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(Review Article)

Changes in workplace chemical risk management in Japan

Shigeru Suna *

Private Health Research Laboratory, 14-22 Shinkita-machi, Takamatsu-shi, Kagawa 760-0001, Japan.

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Abstract

Legally compliant chemical risk management in the Japanese workplace was completed in the middle of the period of high economic miracle. The Ministry of Health, Labor and Welfare is currently considering a shift from legally compliant risk management to autonomous risk management in in response to the growing risk management of new chemicals in the industrial sector in the 21st century. This paper summarizes the transition of chemical risk management in Japanese workplaces from the period of high economic growth to the present day.

Keywords: Japanese Workplace; Legally Compliant Risk Management; Autonomous Risk Management; Control Banding

1. Introduction

Modern industrial and economic activities and our affluent lives have been supported by a wide variety of chemical substances. However, it is easy to imagine that many of them may adversely affect human health and ecosystems. Entering the 21st century, the development of new chemical substances is accelerating, and these chemical substances are about to be put into the field of industrial and economic activities. For this reason, Japan's legally compliant occupational hygiene management is at a turning point. This treatise is a report on the transition of chemical risk management in the Japanese workplace.

2. Establishment of legally compliant risk management

Shortly after World War II, Japan's record economic growth began and continued until the end of the Cold War. Occupational health management in the early stages of economic growth was based on the Labor Standards Act enacted in 1947 [1], but with the introduction of many new chemical substances into the industrial sector, new occupational diseases frequently occurred. Therefore, laws and regulations regarding preventive measures have been put in place [2-6]. However, the risk of occupational accidents has increased due to the increase in the size of machinery and the development of new chemical substances, and a law was needed to deal with this risk.

The Industrial Safety and Health Act [7] was enacted in 1972, the middle of economic growth. The purpose of this Act is to secure, in conjunction with the Labor Standards Act, the safety and health of workers in workplaces, as well as to facilitate the establishment of comfortable working environment, by promoting comprehensive and systematic countermeasures concerning the prevention of industrial accidents, such as taking measures for the establishment of standards for hazard prevention, clarifying the safety and health management responsibility and the promotion of voluntary activities with a view to preventing industrial accidents. In 1975, the Working Environment Measurement Act [8] was enacted. The purpose of this Act is, in conjunction with the Industrial Safety and Health Act of 1972), by providing for necessary matters concerning the measurement of working environments as the qualification of working

* Corresponding author: Shigeru Suna
Private Health Research Laboratory, 14-22 Shinkita-machi, Takamatsu-shi, Kagawa 760-0001, Japan.

environment measurement experts, working environment measurement agencies, etc., to secure a proper working environment ,and maintain the health of workers in workplaces. Under this law, workplace risk management is carried out by measuring the working environment for physical and chemical harmful factors. The two laws mentioned above have completed legally compliant chemical risk management in the Japanese working environment and continue to this day (Figure 1).

