygiene system tends to focus more on supporting administrative measures rather than basic scientific research. The “administrative control level” is one example of such characteristics of the Japanese industrial hygiene system and is one of the benchmarks for evaluating the risk of worker exposure. However, it is not the direct reference for personal exposure that many other countries have adopted. The correct definition of “administrative control level” is “the reference for evaluating the effectiveness of

working environment control”, which is based on the notion that lowering the environmental concentration will consequently lower personal exposure. Thus, in principle, area sampling is adopted instead of personal sampling when measuring the concentration of hazardous chemical substances in working environments throughout Japan.

The following outlines the brief history of industrial hygiene in Japan from its substantial birth to present-day circumstances. Many research subjects have now been added to the Japanese industrial hygiene, such as heat, noise, vibration, ionizing radiation, high-pressure gas, and hazardous rays. At the beginning, however, the most important issue for Japanese industrial hygiene was countermeasures against exposure to organic solvents, which prompted the addition of dust control to the issues a little later.

## Historical trends in Japanese industrial hygiene

Industrial hygiene in Japan has generally been considered emerge in the mid to late 1950s. Of course, even before the 1950s, the importance of ensuring workers’ health had been recognized mainly in the medical field; however, it was not until the “Hepburn Sandal Incident” that industrial hygiene research, which incorporated technology and information from the science and engineering fields, was launched in earnest under the leadership of the Japanese government. The Hepburn Sandals Incident was a major industrial disease in Japan during the mid to late 1950s that was triggered by the success of one American romantic movie. The movie “Roman Holiday”, released in Japan in 1954, was a huge hit, and the sandals worn by the lead actress (Audrey Hepburn) in the movie immediately became widely popular among young Japanese women. At this time, most footwear used in Japan, including sandals, were produced by small-scale manufacturers with only several employees. Unfortunately, at a time when laws and regulations to protect workers’ health were absent, most workers in sandal manufacturers were exposed to and unprotected against toxic solvents, such as benzene, used in the production processes. Benzene, which today requires extremely

strict control due to its high carcinogenic potential, was not regulated in Japan at that time. Therefore, workers—many of whom were young females—in sandal manufacturing workshops were exposed to high concentrations of benzene vapor on a daily basis, which produced a large number of victims in a short period of time. The Japanese government responded promptly and promulgated the *Ordinance on Prevention of Organic Solvent Poisoning* in 1960 to prevent incidents of benzene poisoning, which had frequently occurred among small-scale footwear manufacturers. The ordinance was subsequently incorporated into the *Industrial Safety and Health Law* (1972) and has continued to significantly impact Japanese industrial hygiene from 1960 to the present considering that the ordinance specifies the methods for measuring organic solvent concentrations and ventilation requirements for workplaces involved with organic solvents.

On the other hand, the major early administrative measure in Japan for occupational dust exposure was the enactment of the *Pneumoconiosis Law* in 1960. Unlike the *Ordinance on Prevention of Organic Solvent Poisoning* mentioned earlier, the *Pneumoconiosis Law* regulates workers' health care and does not provide for working environment control. Thus, it had no significant and direct impact on industrial hygiene research in Japan. The *Pneumoconiosis Law* was amended several times thereafter; however, even 20 years after its enactment, it made no significant contribution to the reduction of pneumoconiosis. In 1978, the Japanese government enacted the *Ordinance on Prevention of Hazards Due to Dust*, which mandated the wetting and sealing of dust sources, installation of various types of ventilators, wearing of personal protective equipment, and working environment measurements. This ordinance contributed to the promotion of research on methods of measuring dust concentration, particle size, and chemical composition, as well as research on techniques to protect workers from dust, such as designing effective ventilation systems and the development of high-performance dust masks. The ordinance can be considered successful given that it promoted a decrease in the number of newly diagnosed pneumoconiosis cases from 6,842 in 1980 to 124 in 2020.

