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Commentary

Regulation of occupational exposures in China

Otto Wong

Applied Health Sciences, Inc., 181 Second Avenue, Suite 628, P.O. Box 2078, San Mateo, CA 94401, USA
Department of Epidemiology, Tulane University, New Orleans, LA, USA
Department of Community Medicine, Chinese University of Hong Kong, Hong Kong

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Abstract

The recent passage of the Occupational Diseases Prevention and Control Act of 2002 (ODPCAct) in China and the new occupational exposure limits signify the Chinese government's commitment to improve the environment of the workplace and to eradicate preventable occupational diseases. The effectiveness of the ODPCAct, however, will depend on not only implementation and enforcement but also education and communication. For large industrial facilities, implementation of the new regulations can be enforced with periodic monitoring and inspections. The difficulty will come from small makeshift or crudely converted workshops in villages and small towns in rural areas. The challenge will be to reach out to these small workshop owners and workers, i.e., to communicate and inform them about the newly promulgated regulations, the business owners' legal responsibility and liability, and the workers' right to a safe workplace. Attention and resources should be focused on educating both shop owners and workers about the hazards of the chemicals that they use, basic requirements for a safe workplace, preventive measures, and controls to reduce exposures.

Keywords: Occupational exposure regulation; Occupational exposure limits; China; International harmonization; Benzene exposure; Benzene poisoning

Over the past few decades, significant progress has been made in improving the health of the people in China. For example, life expectancy has increased from 57 years in 1957 to 71 years in 1997. Another significant change is the rapid pace of industrialization, transforming China from an agricultural country to a major industrial powerhouse. With a population of 1.2 billion, China is the most populous country in the world. A large number of men and women in China are blue-collar workers and many of them are exposed to potentially hazardous industrial substances.

The National Technological Committee of Health Standards Setting (NTCHSS), under the auspices of the Ministry of Health, is responsible for setting health standards in the country. The specific responsibility of developing exposure standards in the workplace rests with the Subcommittee of Occupational Health Standards Setting (SOHSS), chaired by Professor Y.X. Liang of Fudan University School of Public Health, Shanghai. In this issue of *RTP*, Liang and his colleagues at NTCHSS (Liang et al., 2003) report the latest developments of occupational exposure limits (OELs) in China. In 1995 a similar paper by Liang et al. (1995), also published in *RTP*, introduced the philosophy and process of OEL development in China. With the recent passage of the Occupational Diseases Prevention and Control Act of 2002 (ODPCAct), the updated report by Liang et al. (2003) is especially timely.

Liang et al. (2003) show how the ODPCAct is one of the most significant and comprehensive legislatures in occupational health in China. Article 11 in Chapter 1 of the ODPCAct reaffirms the authority of the Ministry of Health to set OELs, and Article 13 in Chapter 2 specifies that occupational exposures to hazardous substances at workplaces must be within the OELs issued by the Ministry of Health. First-time non-compliance will result in warning and mandatory remedial actions (Article 24, Chapter 3). As stated in Article 62 in Chapter 6, failure to make proper remediation within the specified time will result in fines up to ¥ 500,000

E-mail address: OttoWong@aol.com.

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(US$61,000). Furthermore, serious violations will result in the revocation of business licenses and the shutting-down of operations, and individuals responsible may be subjected to criminal prosecution (Articles 70 and 71, Chapter 6). The ODPCAct was passed by the 24th Conference of the Standing Committee of the 9th National People's Congress on October 27, 2001 and went into effect on May 1, 2002 (International Labor Day), thereby granting legal status to the OELs developed by SOHSS.

