Trade & Investment Mine Safety

SAFETY ALERT

Fire ignites after worker drills into a sealed void

INCIDENT

A tradesman drilled into an enclosed excavator counterweight using a battery drill. Gas was released as the worker drilled through the steel plate.

The gas ignited and the tradesman suffered second degree burns to his right hand. He was not wearing gloves.

Photo 1: Enclosed compartment with the battery drill

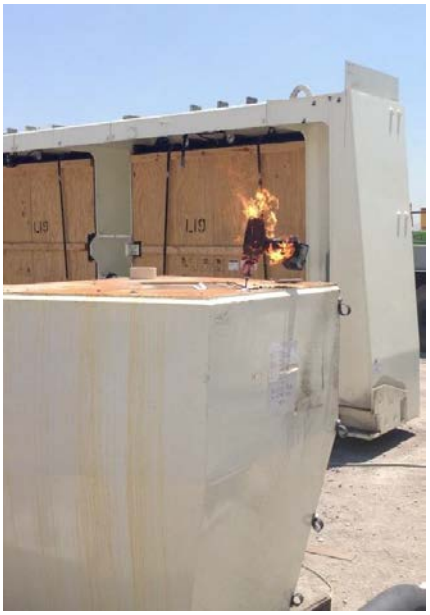
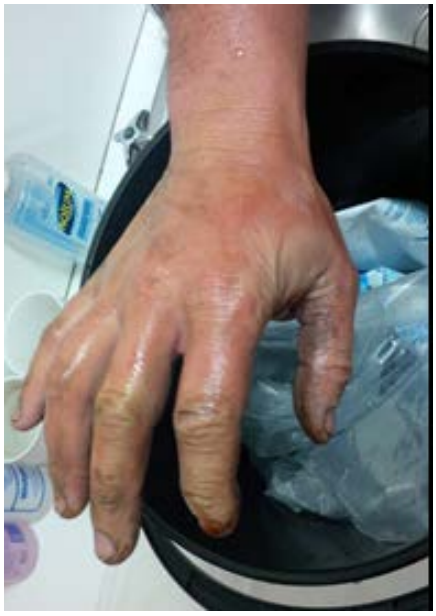


Photo 2: Burn injury to right hand



CIRCUMSTANCES

A project to assemble a large hydraulic excavator was being undertaken at the mine. During the project, bulging in the external steel structure of the 70 tonne counterweight was identified.

Repair instructions were requested from the manufacturer. Before the repair instructions were received, a hole was drilled into the top surface of the enclosed section of the counter weight to relieve the pressure. This caused an uncontrolled release of hydrogen gas stored under pressure in the counterweight, which ignited as it passed the hot drill bit on the electric drill.

ABN 72 189 919 072
www.resourcesandenergy.nsw.gov.au/safety

Mine Safety Alert No:SA15-01
File No:14/14
Comet ID:317631818001
Prepared by: P Sunol, P Drain, D Clarence, Frank Van Dijk
Phone: 02 4931 6626
Date published: 28 January 2015

INVESTIGATION

The investigation showed:

- The counterweight is comprised of a number of compartments filled with steel and concrete to ~95% to 98% of the internal volume and sealed by welding a plate over the access hole.
- A chemical reaction between the steel and the moisture in the concrete generates hydrogen. As the hydrogen cannot escape, pressure builds, deforming the steel work of the compartment.
- Test samples of the entrapped gas varied in hydrogen content, one sample contained 5.4% hydrogen. The lower and upper explosive limits of hydrogen in air are 4% and 74% respectively.

