



## Survey on an acute occupational poisoning event caused by simple asphyxiating gas

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# Statement

In February 2019, an acute simple asphyxiating gas poisoning incident occurred in a county of Yueyang City, Hunan Province, which resulted in poisoning of three workers at the scene, one of whom died. Based on the occupational epidemiological investigation, clinical manifestations and laboratory test results, it is indicated that this is an acute simple asphyxiating gas poisoning event caused by hypoxia in limited space operation. The results of the survey are reported below.

# Epidemiological Survey

## Technological process

Main process flow: **2000kg phenol**

(concentration unknown) + **1500kg**

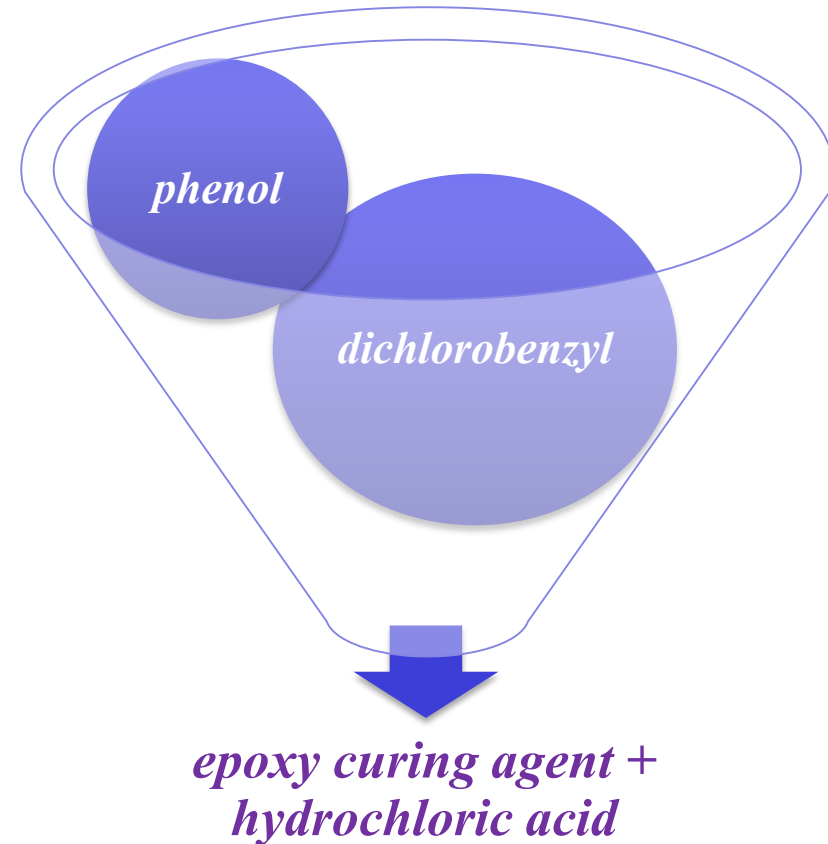
**dichlorobenzyl** + **300kg toluene**

(concentration unknown, mainly plays a catalytic role, evaporation after heating), mixed in the reactor heated to

100 °C, the product is **epoxy curing**

**agent + hydrochloric acid.**

**agent + hydrochloric acid.**



## Epidemiological Survey

On-site environmental investigation:  
Investigators arrived at the poisoning site the next day to investigate the situation, including reactor ventilation measures, production process and other related information, and determine the concentration of oxygen, phenol, toluene and hydrochloric acid in the reactor.



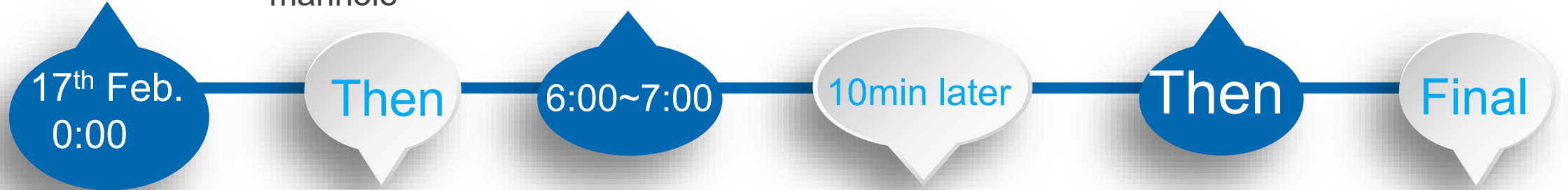
- On-site investigation: the reactor is dry without liquid residue. On-site air detection at the bottom of the reactor: the concentration of phenol, toluene and hydrochloric acid was within the normal range. Oxygen content was **10.0%** detected in the field. There was no stipulated oxygen content in the exposure limit of harmful factors in domestic workplace. Oxygen content in normal air was **20.93%**.