As explained by Liang et al. (2003), the process of developing OELs in China followed closely the World Health Organization's guideline, together with considerations given to technological feasibilities and socio-economic factors relevant to China. The development process consisted of two stages: the health-based recommendations and the final law-based operational OELs. More than 400 newly developed or reaffirmed OELs have been issued after the adoption of the ODPCAct. Some selected OELs can be found in Liang et al. (2003), which shows that almost half (49%) of the Chinese OELs are the same as the ACGIH TLVs. Liang et al. (2003) argue convincingly that complete international harmonization of final operational OELs is not only difficult but also unnecessary. Further, it should also be noted that harmonization does not mean standardization (Sonich-Mullin, 1997). Even among countries using very similar methodologies and essentially the same datasets, OELs can still vary markedly. For example, Seeley et al. (2001) pointed out that the OELs for benzene among European countries varied over a range of 10-fold: 0.5 ppm in the EU and Sweden; 1 ppm in The Netherlands; 3 ppm in Ireland; and 5 ppm in the UK, Germany, and Denmark. As reported in Liang et al. (2003), the newly adopted OELs for benzene in China are: 10 mg/m^3 (3 ppm) as 15-min STEL and 6 mg/m^3 (2 ppm) as 8-h TWA, revised downward from the previous OEL (MAC) of 40 mg/m^3.

The significant reduction of the newly adopted OELs for benzene demonstrates the recognition of the health effects of benzene overexposure in the country by both the government and the scientific community. Benzene is one of the most widely used industrial chemicals in China. The Chinese occupational medical literature is replete with reports of benzene overexposure and benzene poisoning (Wong, 2001, 2003). A wide variety of industries and/or occupations in China use benzene or benzene-containing solvents and adhesives, particularly the shoe industry. Many incidents of benzene overexposure occurred at small workshops as a result of no or inadequate ventilation. Li (1999) reported a survey of benzene measurements at 46 shoe factories in the small town of Shishi in Fujian province. Of the 346 samples taken, 140 (40.5%) exceeded the OEL of 40 mg/m^3 in effect at that time. From the province of Zhejiang, Yang (1995) described two cases of benzene poisoning at a small workshop (inside a farmer's residence) that manufactured slippers. The adhesive used was a mixture of chlorobutadiene and benzene (1:4). Four heating lamps were used at the workshop to enhance drying, and there was little or no ventilation. Benzene concentrations ranged from 302.4 to 1383.8 mg/m^3 (average = 731.25 mg/m^3). Two women were diagnosed with benzene poisoning after working there 10 h per day for 4 months. From the province of Suzhou, Tao (2000) reported benzene poisoning at a small shoe workshop at a farmer's residence. There was no ventilation system and the windows were often closed. A mixture of chlorobutadiene and benzene (1:4) was used as adhesive, and two charcoal-heated stoves were used for drying. Benzene concentration was recorded at 1000 mg/m^3. From the province of Heilongjiang, Li et al. (2000) reported 11 cases of benzene poisoning at a small workshop (10 m^2), where an adhesive of chlorobutadiene (containing 87% benzene) was used in making shoes. Air benzene concentrations ranged from 111.2 to 237.6 mg/m^3. The workers were exposed 10 h per day. Among the 11 cases of benzene poisoning, 5 subsequently died and the average values of their hematological parameters were: Hb 45 g/L, RBC 1.44×10^{12}/L, WBC 0.8×10^9/L, PLT 34.2×10^9/L, and RC 0.19%.

Benzene is also used extensively in painting (paint thinners) in China. From Shanghai, Ye (1996) described the condition at a paint shop (250 m^2) at a furniture factory, where no ventilation system was installed. The average benzene concentration was 3373.5 mg/m^3. Among the 34 workers at the shop, 8 were diagnosed with benzene poisoning. From the province of Guangdong, Guo (1994) reported an episode of benzene poisoning of three women who painted the inside of a compartment ($6.7 \times 1.4 \times 1.6$ m, only one circular opening with a diameter of 0.44 m) in a cargo ship. After painting for 15 min, all three women became unconscious, and one subsequently died. The average of the benzene measurements taken inside the compartment on the following day was 615.4 mg/m^3.

