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A Discussion of Occupational Health and Safety Management for the Catering Industry in China

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The catering industry is developing rapidly in China. Statistics in 2002 indicated that there were over 3.5 million dining places in China, hiring over 18 million people. However, the accident rate was high. Occupational health and safety (OHS) has to be watched more carefully. It is proposed to develop an OHS management system for the catering industry and to integrate it with an ongoing management system by referring to OHSAS 18001:1999. The first step is risk identification and evaluating the major factors concerned by referring to the codes in China, the list of occupational diseases, operation rules, requirements of the law, and records of past incidents. The technological aspect has to be considered in working out the safety strategies. This includes technical measures in accident prevention at the workplace. The kitchen is the main area to be focused on. Methods for hazard identification and risk assessment of dangerous factors in kitchens are proposed in this paper.

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1. INTRODUCTION

With the rapid economic development and improved living standard in China, the catering industry is growing fast, especially in major cities [1]. According to the statistics of the China Cuisine Association, there were more than 3.5 million dining places in China in 2002, hiring over 18 million people. At the same time, there have been growing concerns about the occupational health and safety (OHS) problems in the catering industry.

Technical problems and the lack of proper management result in health damage and frequent occurrence of accidents in the kitchens. Factors such as lighting, noise, high temperature, and high concentration of carcinogenic substances in the air in the kitchen environment pose serious threats to the safety and health of kitchen staff. Lack of directional signs to emergency exits, smoke doors kept open all the time, stagnant water and slippery floor, blocked emergency routes, piling up of objects to heights, improper way of lifting heavy objects, and lack of training and emergency drills are possible reasons leading to industrial accidents and occupational diseases [2]. These problems not only endanger the health and safety

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of the staff but they may also significantly affect the public environment. In fact, this has become one of the concerns of the society. Therefore, it is necessary to look for solutions to OHS problems in the catering industry. It is proposed in this paper that an effective measure is to set up an OHS management system (OHSMS) based on OHSAS 18001[1] (GB/T28001-2001 [3]). OHSMS is the basis for organizational health development. Setting up an OHSMS is a continuous upgrading exercise to solve OHS problems.

Up to February 2006, there were 5 922 corporations in China which had OHSMS accreditation [4]. A total of 18 inter-related requirements is specified in OHSAS 18001 (GB/T28001-2001 [3]) for organizations to set up an OHSMS. Their five main characteristics are plan–do–check–action operation mode, risk prevention, involvement of all staff, three-level monitoring, and regular upgrading. Hazard identification is the basis for setting up an OHSMS. Risk assessment is the key to an effective control of risks. This is specified particularly in section 4.3.1 "Planning for hazard identification, risk assessment and risk control" [3] that organizations have to identify and evaluate their own dangerous and hazardous factors.

2. HAZARD IDENTIFICATION

Dangerous and hazardous factors can be classified according to two national codes: Standards No. GB/T13861-1992 [5] and GB6441-1986 [6]. The former classifies dangerous and hazardous factors into six categories according to the direct cause of the incident and occupational hazard:

- physical factors: inadequacy of equipment and facilities, insufficient protection, electrical hazard, noise hazard, vibration hazard, electromagnetic radiation, moving body hazard, fire, high-temperature substances that may cause burns, low-temperature substances that may cause frostbites, dust and aerosols, poor working environment, signal failure, inadequate signs, etc.;
- chemical factors: inflammables or explosives, self-combustibles, toxic and corrosive elements, etc.;
- biological factors: pathogenic microorganisms, media of infectious diseases, harmful animals, harmful plants, etc.;
- psychological and physiological factors: overloading, abnormal health conditions, jobs of a taboo nature, abnormal psychological conditions, problems in identification, etc.;
- behavioural factors: errors in giving instructions, operational errors, errors in monitoring, etc.;
- other dangerous and hazardous factors: lifting heavy objects, working space, inappropriate tools, and unclear labeling.

On the other hand, Standard No. GB6441-1986 [6] classifies occupational deaths and injuries into the following categories by considering factors leading to the incident, substances causing harm, the type of injury, etc. Those categories include being hit by objects; being injured by vehicles; suffering from mechanical injuries, injuries due to lifting weights, electric shock, drowning, burns, fire; falling from heights; collapsing; falling from heights including from roofs and walls; a flood; injuries due to explosions, gunpowder explosions, gas explosions, boiler explosions, container explosions, other explosions; and toxification and suffocation.

