Queensland Mining Industry Health and Safety Conference

Safety Innovation Award Application

Company: Peabody Energy

Site: Wilkie Creek Mine

Innovation: Tailings Dam Capping Scoop

Presenters: Matt Bahr – Maintenance Fitter.

The Problem

Tailings dam capping and associated works has resulted in numerous incidents throughout the world causing fatalities. Therefore it is well known and identified hazard a different process was created to perform the task which implemented various controls to reduce the risk to an acceptable level.

Wilkie Creek has 47ha of in-pit tailings storage facilities across 4 mined out open cut voids – depth of tailings approx. 55m.

The tailings has very low and unpredictable foundation stability. Standard earthmoving equipment is unable to be safely supported and operate over the surface to allow placement of overburden.

EA requirement to cap tailings cells with a layer of overburden to create a stable landform capable of supporting a 20 tonne vehicle.

Technical data was sourced to determine foundation strength via shear vane testing. Results showed pressure lower than required to support a D6 swamp dozer.

		Result of shear strength testing - West #1 (kpa)										
	Test Depth	0.1m	0.25m	0.5m	0.75m	1.0m	1.5m	2.0m	2.5m	3.0m	3.5m	4.0m
Test Location	W1-1	84	104	100	3.8	0.8	1.2	1	1.2	1.2		
	W1-2			6		2.2	1.8	1.6	1.6	1.4		
	W1-3	4.5	2	2.6		1.6	1	2	2	2.6		
	W1-4	12	80	64		40	56	72	84	140		
	W1-5	1		1	3	2.2	1	2.4	2	1.4		
	W1-6			3.5		3	1.5	2	1.8	3		
	W1-7			1.5		2	1.5	1.8	2	3		
	W1-8	56	36	0.8		0.8	1	1.2	1.6	1.4		
	W1-9		40	3.5		2	1.2	1.5	3	2		
	W1-10	10	20	3.5		2.5	4	8	8	7		
	W1-11			1.2		1	0.8	1.5	2.5	2		
	W1-12		44	3.5		1.4	3					
	W1-13		16	1.8		0.8	1.8	2.6	4	7		
	W1-14	140	12	4	3.4	1.8	3.4	1.8	2	3.2	3.2	
	W1-15	60	12	3.8	1	0.8	0.8	1.2	0.8	0.6	0.4	
	W1-16	16	80	80	1	0.8	0.8	0.6	0.6	0.8	1	
	W1-17	8	16	0.6	0.4	0.6	0.4	0.4	0.6	0.8	1	
	W1-18		16	2.4	1	1.2	1	0.8	1	1.2	1.2	
	W1-19	24	32	2.8	1.2	0.8	0.8	0.6	0.8	1	1	
	W1-20		40	4	2.4	1.8	1.6	1.2	1.4	1.4		
	W1-21	16	24	4.6	3	1.4	1.4	1.2	1.2	1.6	1.6	
	W1-22	3.6	2	0.8	1	1	0.6	0.8	0.8	1	0.8	
	W1-23	5	12.5	10	9	1.6	1.4	0.8	1	1	1	1
	W1-24	9	4	8	7	5	7.5	8.8	7	5.6	7	6.5
	W1-25	9	8	17	10	1.8	0.8	1.2	1	0.8	0.8	0.8
	W1-26	5	5	9	5	1.4	1	0.6	1	1.4	1.2	1.2
	W1-27	7	25	8	16	12	3.8	2.2	1.8	2	1.4	1.8
	W1-28	4	2	1.8	2.4	0.8	0.4	0.4	0.6	0.6	0.8	0.6
	W1-29	6	7	6	4	0.6	0.6	0.6	0.6	1	1	1
	W1-30	15	13	9	6	3	0.8	1.6	1	1	1	1
	W1-31	6	20	15	12	10	1.8	1	1	1.2	1.2	1.8
	W1-32	7.2	5.2	3.4	1.4	1	0.6	0.2	0.8	0.8	1	1.2
	W1-33		4	10	9	6	1.2	1	1	1.2	2.6	1

Model	Shoe width		Contact Area		Ground Pressure	
	mm	in	m^2	In^2	kpa	psi
D6R LGP	810	32	5.31	8256	40.0	5.80
	915	36	5.99	9288	35.5	5.15
	991	39	6.49	10062	32.8	4.76

The traditional method of capping tailings involves pushing a layer of overburden out over the tailings with a dozer, but the issue arises when the tailings is unable to support the weight, the overburden is displaced under surface and if the dozer is out in the area the machine is engulfed.

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The Solution

Team discussion/ investigation on selecting a process which placed overburden onto the tailings surface without personnel operating equipment on the tailings surface

Planning focused on key personnel experience who have had exposure to alternate work methods outside of the mining industry

Modification of an existing agricultural silt scoop and dozer application which would allow overburden to be slid out and dumped over tailings surface.

Process involved towing the scoop via two dozers backwards and forwards from the loading area to the dump point.

The “silt scoop” was originally used in an agricultural application for the purpose of “de-silting” (pulling mud out of) farm dams.

Used now to pull overburden in over the top of the tailings surface

Capacity of approximately 10m3 equating to a loaded weight of approximately 25 tonne.

Towed by 32mm wire rope following calculation of load and force applied by a D8 dozer

Loaded by an excavator to achieve a consistent load for towing force calculation

Progressive loading of the crust via thin layers as opposed to a conventional method of a thicker capping layer which creates point loading, ground instability and therefore an unsafe work area

D8 – Lead dozer

- Ripper tyne replaced with towing eye
- Flexible support arm fabricated to assist with managing slack in the cable whilst dozer is reversing and returning the scoop to the loading position
- Mesh screen fitted to rear window to provide operator protection
- Camera installed on ripper box to give operator assisted vision of the cable during operation

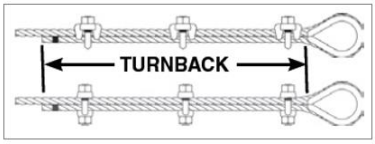
D6 – Return dozer

- Due to the lighter load of towing the scoop empty the D6 was able to be turned to face forwards to give the operator better ergonomics
- Middle ripper tyne replaced with towing eye and cable supported under dozer
- Flexible support arm and an A frame mounted to the blade to assist with managing slack in the cable whilst scoop is towed to the dumping position
- Cabin screened with mesh to provide operator protection
- Operator awareness of scoop process and coordination between scoop operators prevent cable contact
- Camera installed on the front of the dozer to provide operator with assisted vision of the cable during operation

Development of process

- D6
  - Originally towed from rear point
  - Modification 1: Mount moved to the front blade to alleviate ergonomic issues
  - Mod 2: Pole extended from 2m to 6m for operator visibility
  - Increase rope slack improving coordination between D6/D8
  - Addition of camera to improve visibility
- D8
  - Addition of support arm to ripper box
- Cables
  - Varying length ropes made up to suit work areas

Trialed rope turn-back clamp quantities to determine adequate quantity to prevent rope slippage



Benefits/Effects

Safe operation – No incidents. This is a lot safer method of doing the task, people are eliminated from having to go onto capped dam.

- Cost efficient – Low setup cost
- Utilisation of equipment and resources already onsite – including dozers, excavator and steel and components used to fabricate components mostly salvaged from CHPP before demolition

Transferability

Many mines have tailings storage areas across current and old operations with similar foundation strength issues.

The capping system is easily transportable and adaptable to suit various conditions.

Can also be used in original configuration for de-silting slurry ponds, sediment dams or in co-disposal areas to increase dam capacity.

Innovation and Originality

This type of capping system has not been used previously in the industry

Approximate Costs $10,000