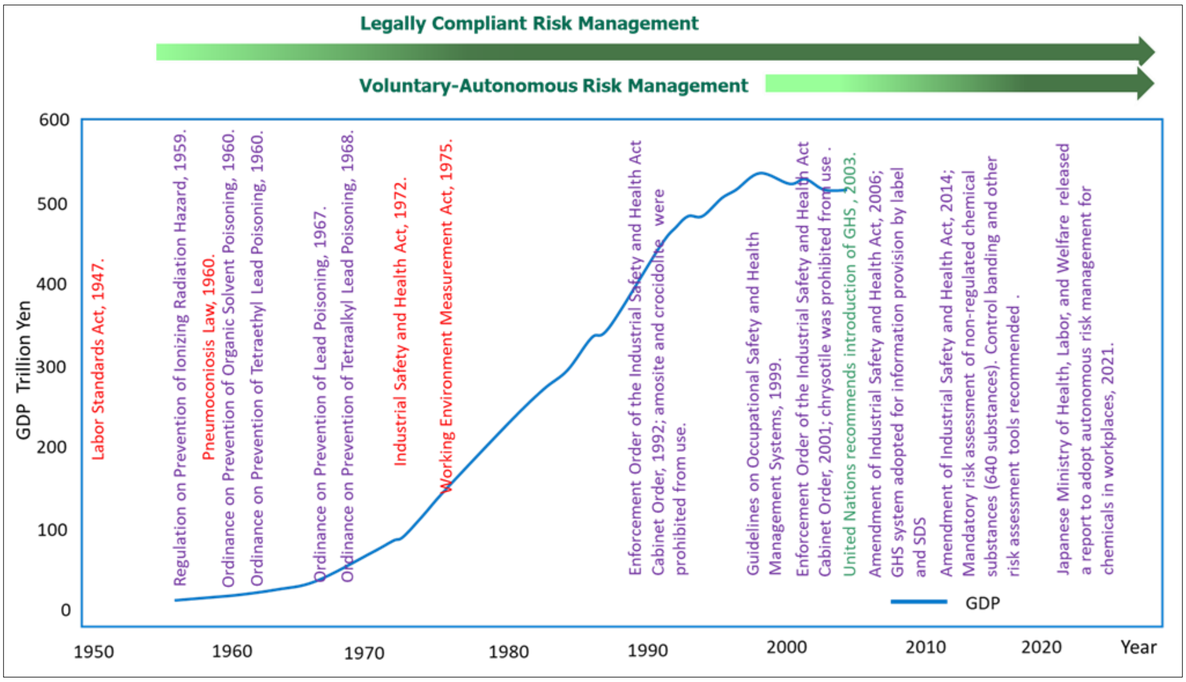

Figure 1 Changes in workplace chemical risk management in Japan

3. Measurement of the working environment

The Industrial Safety and Health Law [7] requires periodic measurement of various environmental conditions. The following places require measurement of the working environment according to the standards established by the Minister of Health, Labor and Welfare [9]:

- (a) Indoor workplaces where dust from earth and rock, minerals, metals, or carbons are remarkably emitted
- (b) Extremely hot, extremely cold, or highly humid indoor workplaces
- (c) Extremely noisy indoor workplaces
- (d) Workplaces located in pits
- (e) Indoor workplaces where a specified chemical substance, etc. is produced or handled, or workplaces where coke is produced
- (f)Workplaces involving radiation work
- (g) Indoor workplaces where a specified chemical substance, etc. is produced or handled, or workplaces where coke is produced
- (h)Indoor workplaces for lead-handling work
- (i) Hazardous workplaces of anoxia
- (j) Workplaces where an organic solvent is produced or handled

4. Evaluation Standard for measurement of the working environment

The measurement results of chemical hazards in the workplaces of (a), (g), (h) and (j) are evaluated for general classification into the three classes [10].

When the upper limit of the 90% confidence interval calculated from the geometric mean and geometric standard deviation of the A measurement (measured five or more samples in the workplace) is below the administrative control level, and the result of the B measurement (measured at the time when concentration is highest) does not exceed 1.5

times the administrative control level, the work area is classified as control class I. It is in a state where it is judged that work environment management is appropriate. From the measurement result of A, it is estimated that the probability of exceeding the administrative control level is 5% or less (Figure 2), and the measurement result of B shows that the workplace is properly managed.

If the worker's exposure concentration level estimated from the measurement result of A exceeds the administrative control level or if the result of the B measurement exceeds 1.5 times the administrative control level, it is classified as control class III. The measurement result of A suggests that more than half of the workers are exposed to concentrations above the administrative control level (Figure 2). Workplace improvement is needed immediately.

Measurement results other than the above are classified as control class II. Workplaces need to be improved towards control class I.