Indeed, industrial hygiene in Japan has reduced the number of occupational diseases in conjunction with various government regulations; however, it must be noted that the needs for industrial hygiene have gradually changed as society has evolved. Since the mid-20th century, the share of the tertiary sector in Japanese industry has steadily expanded. According to the Japanese Census, the share of tertiary

workers in 1950 was 29.6%, whereas that in 2019 was 71.2%. In line with this, ensuring the health of office workers, caregivers, delivery service providers, and hospitality workers, such as preventing low back pain, muscle fatigue, eye strain, and passive smoking, had emerged as an important issue for industrial hygiene, increasing the presence of ergonomics, aerosol science, and chemical engineering. In this context, the relative presence of conventional industrial hygiene declined with times, and the “Osaka Occupational Cholangiocarcinoma Disaster (2012)” occurred.

## Recent status of industrial hygiene in Japan

The “Osaka Occupational Cholangiocarcinoma Disaster” was an industrial disease that occurred at a small printing factory in Osaka City, in which 17 employees developed cholangiocarcinoma, among whom 9 died. Subsequent investigations found that the primary cause of their cholangiocarcinoma was exposure to dichloropropane (DCP), which was used to clean the printing presses. However, no legal restrictions on the use of DCP were in place at this time. This industrial disease prompted Japanese labor administrators and industrial hygienists to recognize that conventional controls of chemical substances through legal restrictions alone were insufficient to protect workers' health. The Japanese government immediately designated DCP as a regulated substance while developing a new law on risk assessment for chemicals. Currently, DCP is classified as a “special organic solvent” under the *Ordinance on Prevention of Hazards Due to Specified Chemical Substances*, which requires particularly strict control measures for use. In 2016, the *Industrial Safety and Health Law* was amended to require discretionary risk assessment, in which chemical users have discretion in the frequency and method of their assessment, for 640 chemicals, including approximately 520 chemicals that have yet to be legally regulated. Since 2016, chemicals subject to risk assessment have been added continuously, with risk assessment being mandatory for 674 chemicals as of January 2023.

## Future prospects for industrial hygiene in Japan

In the future, the Japanese government looks to increase the number of substances subject to risk assessment, which is expected to reach approximately 3,000 substances within a few years. In addition, the government intends to require personal exposure measurement using a personal sampler in addition to conventional working environment measurements based on area sampling. Along with these, the gov-

ernment also plans to essentially abolish the *Ordinance on Prevention of Organic Solvent Poisoning*, the *Ordinance on Prevention of Hazards Due to Specified Chemical Substances*, and other ordinances that have been the cornerstones of Japanese industrial hygiene, although no definite date has yet been finalized as of January 2023. As mentioned earlier, these ordinances specify not only the measurement procedures of the substances concerned but also countermeasures against their exposure. For example, when a local ventilation system (LEV) is applied to prevent exposure to regulated organic solvents, the current ordinance specifies the type of exhaust hood to be applied and the exhaust flow velocity. Therefore, after the abolishment of the ordinance, the users of the organic solvent will be responsible for selecting exposure control methods, including the LEV at their own discretion. However, it may be difficult for most users to select appropriate control methods independently. Currently, the Ministry of Health, Labor and Welfare Japan (MHLW) is preparing a “Recommended Case Studies for Reducing Chemical Exposure” through the National Institute of Occupational Safety and Health, Japan (JNIOSH), which will be of great benefit to many industrial hygienists who are struggling with countermea-

sures against hazardous substances once completed and released.

One of the serious problems expected by the Japanese industrial hygiene system in the near future will be the shortage of young professionally trained industrial hygienists. In fact, three Japanese universities, namely Kitasato University, University of Occupational and Environmental Health, Japan (UOEH), and Waseda University, offered specialized industrial hygiene courses just a few years ago, but only the School of Health Sciences, UOEH remains now. Furthermore, even JNIOSH, which is to be the national center of occupational safety and health research in Japan, seems to abolish its research branch on industrial ventilation within a few years. As such, the future of industrial hygiene in Japan will perhaps be directed not by experts from universities or public research institutes but primarily by engineers from ventilator or protective equipment manufacturers or publicly licensed professionals, such as certified consultants, occupational hygienists, industrial physicians, official health supervisors, and environmental measurement specialists who are in charge of health and safety practices in the workplace.

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