Though different, those two codes (i.e., [5, 6]) are inter-related. The latter is the result of the incident, while the former leads to the incident. For example, in Standard No. GB6441-1986 [6], fire is the result of an incident. The fire may be caused by flames or a poor working environment; inflammables, explosives or self-combustibles; errors in command or operational errors as listed in Standard No. GB/T13861-1992 [5].

In identifying dangerous and hazardous factors, reference has to be made to occupational diseases, operation rules, complaints of the parties involved, laws and regulations, as well as records of past incidents.

[1] British Standards Institution (BSI). Occupational health and safety management systems—specification. Occupational Health and Safety Assessment Series (Document No. OHSAS 18001:1999). London. UK: BSI; 1999.

3. LEC METHOD FOR EVALUATING DANGEROUS FACTORS

After the dangerous factors have been identified, evaluation has to be carried out to classify them according to the levels of danger, so that priority can be given to those requiring urgent control measures. There are many methods for determining the level of danger. The likelihood–exposure–consequence (LEC) method is commonly used in the catering industry for conducting semiquantitative evaluations of identified dangerous factors. The degree of danger D is calculated according to the following formula: $D = L \times E \times C$, where L is the likelihood of the incident, E is the rate of exposure to the dangerous environment, and C expresses the possible consequences of the incident. Table 1 presents reference values of L, E and C; Table 2 a classification of the levels of danger D.

In determining major dangerous factors, the following aspects have to be considered: (a) noncompliance with laws, regulations, and other requirements; (b) prior incidents where no effective measures were taken; (c) lack of appropriate control measures; (d) reasonable complaints and requests of related parties; (e) the LEC method applied to determine the value of D. An example of hazard identification and risk assessment in a restaurant kitchen is shown in Table 3.

TABLE 1. Values of *L*, *E* and *C*

Likelihood of Incident	*L*	Rate of Exposure to Dangerous Environment	*E*	Possible Consequences of Incident	*C*
Predictable	10	24 hrs a day	10	more than 10 people died	100
Highly possible	6	daily working hours	6	2–9 deaths	40
Possible but not frequent	3	once a week	3	1–2 deaths	15
Unlikely	1	once a month	2	serious injuries	7
Very unlikely	0.5	several times a year	1	minor injuries	3
Highly impossible	0.2	very rare	0.5	of concern	1
Almost impossible	0.1				

Notes. *L*—likelihood of incident, *E*—rate of exposure to the dangerous environment, *C*—possible consequences of the incident.

TABLE 2. Classification of Danger (*D*) Levels

D	*D* Level	Description	Action Required
>320	5	very dangerous; work to be stopped immediately	correct the scheme immediately
160–320	4	highly dangerous; to be improved immediately	introduce control measures
70–160	3	obviously dangerous; to be improved	introduce more testing and inspections
20–70	2	generally dangerous; more attention required	maintain existing measures
<20	1	slightly dangerous; acceptable	maintain existing measures

TABLE 3. Hazard Identification and Risk Assessment of a Restaurant Kitchen

Job Description/ Equipment Used	Code for Dangerous/ Hazardous Factor	Hazardous Factor	Possible Incident or Injury	*L*	*E*	*C*	*D*	Risk Level
Floor cleaning	16005	slippery floor	physical injury	3	6	1	18	1
Use of gas	21505	leakage of gas, presence of inflammable goods	fire, explosion	1	10	15	150	3
Pasta machines	11010	exposed moving parts of machines	mechanical injury	1	6	3	18	1
Pasta and flour-mixing machines	11505	leakage of electricity	electric shock	3	6	1	18	1

TABLE 3. *(continued)*

Job Description/ Equipment Used	Code for Dangerous/ Hazardous Factor	Hazardous Factor	Possible Incident or Injury	*L*	*E*	*C*	*D*	Risk Level
Multifunction stirrers	11010	exposed moving parts of machines	mechanical injury	1	6	3	18	1
Meat stirrers, baking ovens, sterilizers, steamers	11505	leakage of electricity	electric shock	3	6	1	18	1
Steamers	14505	hot steam	burns	6	3	1	18	1
Fans	12005	noise	hearing impairment	0.5	6	1	3	1
Chopping food	10530	sharp edge	mechanical injury	3	6	1	18	1
Transportation of food	51099	human stress	physical injury	1	3	1	3	1
Cooking	21599	soot	damage to health	3	6	1	18	1
	14599	high temperature	burns	3	6	1	18	1
Food processing	30505	raw and cooked food stored together	food poisoning	3	10	1	30	1
	16005	poor hygienic conditions	food poisoning	1	6	1	6	1

Notes. $D = L \times E \times C$; *D*—danger, *L*—likelihood of the incident, *E*—rate of exposure to the dangerous environment, *C*—possible consequences of the incident.