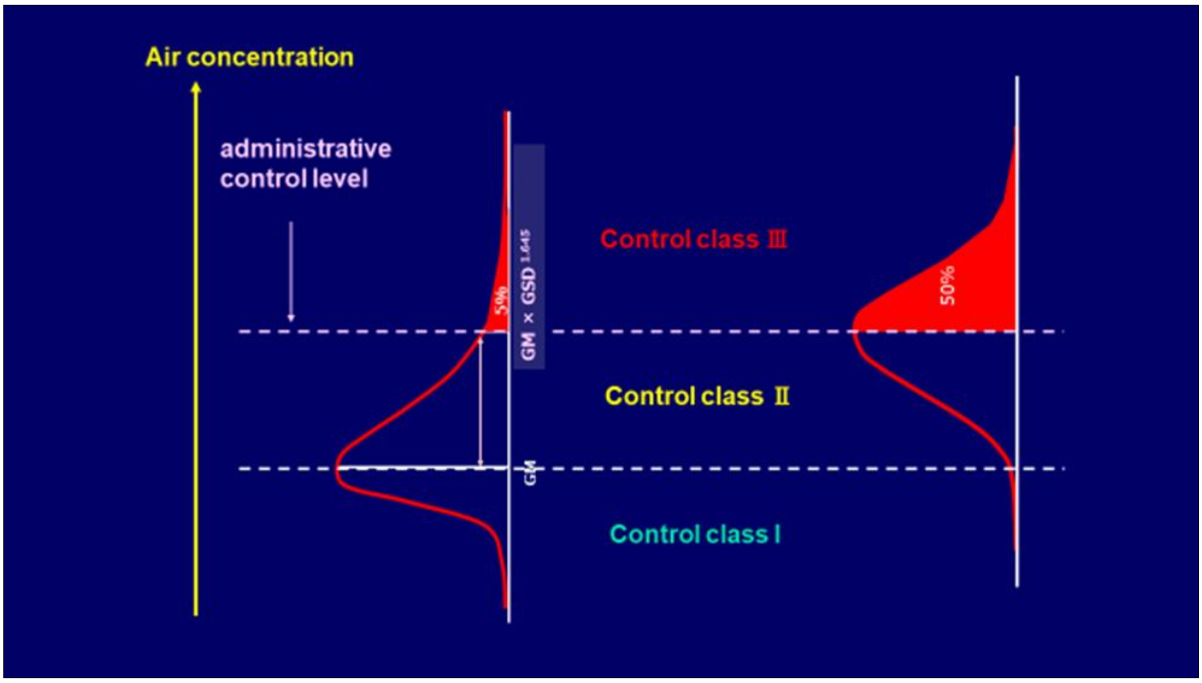

Figure 2 Evaluation for A measurement

5. Utilization of voluntary risk management

Since around 1990, the end of high economic growth, the problem of new chemical substance risks such as endocrine disrupting chemicals [11, 12] has arisen, and the management of ever-increasing new chemical substances has become a global issue (Figure 3). In 2003, the United Nations recommended the introduction of a GHS system that manages chemicals by a universal hazard classification and labeling method for chemicals. The GHS system was introduced into the Japanese industrial sector by the revision of the Industrial Safety and Health Act of 2006.

There are more than 50,000 types of chemical substances used in Japanese industry [15], and 500 to 600 types of new chemical substances are newly introduced every year. Some of these chemical substances cause health problems due to exposure of workers, and a considerable number of workers' health problems due to chemical substances occur every year. Among these, there have been cases of worker health problems due to leakage in the process of storage, storage, transportation, etc. of chemical substances at business sites, improper handling, etc. On the other hand, the number of chemicals legally regulated in the workplace is limited to just over 100. Therefore, the use of voluntary risk management by the occupational health and safety management system introduced in Japan in 1999 [16] was considered. At the time of the revision of the Industrial Safety and Health Act in 2014, it was obligatory for business establishments to voluntarily conduct risk assessments and take measures for 640 chemical substances that are not regulated by law. In addition to the conventional quantitative air environment assessment methods, qualitative air environment assessment methods such as control banding have been added to the risk assessment tools.

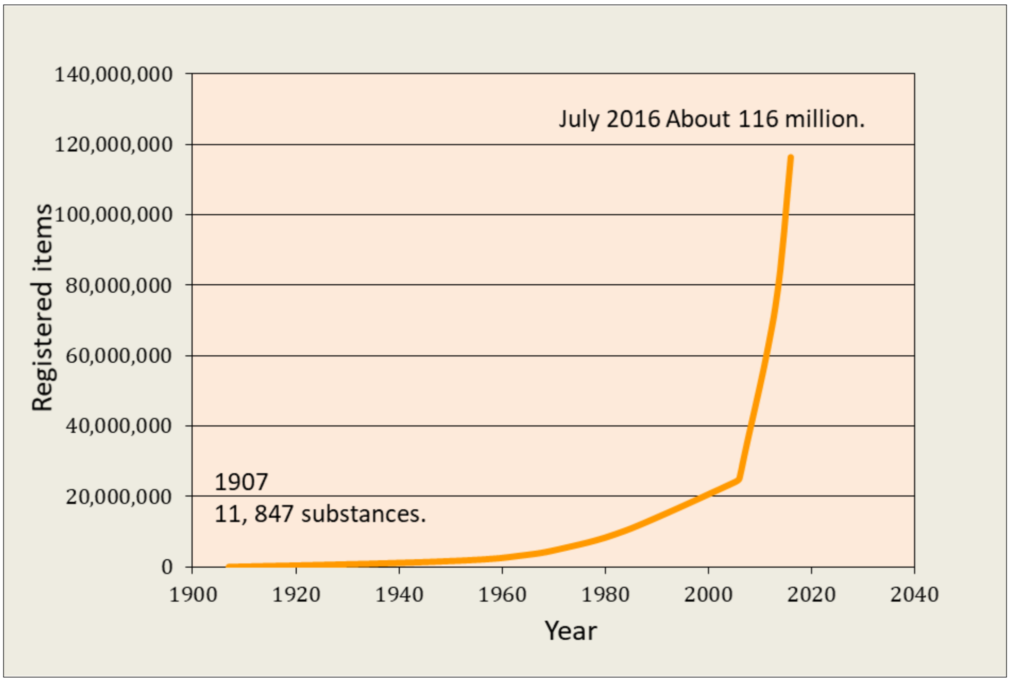

Figure 3 Chemicals registered in the CAS Registry Number

The CAS Registry is the world's largest database of chemicals, containing almost all of the chemicals identified in scientific papers from 1907 to the present [13, 14]

6. Risk assessment by control banding

The original control banding model was developed in the pharmaceutical industry [17]. However, the generalized model is a model developed for non-professionals [18]. This model is a qualitative and semi-quantitative risk assessment tool developed to complement traditional quantitative risk assessments that assess risk with air sampling and analysis. It has been applied and tested in small businesses around the world. However, large companies are also incorporating these strategies into their chemical safety programs.