Other significant factors include:

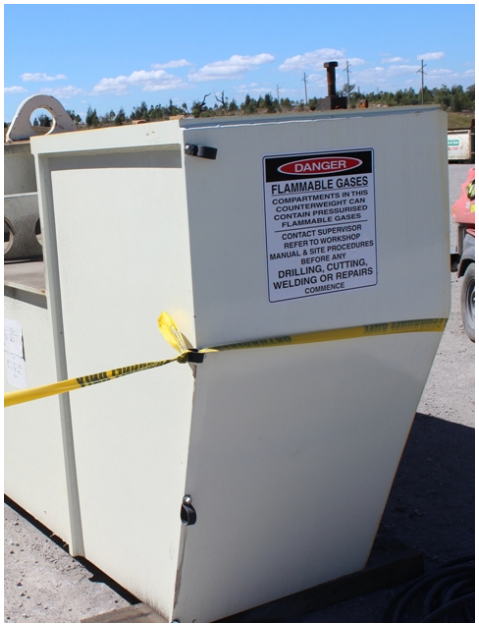
- This was the third excavator of the same model which had been built in the past two years at the mine.
- The original equipment manufacturer (OEM) of the excavator recently changed ownership and premises.
- In 2006 an OEM service bulletin was issued relating to hot work drilling on the counterweights and the potential for explosive gases to be trapped in cavities inside the counterweight. Afterward the OEM design was to have open vents in the compartments. This design change was not implemented in new and larger model excavators.
- On the day of the incident (in early 2014):
  - the OEM recommendations for hot work and drilling of the counterweight were not followed, as per the 2006 service bulletin.
  - after noticing the bulging plates, counterweights were not suitably quarantined.
  - there was a failure to identify the hazards prior to commencing the work.
  - there was inadequate supervision of the task.

RECTIFICATION

Following the incident:

- The counterweight was quarantined and fitted with a danger sign.
- The OEM supplied a procedure for drilling into the voids.
- Risk assessments were carried out and a safe work procedure developed for drilling into the sealed compartments where there was potential for a fuel (hydrogen) enriched atmosphere.
- External advice was sourced from people with competence in carrying out hot work on confined spaces with a flammable gas inside the compartment.
- An air operated and remote controlled drill that could drill and retract automatically with a magnetic base, was used.
- Pre-drilling trials were carried out in which temperature measurements were taken to prove the temperature reached would not ignite the hydrogen gas.
- Safe zones were established.
- A camera monitored the drilling process.
- Firefighting equipment was prepared.
- Inert gas flushing of cavities was carried out when the holes were drilled.

Photo 3: Danger flammable gases sign installed after incident



RECOMMENDATIONS

Mines and other persons involved in the control or management of plant (or structures) should:

- carry out a review of plant and structures under their control to identify if there are any enclosed spaces (including voids and counterweights) which may have potential for a flammable gas build-up during hot work, see also SA03-08 '*Explosive conditions: Pre-heating of confined space prior to welding*'
- check for signs of distortion and consider warning signs on any of the identified enclosed spaces. If there are signs of steel plate distortion notify the OEM for possible causes.
- review hot work control measures with respect to this incident and include this hazard into relevant risk assessments for any hot work. This should include:
  - knowing what is on the other side of a plate that is being cut, welded or vented, prior to any hot work commencing
  - where applicable, testing the atmosphere for flammable gases, dust or flammable material
  - considering the potential for organic material such as grease and oils to become flammable when heated
  - reviewing adequacy of the equipment on site to carry out hot work on enclosed spaces
- where enclosed spaces are vented, check signage and have systems in place to carry out hot work in a safe manner (i.e. check atmosphere for flammable gasses)
- raise awareness of this hazard through tool box talks.

OEMs should review their plant designs for possible enclosed spaces and voids which may have potential for a flammable gas build-up over the intended plants lifecycle. Where the potential is identified, implement risk control measures in accordance with the hierarchy of risk controls and provide adequate information on managing the hazard to users.

NOTE: Please ensure all relevant people in your organisation receive a copy of this Safety Alert, and are informed of its content and recommendations. This Safety Alert should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's notice board.

Signed

Bill Barraclough

ACTING DIRECTOR

MINE SAFETY OPERATIONS BRANCH

NSW TRADE & INVESTMENT

View more safety alerts and search our safety database at www.resourcesand energy.nsw.gov.au/miners-and-explorers/safety-and-health/safety-alerts. If you would like to receive safety alerts by email, enter your contact details at www.resources.nsw.gov.au/info/signup.