

## **Analysing Risk Factor Identification for Deep Well Casting and the Current Situation of Safety Management in China**

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<https://doi.org/10.71659/icsoba2025-ch001>

### **Abstract**

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In recent years, several explosion accidents have occurred in the aluminium industry using Deep Well Casting also known as DC Casting pits. These accidents caused not only serious casualties but also near disasters. To effectively prevent and control explosion accidents in the Deep Well industry. This paper, firstly, starts from the mechanism and necessary conditions of deep-well casting explosions and provides a detailed analysis and introduction; secondly, summarizes the current main measures for explosion protection in Deep Well and describes the mandatory requirements imposed on deep-well casting enterprises by our safety authorities. Through these analyses, the aim is to provide scientific safety management guidance and accident prevention strategies for the Deep Well industry to reduce the occurrence of similar accidents and ensure personnel safety and production stability.

**Keywords:** Deep well, Risk factor identification, Safety management.

### **1. Introduction - Raising of the Problem**

In recent years, production safety accidents in aluminium processing (Deep Well Casting or DC casting pits) enterprises have shown a tendency of frequent occurrence, bringing serious losses to the lives and properties of enterprises and employees, and attracting high attention from all sectors of society. The following are several typical accident cases:

On August 31, 2024, an aluminium liquid-water explosion accident occurred in the casting workshop of Shanxi Southeast Seiko Technology Co., Ltd. in Lüliang City, Shanxi Province, resulting in 3 deaths and 10 injuries. Before the accident, the cooling water pump relay had experienced multiple power outages and tripping, which was an obvious sign of equipment abnormality. However, the operators of the enterprise had a weak safety awareness and continued to organize production without thoroughly troubleshooting and completely repairing the fault. It was precisely this illegal operation that led to the cutoff of cooling water and eventually triggered the aluminium liquid-water explosion. The operators failed to fully recognize the serious consequences that equipment abnormalities might bring about and lacked sufficient attention to safety hazards. They took risks and continued working without solving the fundamental problems, which became the key human factor in the occurrence of this accident.

Similarly, on July 26, 2024, an aluminium liquid-water explosion accident also occurred in the deep well casting workshop of Henan Zhongrui Nonferrous Metal Materials Co., Ltd. in Shangqiu City, Henan Province, causing 5 deaths and 14 injuries. This accident also exposed the problem of illegal operations by operators. During the daily production process, the operators might not have carried out equipment inspection and maintenance in strict accordance with the safety operation procedures and turned a blind eye to the potential safety risks. When the aluminium liquid come into contact with water during the casting process, due to the lack of correct emergency treatment measures and sufficient safety awareness, a tragedy was finally caused.

In addition, there were several similar accidents in 2024. For example, on July 9, an aluminium liquid-water explosion accident occurred in the casting workshop of Fuan Aluminium Industry Co., Ltd. in Fuzhou City, Fujian Province, resulting in 2 deaths and 1 injury. On February 18, an aluminium liquid-water explosion accident occurred in the melting workshop of Asia-Pacific Light Alloy (Nantong) Technology Co., Ltd. in Nantong City, Jiangsu Province, causing 5 deaths and 13 injuries. Moreover, looking back at the past, similar metal smelting accidents were also common. See Table 1 for details.

**Table 1. List of liquid metal accidents.**

Time	Accident Name	Casualties	Remarks
2007	"8·19" Aluminium Liquid Overflow and Explosion Accident of Shandong Weiqiao Pioneering Group	20 deaths, 59 injuries (including 13 seriously injured)	
2018	"8.28" Larger Explosion Accident of Jiangyin Yize Aluminium	5 deaths, 1 seriously injured	Deep well casting
2022	"4·3" Larger Explosion Accident of Guangdong Jingmei Special Profile in Qingcheng, Qingyuan	5 deaths	Deep well casting
2023	"10·20" Larger Explosion Accident of Guangxi Xingyue Material Technology in Pingguo City, Baise	6 deaths, 5 injuries	Deep well casting
2024	Aluminium Liquid-Water Explosion Accident of Asia-Pacific Technology in Haian City, Nantong, Jiangsu Province	5 deaths, 13 injuries	Deep well casting
2024	Aluminium Liquid-Water Explosion Accident of Fuan Aluminium Industry in Fuzhou City, Fujian Province	2 deaths, 1 injury	Deep well casting
2024	Aluminium Liquid-Water Explosion Accident of Henan Zhongrui Nonferrous Metal Materials in Yongcheng City, Henan Province	5 deaths, 14 injuries	Deep well casting
2024	Aluminium Liquid-Water Explosion Accident of Shanxi Southeast Seiko Technology in Lüliang City, Shanxi Province	3 deaths, 10 injuries	

These actual cases fully demonstrate a serious fact: the illegal operations and weak safety awareness of operators will bring great safety hazards to deep well casting production. Therefore, enterprises must strengthen the safety education and training for operators, effectively improve their safety awareness and operation skills, strictly implement safety regulations and systems, and eliminate illegal operations, to effectively prevent and reduce safety accidents caused by human factors.

## **2. Process Flow and Risk Factor Analysis of Deep Well Casting**

### **2.1 Process Flow of Deep Well Casting**

Deep well casting is a casting process commonly used for the forming of metal materials such as aluminium and aluminium alloys. Its basic principle is to use the effect of gravity to make the molten metal enter the crystallizer through the gate and gradually solidify and form under the action of water cooling.

By promoting technological innovation and application, the deep well casting industry can achieve inherent safety, improve production efficiency and quality, and promote the sustainable development of the industry.

#### 4.4 Establishing a Long-Term Mechanism

To establish a long-term mechanism for deep well casting safety management, it is necessary to start from multiple aspects such as systems, technologies, and cultures to ensure the long-term safe and stable development of the industry.

At the institutional level, it is required to continuously improve the regulatory and standard systems, update relevant policies in a timely manner according to the development of the industry, further clarify the responsibilities of all parties, and establish strict access and exit mechanisms. Meanwhile, strengthen the construction of supervision systems, build a joint supervision network involving multiple departments, and achieve normalized and precise supervision to ensure that the development of the industry is always on a standardized and orderly track.

At the technological level, it is necessary to unrelentingly promote the innovation of safety technologies, encourage enterprises to increase their investment in research and development, actively promote and apply advanced monitoring and early warning, automation, and protection technologies, and continuously enhance the inherent safety level of the industry, thus building a solid safety defence line at the technological level.

At the cultural level, strengthening the construction of safety culture is of vital importance. Through diversified means such as publicity, education, and training, the safety awareness and sense of responsibility of enterprises and employees can be enhanced. In addition, an accident case database and an experience sharing platform should be established to facilitate exchanges and learning among enterprises, jointly improve the safety management level, make the safety concept deeply rooted in people's hearts, and become the internal driving force for the development of the industry.

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