Australian Coal Mine

Clarified Water Pumps Case Study Report

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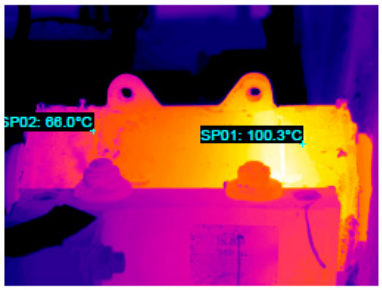
Weir Minerals Pump

Problem:

The customer had installed four new clarified water pumps. These pumps are powered by a 260 kW, 4 pole motor running through a pulley reduction belt assembly. The driver pulley was a SPC 375/8 and the driven pulley a SPC 500/8 with eight Carlisle Blue SPC4250 v-belts.

The reliability department was concerned with the high temperatures that were being detected on the pump barrel bearings; temperatures in excess of 100 °C were recorded on the pump barrel bearings. High temperatures often indicate that the bearing is acting abnormally. High temperatures can be detrimental to the bearing lubricant. Bearings operating for extended periods at temperatures in excess of 100 °C can reduce the bearing life. Causes of high bearing temperatures include insufficient or excessive lubricant, impurities in the lubricant, bearing damage, insufficient clearance, pinching, high friction in the seals and overloading.

Equipment	**Clarified 4 D171**
Compartment	**Barrel**



Emissivity:	0.95
Ref. App. Temp.:	27.0°C
Amb. Temp.	27.0°C
Rel. Hum.:	0.50
Obj. Distance:	1.0 m

Problem Description:

Pump bearing still indicates high temperatures.

#4 Clarifier Pump Barrel Bearing Assembly with eight SPC 4250 Carlisle Blue label.

Position SP01 the bearing closest to Driven pulley recording 100.3 °C

Solution:

The Optibelt technical representative recommended running a drive analysis to determine drive service factor and shaft loads between current drive assembly and upgrading to the high power rated Red Power 3 v-belt. This analysis would indicate if the bearing assemblies were being overloaded by the current v-belt drives arrangement.

The results from Optibelt CAP 6.0 drive design program indicated the static shaft load of eight standard SPC4250 v-belts was 23,151 N compared to 18,748 N using six Red Power 3 SPC4250 v-belts.

The reduction in static shaft load was due to being able to reduce the number of belts on the drive from eight to six. The Optibelt Red Power 3 v-belt have a higher power rating than the standard wrapped wedge belts, up to 50% higher power ratings depending on the profile, size and pulley diameter.

By installing the six SPC 4250 Red Power 3 belts this would reduce the static shaft load should and directly contribute to reducing the temperature on the pump barrel bearings

Existing Standard Belt Drive:

Drive Calculation based on a theoretical belt life of 25000 h

V Belts 2 Pulley Drive

No.	: C000000112	Data	: 13.10.2014	SN	: 11116858
Project	: 0001	Drawing No.	: 0001	Drive	: 0001

The drive requires:

- 8 x Optibelt-SK wedge belt SPC 3350 Ld S=C plus

- Optibelt-KS pulley for taper bush TB SPC 425-8
- Optibelt-TB taper bush 4545 (Bore-diameter 55-110 mm)
- Optibelt-KS pulley for taper bush TB SPC 500-8
- Optibelt-TB taper bush 5050 (Bore-diameter 70-125 mm)

					Deviation / Hints
Type of driver unit		:	**Electric motor**		
Type of driven unit		:	**Tailings Pump**		
Calculation Power	PB	:	350.00	kW	
Driver Power	**P**	:	**250.00**	**kW**	
Torque at driver pulley	M	:	1613	Nm	
Driver speed	**n1**	:	**1480**	**1/min**	
Required driven speed	**n2**	:	**1258**	**1/min**	**0 1/min**
Datum diameter pulley 1	**dd1**	:	**425.00**	**mm**	
Datum diameter pulley 2	**dd2**	:	**500.00**	**mm**	
Datum length	Ld	:	3350	mm	
Actual centres	**C**	:	**947.76**	**mm**	**---** **mm**
Actual drive ratio	i	:	1.18		--- %
Adjustment required for belt fitting	y	:	30.00	mm	
Adjustment required for belt tensioning	x	:	45.00	mm	
Actual service factor	**c2**	:	**1.49**		
Belt speed	v	:	32.93	m/s	Warning: required balance!
Flex rate	fB	:	19.66	1/s	
Power per belt	PN	:	50.49	kW	
Arc of contact factor	c1	:	1.00		
Belt length factor	c3	:	0.92		
Arc of contact on small pulley	ß	:	175.46	°	
Pulley face width	b	:	212.50	mm	
Span length	l	:	947.02	mm	
Calculated number of belts	**z1**	:	**7.52**		**given c2 = 1.40**
Weight of drive		:	199.37	kg	
Static shaft load (Initial installation)	Samin	:	22480	---	
Static shaft load (Re-tension)	Samin	:	17292	N	
Dynamic shaft load	Sadyn	:	11098	N	

