

Survey on occupational health status of 37 ceramic production enterprises in Jiajiang County

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Keywords: Ceramic production enterprises; Occupational health status; occupational hazards; Survey

Abstract: To understand the degree of occupational hazards in ceramic production enterprises, we conducted a survey on the occupational health status of 37 ceramic production enterprises in Jiajiang County, and conducted occupational hazard factor testing and evaluation on 4 of them. We proposed targeted control measures and suggestions. The survey showed that out of 62 dust samples, 44 were qualified; 26 out of 41 noise detection points have qualified noise intensity; 23 out of 24 high-temperature detection points are qualified; 13 carbon monoxide detection points and 12 carbon monoxide concentrations are qualified; The remaining 39 samples are all qualified. The main occupational hazards of ceramic production enterprises in Jiajiang County are silicon dust, coal dust, noise, high temperature, carbon monoxide, etc.

1. Introduction

Jiajiang County is known as the porcelain capital of western China and also the largest ceramic production base in the western region. The number of ceramic production enterprises exceeds one fourth of that in Sichuan Province. China's occupational health work started relatively late, and the development of occupational disease prevention and control work is slow, which leads to a lack of understanding of the occupational disease hazards in ceramic production. In order to understand the current situation of occupational hazards in the ceramic industry and explore suitable occupational health management models for ceramic production enterprises, a survey was conducted on the occupational health status of 37 ceramic production enterprises in Jiajiang County to evaluate their occupational hazards and provide scientific management basis for regulatory authorities.

2. Objects and Methods

2.1 Objects

We conducted an occupational health survey on 37 ceramic production enterprises in Jiajiang County, and randomly selected 4 enterprises to conduct occupational disease hazard factor testing on their key control positions.

2.2 Methods

The occupational health survey is conducted through cluster sampling, with no less than 2 investigators as the investigation team entering the factory. The survey information is collected through methods such as data review, face-to-face questioning, and on-site investigation. The survey information is registered and summarized through a unified form.

The detection of occupational disease hazards is based on *Specifications of air sampling for hazardous substances monitoring in the workplace*^[1]. Determination of dust concentration according to *Method for determination of dust in the air of workplace Part 1: Total dust concentration*^[2]. High temperature measurement according to *Measurement of Physical Agents in Workplace Part 7: Heat Stress*^[3]. Noise detection shall be carried out in accordance with

Measurement of Physical Agents in Workplace Part 8: Noise^[4]. We need to evaluate the test results according to *Occupational exposure limits for hazardous agents in the workplace-Part 1: Chemical hazardous agents*^[5] and *Occupational exposure limits for hazardous agents in the workplace Part 2: Physical agents*^[6].

2.3 Survey content

The survey content includes the basic situation of ceramic production enterprises, occupational disease prevention and control plans and implementation plans, occupational health management systems, occupational health management institutions and personnel, occupational health management archives, occupational disease hazard assessment, occupational disease hazard factor detection, occupational health bulletin boards and warning signs, occupational disease protection facilities, personal protective equipment, occupational health training, occupational health monitoring, Occupational disease hazard emergency rescue, etc. We analyze the survey results and identify common issues in occupational health management in ceramic production enterprises.

3. Result

3.1 Spot investigation

We have investigated 37 ceramic production enterprises, all of which are private small and medium-sized enterprises. The total number of employees on duty is 10406, and the total number of workers exposed to occupational hazards is 7808, accounting for 75.03% of the total number of employees on duty. The main raw and auxiliary materials used by ceramic production enterprises are kaolin ore ($\text{SiO}_2\text{Al}_2\text{O}_3\text{Fe}_2\text{O}_3$), potassium feldspar ($\text{K}_2\text{O}\cdot\text{Al}_2\text{O}_3\cdot 6\text{SiO}_2$) sodium feldspar ($\text{NaAlSi}_3\text{O}_8$), quartz sand (SiO_2), glaze, and coal. The main technological processes of ceramic manufacturers include raw materials, ball milling, slurring, screening, spray drying, aging, molding, drying, glazing, glaze firing, edging, finished products, and packaging. The gas station provides gas. The main occupational hazards in key control positions of ceramic production enterprises are silicon dust, coal dust, noise, high temperature, carbon monoxide, sulfur dioxide, nitrogen dioxide, hydrogen sulfide, which is Consistent with the research results of LIU Fu guang, FENG Hai fei, etc^[7].