Detailed results are shown in the table.

Toxic species	detection result	Occupational exposure limits for hazardous factors in the workplace (PC-STEL <sup>a</sup> ) (mg/m <sup>3</sup> )	Occupational exposure limits for hazardous factors in the workplace (MAC <sup>b</sup> ) (mg/m <sup>3</sup> )
phenol	0	10 (skin)	-
toluene	0	50	100
hydrochloric acid	0	-	7.5
Oxygen content(%)	10	-	-

# Event Course

After replacement, the residual liquid and gas were not detected, oxygen content and temperature of the reactor were not detected. The manhole was not opened. The second worker entered the reactor with a filter respirator (no air respirator). Due to the damage of the temperature monitor of the reactor, the repairman opened the manhole to flush the residual liquid and gas in the reactor with water. The maintenance worker immediately lost consciousness after time was about 30 minutes. The cleaning time was about 30 minutes. The worker immediately after entering the reactor floor



the reactor was continuously purged by nitrogen. On February 20, the replacement time was about 6 hours. the workers on the side found that the first worker immediately went down to rescue and immediately fainted in the reactor. 40 minutes later, three workers were rescued by firefighters

## Treatment of patients

After being rescued from the reactor, the maintenance worker had no vital signs and died.

The other two workers were in a shallow coma.

They were sent to a nearby hospital for emergency treatment with "cause of consciousness disorder". The examination results indicated that they were hypoxemia and were given symptomatic treatment such as oxygen therapy and brain nursing.

Ten hours after the accident, two workers were transferred to our hospital (the Poisoning Medicine Department of Hunan Prevention And Treatment Center For Occupational Diseases).

Two workers were hospitalized with "40 minutes of consciousness disturbance, fatigue, dizziness and headache for 10 hours". On admission physical examination, both patients recovered from consciousness disorder, but showed signs of fatigue, dizziness and headache with central nervous system injury.

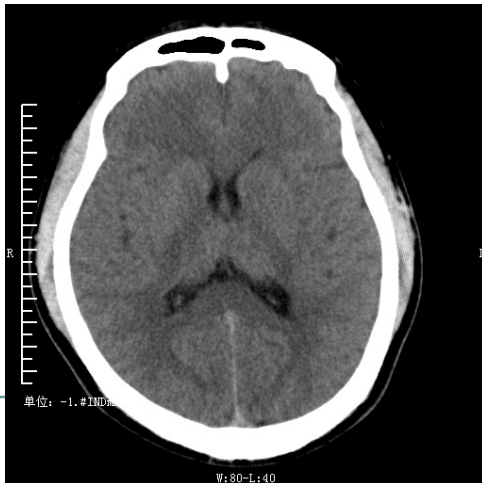


# Examination

Methemoglobin, myocardial enzymes,  
electrolytes ,coagulation function  
and electrocardiogram were normal.

Head CT+Lung CT: Brain Edema?