Many benzene overexposures occurred at small makeshift workshops with no or only rudimentary ventilation systems. For example, of the 46 shoe "factories" in the survey reported by Li (1999) described above, one-third of them were simply converted rooms inside private residences. Many small workshop owners were farmer-turned entrepreneurs, with very little or no knowledge of the chemicals that they used. Many of them were simply unaware of the potential health effects of benzene. Many owners of these small workshops paid little or no attention to even the most basic protective measures of the workers' health, such as ventilation systems. In many situations, exposure could be reduced significantly by simply installing relatively inexpensive ventilation systems. For example, Tan et al. (1991) reported that the average benzene level at a shoe factory in Hunan was 211.74 mg/m^3 (maximum 467.2 mg/m^3) in 1988, and 6 of the 90 workers at the factory were diagnosed with benzene poisoning. After the installation of exhaust hoods and ventilation systems in 1988, the average benzene level was reduced to 26.18 mg/m^3 (maximum 80.0 mg/m^3) in 1990 and no benzene poisoning case was detected among the workers.

The new ODPCAct and the new OELs signify the Chinese government's commitment to improve the environment of the workplace and to eradicate preventable occupational diseases. However, how effective will the new regulations be? For example, will the new OELs for benzene be effective in reducing benzene overexposure in the workplace? The effectiveness of the new regulations will depend on not only implementation and enforcement but also education and communication. For relatively large industrial facilities, implementation of the new regulations can be enforced with periodic monitoring and inspections. The difficulty will come from small makeshift or crudely converted workshops in villages and small towns in rural areas (Li, 1999; Tao, 2000). The challenge will be to reach out to these small workshop owners and workers, i.e., to communicate and inform them the newly promulgated regulations, the business owners' legal responsibility and liability, and the workers' right to a safe workplace. Attention and resources should be focused on educating both shop owners and workers the hazards of the chemicals that they use, basic requirements for a safe workplace, preventive measures, and controls to reduce exposures.

References

Guo, Y.Z., 1994. A report of three cases of acute benzene poisoning. Occupational Medicine 21 (6), 45 (in Chinese).

Li, J.X., 1999. An investigation of benzene exposures at shoe factories. Strait Journal of Preventive Medicine 5 (4), 49–50 (in Chinese).

Li, X.J., Song, L., Shi, D.M., 2000. Serious acute damage on hematopoiesis caused by benzene poisoning with 11 cases reported. Chinese Journal of Industrial Medicine 13 (3), 151–153 (in Chinese).

Liang, Y.X., Gang, B.Q., Gu, X.Q., 1995. The development of occupational exposure limits for chemicals substances in China. Regulatory Toxicology Pharmacology 22 (2), 162–171.

Liang, Y.X., Su, Z., Wu, W.A., Lu, B.Q., Fu, W.Z., Yang, L., Gu, J.Y., 2003. New trends in the development of occupational exposure limits for airborne chemicals in China. Regulatory Toxicology Pharmacology, 38.

Seeley, M.R., Tonner-Navarro, L.E., Beck, B.D., Deskin, R., Feron, V.J., Johanson, G., Bolt, H.M., 2001. Procedures for health risk assessment in Europe. Regulatory Toxicology Pharmacology 34 (2), 153–169.

Sonich-Mullin, C., 1997. Harmonization of approaches to the assessment of risk from exposure to chemicals. In: Kamrin, M.A. (Ed.), Environmental Risk Harmonization: Federal and State Approaches to Environmental Hazards in the USA. Wiley, New York, pp. 11–20.

Tan, X.S., Hu, Y.P., Liu, R., 1991. The effect and economic benefits of preventive measures of benzene poisoning. Chinese Journal of Occupational Medicine 4 (3), 59 (in Chinese).

Tao, G.Y., 2000. Some thoughts and reflections of benzene poisoning. Occupation and Health 16 (8), 67–68 (in Chinese).

Wong, O., 2001. Investigations of benzene exposure, benzene poisoning and malignancies in China. Regulatory Toxicology Pharmacology 35 (1), 126–135.

Wong, O., 2003. Letter from Shanghai. Occupational and Environmental Medicine 60 (3), 223.

Yang, F., 1995. A report of two cases of benzene poisoning and aplastic anemia. Occupational Medicine 22 (2), 26–27 (in Chinese).

Ye, K.Q., 1996. An investigation of chronic benzene poisoning related to painting. Industrial Medicine 13 (3), 155 (in Chinese).