



4TH ANNUAL QUARRYING AND SMALL MINES SAFETY & HEALTH SEMINAR

Exploding Lead Acid Batteries

Presenter: Graeme Brown – Inspector of Electrical Engineering

Date: 21 March 2017

Exploding Lead Acid Batteries

- 15 Minute Presentation
- Presentation includes references that will be useful for quarry operators and copies of presentation are available on request
- Outcomes of presentation
 - Battery Incidents are common in quarries
 - Batteries are energy sources and need to be managed on your site
 - Are you managing batteries on your site???

Exploding Lead Acid Batteries

- Last presentation of the day



Exploding Lead Acid Batteries

Presentation Content

1. Battery Incidents

2. Battery Failure Contributing Factors

3. Summary

4. Reference - Battery Types – Sealed and Vented

5. References – Related to Battery Incidents

1. Battery Incidents

- There was a Safety Alert in 2000 (SA 00-26) when a person was injured disconnecting a battery charging unit
- Safety Bulletin 16-02 was issued in May 2016 detailing four reported explosions involving lead-acid batteries in NSW open cut coal mines since November 2015
- There has been SIX reported incidents involving lead acid batteries since the Safety Bulletin 16-02 was issued in November 2016
- FOUR of these incidents have occurred in quarries

- People were in close proximity in 50% of the incidents
- Acid was sprayed on one person in one of the incidents
- Incidents involved both mobile and fixed installations
- Incidents involved Sealed (Maintenance Free) and Flooded (Vented-Maintainable) type batteries. More about this later - (Time permitting)
- Debris was scattered up to 10 metres away from the battery in one incident

Recent Battery Incidents

- A stand alone battery was used to jump start a water cart. When the pump was cranked over, the stand alone battery exploded. The worker was approximately 4 metres away from the exploding battery and was not injured by either the acid or pieces of battery ejected during the explosion
- Smoke was observed emanating from an automotive battery on an excavator. There is evidence that the battery failed, producing intense localised heat and a fire

Photo from incident involving battery failure.



Fire Investigation

- Fire occurred over nite when equipment was not operating
- Police confirmed in their opinion causation of the fire was an electrical short from the wiring to the “Anderson Plug”
- Wiring insulation had worn through cabling to “Anderson Plug” causing a short circuit to earth
- Anderson Plug was used to jump start the machine
- Equipment loss - \$450,000
- Production loss ???????

YOUR SITE

- Does your site have potential to have a battery failure that could cause injury to persons or substantial equipment loss ????

YOUR SITE – do your battery installations look like this?



YOUR SITE – do your battery installations look like this?



YOUR SITE – do your battery installations look like this?



Electrical Standards

- Is your equipment installed and maintained to

*AS-4871 Electrical Equipment for
mines and quarries - Diesel
powered machinery and ancillary
equipment ?*

AS/NZS 4871.6:2013

Australian/New Zealand Standard™

Electrical equipment for mines and
quarries

Part 6: Diesel powered machinery and
ancillary equipment



Electrical Standards

- Section 2.5 covers Battery Systems including Jump Start Facilities.
 - Connection point is away from sparking
 - Correct polarity
 - Shrouding of plugs and receptacles
 - Connected to the battery side of the battery isolator to prevent inadvertent starting of the machine
 - etc

2. Battery Failure Contributing Factors

Battery Failure Contributing Factors

- Incorrect size and duty
- Maintenance
- Ventilation of Battery
- Battery Installation

Incorrect Size and Duty

- Battery must have sufficient capacity for its application
- CCA (Cold Cranking Amps) to be considered for vented lead acid batteries
- Correct battery charging is used for the battery
- Consult manufacturers recommendations

Maintenance

- Information to assess battery condition is in good condition to be readily available
- Persons performing checks / maintenance to have necessary experience / skills
- Checking battery condition to be included in sites maintenance system (Check lists etc)

Ventilation of Battery

➤ YES

➤ YES

➤ YES

➤ YES

➤ YES

Battery Installation

- Securely mounted
- Protected from harmful effects of vibration
- Ventilated
- Easily accessible

3. Summary

Exploding Lead Acid Batteries

1. Batteries are NOT Maintenance free
2. All batteries need to have adequate ventilation
3. Consult the OEM and / or battery supplier to confirm battery is suitable for the application
4. Batteries are commonly used in the industry and contain significant stored energy that needs to be properly managed by site
5. Not all battery failures result in catastrophic failures and the battery explodes. But there is a **likelihood** that this could **occur**

4. Reference - Battery Types – Sealed and Vented

Battery Types

VENTED - Also termed “Maintainable”



Battery Types

SEALED - Also termed “Maintenance Free”



ITEM	VENTED (MAINTAINABLE)	SEALED (MAINTENANCE FREE)
------	-----------------------	---------------------------

FIRST INVENTED	1859	1970's
----------------	------	--------

COMMON
NAMES

- Vented
- Maintainable
- Flooded

This is a type of LEAD ACID BATTERY and is also referred to as

- VLRA (Valve Regulated Lead Acid Battery) or
- AGM (Absorbed Glass Mat)
- Gel Cell
- Maintenance Free Battery.

ITEM	VENTED (MAINTAINABLE)	SEALED (MAINTENANCE FREE)
OPERATING POSITION	Flat Horizontal	Any
VENTILATION REQUIRED	YES Hydrogen emissions	YES Batteries are equipped with check valves that are engineered to open at between 2-3 PSI depending upon the specific brand. Hydrogen gas will be expelled if battery vents.

ITEM	VENTED (MAINTAINABLE)	SEALED (MAINTENANCE FREE)
APPLICATIONS	High surge currents – starting large equipment, cars etc	UPS's, Off Grid solar power, aviation, marine, telecommunications. Modern motorcycles and motor vehicles
COST	LOW	HIGH

References – Related to Battery Incidents

- AS4871.6 - Electrical equipment for mines and quarries Part 6: Diesel powered machinery and ancillary equipment. Clause 2.5 Batteries and 2.6 Battery Isolator.
- Queensland Department of Mineral Resources and Mines Safety Bulletin No 150 (<https://www.dnrm.qld.gov.au/mining/safety-and-health/alerts-bulletins-search/alerts-bulletins/mines-safety/exploding-lead-acid-batteries>).
- NSW Department of Industries Safety Bulletin SB16-02 (http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0009/654615/SB16-02-Lead-acid-battery-explosions.pdf)
- NSW Department of Industries Safety Alert SA00-26 (http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0016/67003/Safety-Alert-00-26-Battery-explosion-injures-mechanic.pdf)
- Victoria WorkSafe Safety Alert – Preventing Battery Explosions (https://www.worksafe.vic.gov.au/_data/assets/pdf_file/0018/44343/Alert-Battery-explosionsv3.pdf)