Tensioning recommendations			**Initial installation**	**Re-tension**
given c2 = 1.40			new belts	existing belts
1. OPTIKRIK II + III	Static tension per belt	:	1406 N	1082 N
2. Load/deflection tension gauge	Load at centre of span	:	125 N	125 N
	Deflection	:	18.18 mm	22.92 mm
3. Length additinal value per 1000 mm belt length		:	5.42 mm	4.03 mm
4. Optibelt-TT 3 / TT mini Tension Tester	Frequency	:	32.24 1/s	28.28 1/s

Proposed Red Power 3 Belt Drive:

Drive Calculation based on a theoretical belt life of 25000 h

V Belts 2 Pulley Drive

No.	: C000000113	Data	: 13.10.2014	SN	: 11116858
Project	: 0001	Drawing No.	: 0001	Drive	: 0001

The drive requires:

- 6 x Optibelt-RED POWER 3 service free SPC 3350 Ld S=C plus

- Optibelt-KS pulley for taper bush TB SPC 425-6
- Optibelt-TB taper bush 4545 (Bore-diameter 55-110 mm)
- Optibelt-KS pulley for taper bush TB SPC 500-6
- Optibelt-TB taper bush 4545 (Bore-diameter 55-110 mm)

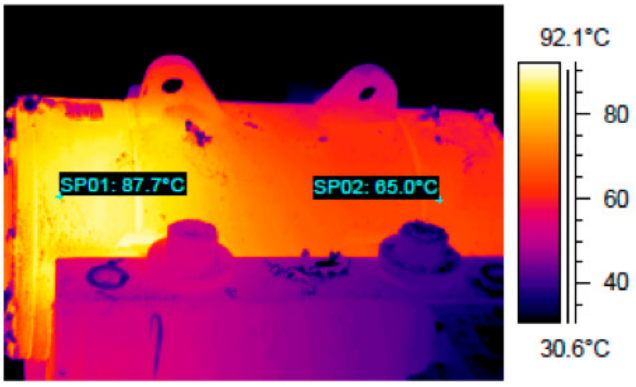
					Deviation / Hints
Type of driver unit		:	**Electric motor**		
Type of driven unit		:	**Tailings Pump**		
Calculation Power	PB	:	350.00	kW	
Driver Power	**P**	:	**250.00**	**kW**	
Torque at driver pulley	M	:	1613	Nm	
Driver speed	**n1**	:	**1480**	**1/min**	
Required driven speed	**n2**	:	**1258**	**1/min**	**0 1/min**
Datum diameter pulley 1	**dd1**	:	**425.00**	**mm**	
Datum diameter pulley 2	**dd2**	:	**500.00**	**mm**	
Datum length	Ld	:	3350	mm	
Actual centres	**C**	:	**947.76**	**mm**	**---** **mm**
Actual drive ratio	i	:	1.18		--- %
Adjustment required for belt fitting	y	:	30.00	mm	
Adjustment required for belt tensioning	x	:	45.00	mm	
Actual service factor	**c2**	:	**1.56**		
Belt speed	v	:	32.93	m/s	Warning: required balance!
Flex rate	fB	:	19.66	1/s	
Power per belt	PN	:	70.31	kW	
Arc of contact factor	c1	:	1.00		
Belt length factor	c3	:	0.92		
Arc of contact on small pulley	ß	:	175.46	°	
Pulley face width	b	:	161.50	mm	
Span length	l	:	947.02	mm	
Calculated number of belts	**z1**	:	**5.40**		**given c2 = 1.40**
Weight of drive		:	151.18	kg	
Static shaft load (Initial installation)	Samin	:	18038	---	
Static shaft load (Re-tension)	Samin	:	13876	N	
Dynamic shaft load	Sadyn	:	11098	N	