The control banding procedure shown in the International Chemical Control Toolkit [19] is as follows.

- The first step is to identify the hazard group for the substance. Hazard groups are categorized into A (safest) to E (most dangerous) scales and Group S based on the GHS hazard classes below.
  - Group A: Acute toxicity (lethality, any route) class 5, Skin irritancy class 2 or 3, and Eye irritancy class 2.
  - Group B: Acute toxicity (lethality, any route) class 4, acute toxicity (systemic, any route) class 2.
  - Group C: Acute toxicity (lethality, any route) class 3, Acute toxicity (systemic, any route) class 1, Corrosivity, subclass 1A, 1B or 1C, Eye irritancy class 1, Skin sensitization, Repeated exposure toxicity (any route) class 2.
  - Group D: Acute toxicity (lethality, any route) class 1 or 2, Carcinogenicity class 2, repeated exposure toxicity (any route) class 1, Reproductive toxicity class 1 or 2.
  - Group E: Mutagenicity class 1 or 2, Carcinogenicity class 1, Respiratory sensitization.
  - Group S: Acute toxicity (lethality, dermal only) class 1, 2, 3 or 4, Acute toxicity (systemic, dermal only) class 1 or 2, Corrosivity, subclass 1A, 1B or 1C, Skin irritation class 2, Eye irritation class 1 or 2, Skin sensitisation, Repeated exposure toxicity (dermal only) class 1 or 2.

Compare available inhalation toxicity data, such as Material Safety Data Sheets, with the Hazard Group's GHS Hazard Class. In addition to the risks associated with inhalation, the potential skin and eye risks of this substance should also be identified. Use the GHS hazard class again to determine if a substance belongs to hazard group S.

- Classifies solid dustiness and liquid volatility into three levels (low, medium, high). The amount of substances handled is classified into 3 stages (small, medium, large).
- Select Control approach from the matrix table for each hazard group (Figure 4).

Volatility	Low Vlatility	Medium Volatility		High Volatility
Dustiness	Low Dustiness		Medium Dustiness	High Dustiness
Hazard Group A				
Small (g or ml)	1	1	1	1
Medium (kg or l)	1	1	1	2
Large (ton or kl)	1	1	2	2
Hazard Group B				
Small (g or ml)	1	1	1	1
Medium (kg or l)	1	2	2	2
Large (ton or kl)	1	2	3	3
Hazard Group C				
Small (g or ml)	1	2	1	2
Medium (kg or l)	2	3	3	3
Large (ton or kl)	2	4	4	4
Hazard Group D				
Small (g or ml)	2	3	2	3
Medium (kg or l)	3	4	4	4
Large (ton or kl)	3	4	4	4
Hazard Group E				
Small (g or ml)	4	4	4	4
Medium (kg or l)	4	4	4	4
Large (ton or kl)	4	4	4	4
Hazard Group S				
Small (g or ml) Medium (kg or l) Large (ton or kl)	Wear protective equipment to prevent exposure to skin and eyes			

1	General ventilation; Basic occupational hygiene practice, such as housekeeping, administrative controls
2	Local exhaust ventilation; Engineering controls
3	Isolation, containment; Enclosure, containment, strict engineering controls
4	Requires specialist advice

Figure 4 Severity matrix and control approach [20]

7. Shift to autonomous management

According to a survey conducted by the Ministry of Health, Labor and Welfare (MHLW) in 2019, only about 50% of companies voluntarily conduct risk assessments. A study group of the MHLW examined future chemical risk management methods. In July 2021, the MHLW published a report to adopt of regulations based on the autonomous management of chemicals in the workplace [21]. Under regulations based on autonomous control, companies are obliged to manage the risk of all chemicals identified as dangerous or harmful in accordance with government-established control standards. However, the management method is left to the company. Within five years, autonomous control will be applied to all chemical substances (2900 substances) that have been evaluated by the national government according to the GHS classification and have been confirmed to be dangerous or harmful. The center of gravity of Japan's working environment management will shift from legally compliant risk management to autonomous risk management.

8. Conclusion

In Japan today, the impact of industrial chemical diversification and global harmonization provides a turning point in chemical risk management in the workplace. The author investigated the transition of chemical management in Japanese workplaces from the post-WWII period to the present, and hoped that this paper would be a place to reconsider the future use of chemicals in human society.

Compliance with ethical standards

Acknowledgments

The author appreciates the help of colleagues in the laboratory.

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