blood gas analysis: partial oxygen  
pressure 69.00 mmHg



blood gas analysis: partial oxygen  
pressure 74.00 mmHg

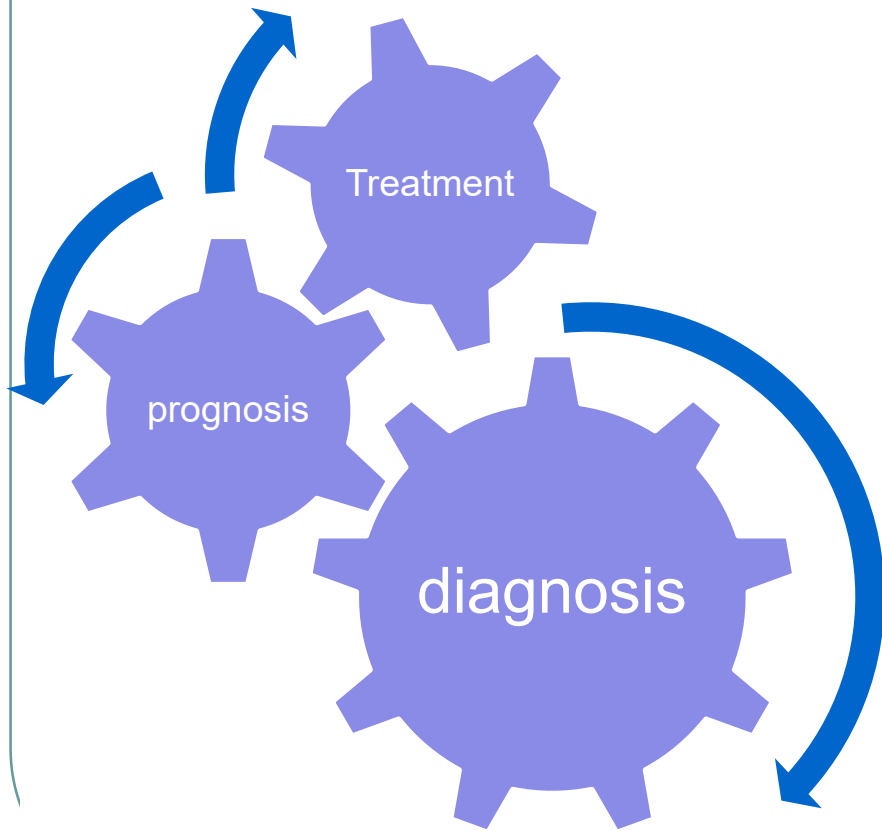


# Treatment of patients

In the early stage, it is impossible to determine whether there are phenol, toluene and hydrochloric acid residues in the reactor. Chemical phenol, hydrochloric acid burns and irritant gas poisoning are not excluded.



## Treatment of patients



Immediately bathing and changing clothes to remove toxic residues, high flow oxygen therapy, prevention of brain edema, prevention of pulmonary edema, prevention of secondary infections, maintenance of water and electrolyte balance, and promotion of brain cell recovery

After 14 days of active treatment in our department, the clinical symptoms of the two patients recovered, and the cranial CT and blood gas analysis returned to normal.

According to the fact that two poisoned patients had the chance of simple asphyxiating gas contact, the clinical manifestation of central nervous system damage appeared in a short time, and the oxygen content of air sampling in poisoning site decreased. The diagnosis was simple asphyxiating

## Analysis of Accident Causes

- According to the accident scene investigation and the poison contact history of three patients, it can be considered that this is an acute occupational poisoning accident which resulted in 1 death and 2 injuries caused by simple asphyxiating gas poisoning due to violation of safety production operation rules in the production process.

## Analysis of Accident Causes

- The causes of the accident were analyzed as follows:
- (1) The reactor was washed with water and replaced with nitrogen. Nitrogen was a simple asphyxiating gas, which could significantly reduce the oxygen content in the reactor.
- (2) In this accident: the reactor of the enterprise is closed type, and the natural ventilation with single hole is adopted after replacement. On the day of the accident, the replacement time is shortened from 24 hours to about 6 hours. The natural ventilation in the reactor is insufficient, and there is no mechanical ventilation device

## Analysis of Accident Causes

- (3) Before the workers work, there is no individual protective measures. The oxygen content and toxic and harmful gas content in the reactor are not detected. On-site rescue should first ensure the safety of staff, and on-site rescue and investigation work requires more than two people to cooperate. Entering severe hypoxic environment (such as coma/death cases or dead animals, or rapid on-site detection of oxygen content below 18%) requires the use of self-contained air breathing apparatus (SCBA) and the wearing of oxygen gas alarms; seat belts (ropes) must be fastened and communication tools carried

## Analysis of Accident Causes

- (4) The first worker was found after fainting for more than ten minutes and died after missing the golden time for treatment. The second and third workers in the field were rescuing blindly under known dangerous environment. Company leaders and on-duty employees lack awareness of the hazards of limited space operations, and the company has not formulated specific operating procedures for limited space operations. Enterprises do not have a Permit for Entry into the Internal Work of Equipment. Workers fail to comply with the company's Employee Safety Code.





● *Thank you!*