Tensioning recommendations			**Initial installation**	**Re-tension**
given c2 = 1.40			new belts	existing belts
1. OPTIKRIK II + III	Static tension per belt	:	1504 N	1157 N
2. Load/deflection tension gauge	Load at centre of span	:	125 N	125 N
	Deflection	:	17.43 mm	21.59 mm
3. Length additinal value per 1000 mm belt length		:	5.82 mm	4.33 mm
4. Optibelt-TT 3 / TT mini Tension Tester	Frequency	:	33.35 1/s	29.25 1/s

Result:

After installing the 6 x SPC4250 Red Power 3 v-belts onto #1 clarifier pump the temperatures recorded through thermal imaging at SP01 was 87.7 °C. This temperature was considerably lower than existing drives currently using 8 x SPC4250 Carlisle Blue label v-belts installed on #2 clarifier pump 95 °C, #3 clarifier pump 125 °C, # clarifier pump 108 °C.

Date	**18 09 2014**
Equipment	**Clarified 1 D170**
Compartment	**Barrel**

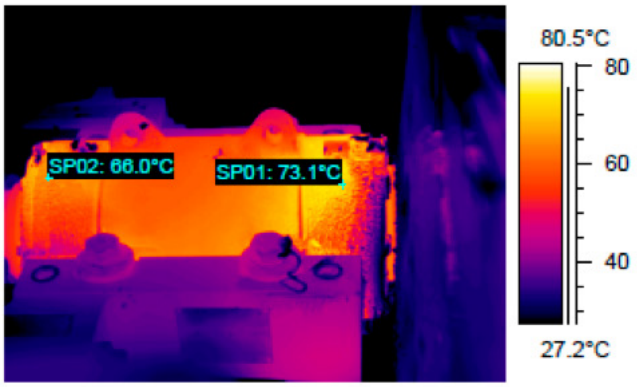


Emissivity:	0.95
Ref. App. Temp.:	27.0°C
Amb. Temp.	27.0°C

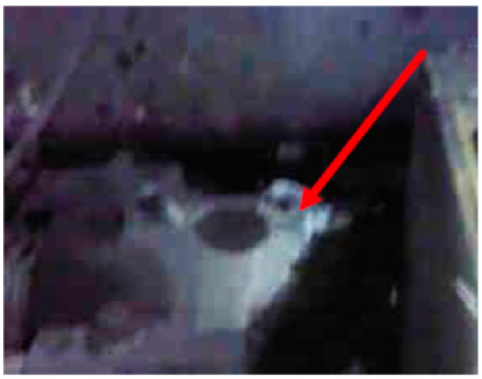
Component Temp:	87.7°C
Reference Temp:	65.0°C
Temp Rise (ΔT):	22.71

A month later the reliability department at the mine site had advised that the thermal imaging report indicated that 6 x SPC4250 Red Power 3 v-belts fitted to # #1 Clarifier pump was now recording an even lower temperature of 73.1 °C at SP01 of clarifier #1 pump barrel.

Date	**23 10 2014**
Equipment	**Clarified 1 D170**
Compartment	**Barrel**



Emissivity:	0.83
Ref. App. Temp.:	38.0°C
Amb. Temp.	38.0°C



Component Temp:	73.1°C
Reference Temp:	66.0°C
Temp Rise (ΔT):	7.08

Conclusion:

The reduction of bearing temperatures will increase the reliability of the bearings and should extend the mean time between repair of the bearings in the barrel pump. The successful performance of the Optibelt Red Power 3 v-belts has led to site directive to replace the other three clarifier pumps with 6 Red Power 3 SPC4250 on these drives.

The site is now investigating the possibilities of a redesign and trial of Optibelt Red Power 3 belts on their tailings pumps which are currently operating at 110 °C

The unit cost for the Optibelt Red Power 3 was higher than the existing drive, however with the reduction in pulley width, increasing bearing reliability through reducing the temperature on barrel bearings, eliminating the requirement to re-tension belts, increase efficiency has led to the total cost of the maintenance of the pump to be considerably lower than the previous Carlisle Blue Label belt drive.

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