37 companies do not have annual occupational disease prevention and control plans or implementation plans, occupational health job operation procedures, on-site occupational health bulletin boards, lack of occupational disease protection facilities for noise and high temperature, and incomplete occupational health management files. The main responsible persons and occupational health management personnel of the enterprises have not received occupational health job training. 11% of ceramic production enterprises have not established occupational health management systems, and 89% of enterprises that have established occupational health management systems are not fully implemented. 5% of enterprises have not established occupational health management institutions. 86.5% of enterprises do not have dedicated occupational health management personnel. 54% of enterprises have not conducted occupational hazard assessments. 14% of enterprises have not conducted occupational disease hazard factor testing and evaluation. 86% of enterprises that have completed the detection and evaluation of occupational hazards also have missing or omitted items in the detected occupational hazards. 38% of enterprises have not set up occupational health warning signs. 62% of enterprises have set up warning signs, but there are problems such as non-standard content and size of warning signs, incomplete information on occupational disease hazards, and failure to announce the results of occupational disease hazard factor testing on site. 37 companies are all equipped with dust collectors, usually 2-4 units, with a small number of 1 unit, mostly arranged in positions such as raw material feeders, presses, grinding edges, and coal loading. As a compressor with severe dust production, large-scale newly built enterprise production lines have undergone fully enclosed operations, and most of the enterprise compressors are not sealed. The gas station is equipped with several axial fans, and on-site workers completely ignore the chronic hazards of low concentration

carbon monoxide. 32% of enterprises have not provided personal protective equipment that is suitable for workers who have been exposed to harm. 68% of companies have issued personal protective equipment to workers who are exposed to dust, but the problem is that not all dust workers have been given dust masks. Dust workers are not equipped with unified dustproof work clothes. Enterprises have not issued suitable protective equipment to workers exposed to noise and high temperatures. Most workers do not wear corresponding effective protective equipment (such as dust masks, noise earplugs, etc.) Part of the occupational health training for frontline workers was mentioned in the pre shift meeting, but the training content was not systematic or comprehensive, resulting in a lack of knowledge about occupational disease prevention and weak self-protection awareness. 10.8% of enterprises have not organized pre employment, on-the-job, and post employment occupational health examinations for workers. 89.2% of enterprises have conducted occupational health examinations for workers, but the number of pre employment examinations and actual experience during employment is much smaller than the number of people who should be examined. The rate of post employment examinations is low, and the items of occupational health examinations are not complete., Enterprises generally organize workers to undergo physical examinations for items such as dust, noise, and high temperature, without involving chemical toxins such as carbon monoxide and coal tar. Most enterprises do not organize occupational health examinations for workers when they are transferred. All 37 enterprises have gas stations, and most of them have on-site disposal plans for acute carbon monoxide poisoning in emergency management of gas stations, but no emergency drills or revisions of emergency plans have been carried out. The isolated air respirator equipped on site is outdated, and the carbon monoxide monitoring alarm is not functioning properly. The emergency passage set up at the gas station is not obvious and there are no visible wind indicators at night. The desulfurization and laboratory positions using sodium hydroxide are not equipped with flushing devices and eye washers. The sampling position at the gas station is not equipped with a carbon monoxide gas mask. The survey statistics are shown in Table 1.

Table 1 Implementation of Occupational Health Management in 37 Ceramic Production Enterprises in Jia jiang County

Occupational Health Management Content	Partial implementation		unimplemented	
	Number of enterprises/unit	Proportion /%	Number of enterprises/unit	Proportion /%
Occupational disease prevention and control plan and implementation plan	0	0	37	100
Occupational Health Management System	33	89	4	11
Occupational Health Management Archives	33	89	4	11
occupational hazard evaluation	17	46	20	54
Detection of occupational disease hazards	32	86.5	5	13.5
Occupational health bulletin board and warning signs	23	62	14	38
Occupational disease prevention facilities	23	62	14	38
Personal protective equipment	25	68	12	32
Occupational health training	37	100	0	0
health surveillance	33	89.2	4	10.8
Emergency response to occupational hazards	16	43	21	57