4. TECHNICAL CONTROL MEASURES FOR OHS

Technical control measures are necessary in each corporation. In the catering industry, health and accident prevention are the two most considered aspects. Staff have to be protected from injuries even when there are operational errors. Requirements are set out in sections 4.4.6 "Operational control", 4.3.3 "Objectives", and 4.3.4 "OHS management programme(s)" of OHSAS 18001 (GB/T28001-2001 [3]).

According to Standard No. GBZ 1-2002 [7], aspects to be considered in the preliminary design stage include the overall design of the kitchen; corridors, exits, and fire protection installations; floor conditions; piling up and storage of materials, equipment, and tools; machines, equipment, and handheld tools; electrical installations; noise control, and ventilation provision; hygiene facilities; emergency equipment; and air purification facilities.

Soot is a volatile substance produced from cooking oil and food under high temperature during the process of thermal oxidation, thermal decomposition, and Mailard reaction. It contains many toxic and hazardous components. Over 200 thermal decomposition products are generated from different types of cooking oil. The main ones are aldehydes, ketones, hydrocarbon lipase, aromatic compounds, and heterocyclic compounds [8]. These compounds pose great hazards to human health. Literature results indicate that soot from cooking oil contains hereditary toxic substances that might induce different biological reactions such as mutation of genes, and damage to the deoxyribonucleic acid (DNA) and chromosomes. Its toxicity is not only hereditary, but also potentially carcinogenic [9].

In order to improve the working environment, protect the staff, and be responsible to the natural environment (e.g., to protect the upper atmospheric ozone layer), soot purification equipment has to be installed to prevent harmful toxic substances produced during food processing from being discharged. In designing and implementing soot purification strategy, many factors have to be taken into account, e.g., the kitchen area, the number of stoves and exhaust hoods, the total projection area of exhaust hoods, purification equipment and the performance of exhaust fans, layout of pipes, and the cost of installation and construction.

Different levels of soot purification have been implemented in many Chinese restaurants. There are six categories of soot purification treatment:

- mechanical separation: applying the principle of inertial collision or rotational separation to separate the soot;
- wet-type treatment: using detergents to form a water film or water mists to absorb the soot, transforming the soot from gas phase into liquid phase;
- filtering through fibres: soot and exhaust gases will be diffused or trapped when passing through fibres;
- adsorption by active carbon: making use of the porous nature and adsorption properties of active carbon to adsorb soot particles;
- high-voltage electrostatic treatment: using a high-voltage field to charge the ions of soot, and then using an electric field to attract the charged particles to separate the pollutants;
- catalytic combustion: using a catalyst to transform the soot pollutants into non-toxic substances during the process of high-temperature combustion.

In fact, different combinations of soot purification treatments are usual, since the performance of a single method is not too satisfactory. The different combinations include mechanical collision combined with electrostatic treatment; filtering combined with wet-type treatment; rotational separation combined with active carbon adsorption; rotational separation combined with water mist or water film treatment; and a combination of filtering, electrostatic treatment and active carbon adsorption. Meanwhile, an important point to note is the fire safety of soot purification equipment.

Kitchen staff working in Chinese restaurants are affected by high noise level, such as noise from steamers and gas stoves, the sound of operating motors of the exhaust fans, cooking utensils pounding on one another, and human noise. Noise control measures in the catering industry are more for environmental protection, so many sound insulation and sound absorption facilities are installed at the exhaust outlets. However, the issue of improving the noisy environment for kitchen staff should not be neglected. The design of sound insulation materials, layout of the working environment, and the selection of equipment are factors to be considered in the design stage.

5. ACCIDENT PREVENTION

As more cooking machines (flour-mixing machines, meat mincers, pasta machines, vegetable choppers, steamed-bun machines, egg whisks, machines for making dumplings, food stirrers, etc.) are used in restaurants, the working conditions, and the quality and efficiency of the kitchen staff have improved. But physical injuries and incidents caused by machines are also quite frequent. Apart from the poor design and manufacturing of some equipment, accidents might be due to poor maintenance, poor working environment, failing to understand the operation rules, and human error.