3.2 Detection of occupational disease hazards

Overview of occupational disease hazard factor detection. A total of 179 samples were tested, of which 35 were qualified. Among the 62 dust samples, 44 were qualified; 26 out of 41 noise

detection points have qualified noise intensity; 23 out of 24 high-temperature detection points are qualified; 13 carbon monoxide detection points and 12 carbon monoxide concentrations are qualified. The dust compliance rate is 70.97%, the noise compliance rate is 63.41%, the high temperature compliance rate is 95.83%, and the carbon monoxide compliance rate is 92.31%. All other occupational hazard factors meet the standards. The positions with excessive dust include: fritter worker, ball glazier worker, press worker, edge grinder, slag remover, ball grinder, batcher, forklift worker. The positions with excessive noise include: ball mill worker, edge grinder, glazier, packaging worker, coal shovel worker, polishing worker, raw material shovel worker, and press worker. The position with high temperature exceeding the standard is a drying kiln inspector. The position where carbon monoxide exceeds the standard is a furnace worker. See Table 2 for details.

Total content of free silica in dust and air in the workplace. We collected settling dust in the air at the inspection points of the glaze kiln, ball mill operation position, raw material feeder conveyor belt operation position, frit workshop batching operation position, coal yard conveyor belt operation position, coal water slurry batching port, coal bunker station on the first floor, polishing machine operation position, raw material yard shovel driver's cab, ball glaze workshop feeding port and other operating locations of four ceramic production enterprises, and tested the content of free silica in the dust. The test results showed that the free silicon dioxide content in 28 samples from the inspection site of the glaze kiln, the operation position of the ball mill, the operation position of the raw material feeder conveyor belt, the batching operation position of the frit workshop, the polishing machine operation position, the forklift cab of the raw material yard, and the feeding port of the ball glaze workshop was between 11.4% and 17.7%, and its dust property was silicon dust. The content of free silica in the remaining 12 samples ranges from 5.2% to 7.7%, and its dust nature is coal dust. See Table 3 for details.

Table 2 Results of occupational hazard factor testing for four ceramic production enterprises

occupational hazards	Sampling points	Excess points	Pass rate /%
dust	62	42	70.97
noise	41	26	63.41
high temperature	24	23	95.83
carbon monoxide	13	12	92.31
sulfur dioxide	12	12	100
nitrogen dioxide	10	10	100
hydrogen sulfide	4	4	100
coke oven emissions	3	3	100
zinc oxide	1	1	100
Lead and its compounds	3	3	100
Chromium and its compounds	3	3	100
Mercury and its compounds	3	3	100
amount to	179	144	80.45

Table 3 Free silica content in productive dust from four ceramic production enterprises

Testing location	Number of test samples	Free silica content(%)	Dust type
		range	
Glaze Kiln Inspection Office	4	14.4-16.8	Silica dust
Ball mill operation position	4	12.3-17.7	Silica dust
Raw material feeder conveyor belt operation position	4	11.9-15.9	Silica dust
Ingredient operation position in the melting block workshop	4	12.1-15.5	Silica dust
Coal yard conveyor belt operation position	4	5.9-6.4	coal dust
Coal water slurry batching port	4	5.2-5.8	coal dust
1st floor of Coal Bunker Station	4	5.6-7.7	coal dust
Polishing machine operation position	4	11.4-15.3	Silica dust
Raw material yard forklift cab	4	11.6-14.7	Silica dust
Ball glaze workshop feeding port	4	12.1-16.8	Silica dust

4. Discuss

The survey shows that the main occupational hazards in ceramic production enterprises in Jiajiang County are silicon dust, coal dust, noise, high temperature, and carbon monoxide, which is consistent with the research conclusions of Liang Heng-jian et al^[8]. The dust properties of positions such as frit, ball glaze, press, edge grinding, slag removal, ball milling, batching, and forklift are all silicon dust, and the dust concentration exceeds the standard. The noise intensity in the positions of ball milling, edge grinding, glazing, packaging, coal shoveling, polishing, raw material forklift, and press exceeds the standard, the high temperature in the drying kiln position exceeds the standard, and the carbon monoxide concentration in the furnace operator position exceeds the standard. Ceramic production enterprises should strengthen on-site occupational health management and take effective protective measures. Suggestions are as follows:

4.1 Strengthen on-site supervision and supervision of occupational health by regulatory authorities, fully utilize social and technological support forces

We should strengthen the supervision of the competent authorities and fully utilize the technical strength of the occupational health expert database. Health administrative departments at all levels should strengthen occupational health supervision and management of ceramic production enterprises. Relevant functional departments should strengthen mutual communication and close cooperation. To address the issue, government authorities should intensify the special rectification efforts of ceramic enterprises, adopt a combination of supervision and service guidance, set goals, make plans, conduct regular supervision, and focus on implementation. They should also strengthen the promotion and training of occupational disease prevention and control knowledge through various channels and means, and increase the training of the main responsible persons and occupational health management personnel of enterprises. Additionally, experts should be encouraged to participate in occupational health supervision and management organized by health administrative departments at all levels, providing comprehensive guidance on the occupational health management of enterprises.

4.2 Implement the main responsibility of employers

Enterprises should strengthen their occupational health management efforts by implementing various measures. These include developing annual occupational disease prevention and control plans and implementation plans, establishing and enhancing occupational health management systems, particularly improving job occupational health operating procedures, appointing at least one full-time occupational health management personnel, establishing and improving occupational health management records, conducting occupational disease hazard assessments every three years, performing occupational disease hazard factor testing annually, setting up notice boards to communicate rules and regulations, operating procedures, emergency response measures for occupational disease hazard accidents, and detection results of occupational disease hazard factors in the workplace. Furthermore, enterprises should enhance on-the-job training for main responsible persons and occupational health management personnel, reinforce occupational health training for frontline management personnel and workers, and promote workers' self-protection awareness through education and publicity initiatives.

Enterprises should improve occupational disease prevention facilities. Strengthen comprehensive ventilation in production workshops. Enterprises take sealing measures to prevent dust from escaping at points where a large amount of dust is generated, such as raw material screening and transportation, drying towers, presses, polishing, and edge grinding^[9]. High concentration coal dust at coal bunker stacking and reclaiming, coal loading, raw material forklift shall be reduced by high-pressure spray. Ceramic production enterprises should take measures to reduce the hazards in the workplace, such as setting up soundproof operating rooms or rest rooms for high noise working positions (next to ball mills and presses) or creating overall fences (next to casting lights and grinding edges). The enterprise shall strengthen the high temperature protection of workers in the drying tower, plain kiln, glaze kiln and other places for patrol inspection, and reduce the

temperature by installing spray fans. Enterprises should strengthen the ventilation of various inspection positions in gas stations, especially focusing on improving the ventilation conditions in the control rooms where workers often stay. High noise workshops should build soundproof rest rooms, which should be equipped with ventilation and cooling facilities, wardrobes, clean drinking water, and first aid kits.

Enterprises need to improve the distribution standards for personal protective equipment. Enterprises should strengthen training on the use, maintenance, and upkeep of personal protective equipment to ensure that it is correctly worn and used by workers. Enterprises should improve the supervision and assessment mechanism for personal protective equipment and strengthen regular testing of personal protective equipment.

Enterprises should strengthen emergency response management for occupational disease hazards. Enterprises should strengthen the emergency management of carbon monoxide in gas stations and popularize the hazards of chronic carbon monoxide poisoning. Enterprises need to strengthen emergency management for heat stroke caused by high temperatures, and popularize the hazards and protection knowledge of heat stroke to workers. Enterprises should install flushing devices and eye washers at locations where acid and alkali are used, such as desulfurization towers and laboratories. Enterprises should strengthen daily occupational hazard protection training for gas station operators and gas samplers. Gas stations should be equipped with visible wind indicators at night and clear emergency channels. Enterprises should improve the ventilation conditions of gas station control rooms and pay attention to the chronic occupational hazards of carbon monoxide.

Enterprises should strengthen occupational health monitoring. Enterprises should organize workers to undergo pre employment, on-the-job, post employment, and emergency occupational health monitoring, and do a good job of "one person, one file" occupational health monitoring file management. It must be emphasized that the occupational health examination items for enterprise workers should be comprehensive, and the examination rate should be guaranteed to be 100%. Occupational health examinations should also be organized during job transfers. If workers do not undergo physical examinations, management measures and methods should be formulated, and payment or exemption clauses should not be used as a substitute for occupational health examinations.

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