The following actions are suggested:

- Moving parts of machines should have a protective cover; belt pulleys, gears, chain wheels and chains, and shaft couplings of the moving parts of cooking machines should have protective lids, covers, or railings. Common requirements of protective lids, covers, and railings can be found in the part of Standard No. GBZ1-2002 [7] on metal cutting machine tools.
- Stirrers should have a tight lid and lock; the lid of the container should be made of a material satisfying the national requirements. The lid should be easy to open and preferably of a turn-over type. The lid should fit tightly with the opening for complete sealing. Containers that cannot be tightly sealed should be locked. Electricity should be automatically cut off once the lid is opened (to prevent hurting the operators if they accidentally put their hands into the machine).
- Reliable protecting earthing (PE) connections and electric circuits; PE connections of metal shells and electric shells of all cooking machines should be reliable. The relevant requirements can be found in the part on metal cutting machine tools. The electric circuits of the cooking machines should satisfy the requirements of electrical installations.

Electric circuits should be protected; if rubber cables are used, they should be laid along the walls without soaking, high temperature, or tamping. There should not be any joints, damage, ageing, or overloading of circuits. The electrical cabinet that comes with the machine should be evaluated according to the part on metal cutting machine tools.

- Each item of equipment should have a separate switch; cooking machines should have separate power supply switches; buttons or switches should be protected against dust and water.
- Dangerous machine parts that involve the motions of crushing, mincing, pressing, squeezing, and cutting should be well-protected to prevent hurting the operators. Those parts have to be designed to be safe, reliable, and practical.

Moreover, meat mincers (including other food stirrers)—the opening for feeding in the food for mincing should not allow the operator's fingers to reach the cutting knives or the spiral parts. The larger opening should also be made taller, otherwise a small tray should be added. The added height of the opening or tray should be made of durable material, and it should be possible to turn over the connected parts for cleaning. The provided tools, and not hands, should be used to push food into the machine for mincing.

Pasta machines (including other wheaten food processing machines)—the rollers should be easy to assemble, disassemble, adjust, and be fixed at position firmly. The opening should be protected to prevent fingers from being hurt. The provided scraping plate, and not hands, should be used to push or scrape the flour.

6. IMPLEMENTING OHSMS FOR CONTINUOUS IMPROVEMENT OF OHS PERFORMANCE

Through implementing OHSMS in the catering industry, a self-monitoring mechanism can be established to reduce the number of accidents and to raise the level of OHS management. The management concept of the OHSAS 18001 (GB/T28001-2001 [3]) system can be integrated into the existing system to create a new management mode such as the ISO 9001 quality control system [10] and the Hazard Analysis Critical Control Point (HACCP) food safety management system [11]:

- upgrading, renewing, and regular maintenance of the hardware (including equipment, protective installations, ventilation facilities, chained installations, devices for reducing noise level, facilities for reaching heights, and transport vehicles); modifying, repairing, and replacing worn-out parts of machines, etc.;
- management measures, including formulating and revising operation rules and user's guides, establishing and reviewing procedures and management scheme, regular inspecting of key areas, improving and increasing the number of safety signs at the workplaces, setting up rosters, regular training and assessing of personnel;
- preventive measures, such as increasing or improving the delivery and usage of protective items, allowing more time for resting and working in shifts;
- measures for handling emergencies, including the setting up and revising all kinds of contingency plans, providing adequate facilities for emergency, regular inspecting and replacing of firefighting equipment;
- setting up some targets, such as controlling the noise and dust level below certain values, maintaining the equipment and facilities in good order, limiting the driving speed of vehicles, keeping the incident rate of mechanical injuries at a low level, and ensuring the correct use of protective items;
- raising individual awareness towards safety. In the appendix of Standard No. GB6441-1986 [6], unsafe human behaviours are grouped into 13 categories: operational errors, human errors leading to failure of safety installations, use of unsafe equipment, doing manually work that should be done with machines or other tools, improper storage of objects, entering dangerous places at risk, sitting in unsafe positions, staying or working under hanging objects, refilling oil when the machine is in

operation, not paying full attention when working, neglecting the use of protective items or tools, improper clothing, inappropriate treatment of dangerous goods such as inflammables and explosives.

Individual awareness towards safety can be raised through training, publicity, providing more directional signs, etc.

7. CONCLUSION

In 2005, the catering industry in China was worth over CNY 880 bn (about US $113.7 bn). With the rapid development of the catering industry, every corporation should pay close attention to OHS, especially to the safety and health of the staff. It is proposed to set up an OHSMS based on the OHSAS 18001 (GB/T28001-2001 [3]) to control hazards through both technology and management. The risk to the organization can be reduced. Consequently, the level of OHS can be improved.

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