LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND
ISSN 0111-6711
REPORT
Vol. 11 No. 4 1986

POLYESTER ROUNDSLINGS AS STROPS

R. L. Prebble

INTRODUCTION

Over the last six years, LIRA has investigated alternatives to wire rope as strops. In 1980, the results of trials with polypropylene strops were reported on (Ref. 1). That Report concluded that polypropylene strops were only suited to logging systems where there was minimal shock loading and abrasion. Later, in 1982, chain strops were evaluated and found to be a viable alternative to wire rope (Ref. 2).

Figure 1 - Polyester roundslings with logs attached

Polyester roundslings have been tried as strops in some European and Scandinavian countries, but their use has not been widespread. In 1985, LIRA undertook trials to test the viability of polyester roundslings as strops in a hauler operation under New Zealand conditions. This Report presents the results of these trials.

ACKNOWLEDGEMENTS

LIRA acknowledges the assistance of John Edward Butler New Zealand Limited who supplied the polyester roundslings, and thanks contractor, Eric Muir and the New Zealand Forest Service, Tairua for their co-operation with the trials.

BACKGROUND

Initially, two 2m long roundslings were tried on a 70 kW skidder in a second thinning of radiata pine. After one day, the slings showed obvious signs of deterioration; one having had the outer casing torn by contact with a splice, and both sling casings being frayed in places from dragging through the scoria-type soils. From that brief trial, it was decided to evaluate the slings in a skyline hauler operation where abrasion could be reduced.

ROUNDSLING SPECIFICATIONS

Polyester roundslings consist of a continuous strand of polyester cord wrapped into an endless sling configuration, and encased in a colour-coded nylon outer sleeving. The colour-coding relates to the strength rating according to international standards and the strength depends on the number of wraps of polyester cord within the sling. The sizes available range in .5 m multiples from 1.5 m to 6.0 m long, measured eye to eye*. John Edward Butler New Zealand Limited started manufacturing polyester roundslings locally in 1985 and they now market the following strength ratings in ten different sizes (lengths).

* *Overseas manufacturers such as Spanset and Mammut size their roundslings according to the circumference measurement.*

Ref. 1 Gaskin J.E. "A Look at Polypropylene Strops", LIRA Report Vol. 5 No.3 1980
Ref. 2 Prebble, R.L. "Chain Strops in Skidder Thinning", LIRA Report, Vol. 7 No. 7 1982

Table 1 - Polyester Roundsling Strength Ratings

Ref.	Colour	Safe Working Load (SWL) Vertical	SWL Strops
		kg	kg
BRS1	Violet	1,000	750
BRS2	Green	2,000	1,500
BRS3	Lemon	3,000	2,250
BRS5	Red	5,000	3,750

The slings are stress tested to the above safe working loads (SWL) with a 6 : 1 safety factor. While the slings were primarily designed for engineering applications, it was felt that with their very high strength to weight ratio (see Table 2) they may be suitable as strops in logging.

Table 2 compares the characteristics and costs of the various strop configurations that could have been used in this study. All minimum breaking strength (MBS) specifications are listed as tensile strength ratings, eye to eye, not in the strop configurations. All costs shown in Table 2 are at 1 August, 1986 and they refer to the purchase of all new items, discounting the fact that logging rings, chokers, hooks, etc. can be reused.

TRIAL CONDITIONS

The machine was a 97 kW Wilhaul hauler, rigged as a North Bend skyline system using 19 mm skyline, 16 mm mainrope and 13 mm tailrope. The three strops in use at the time were 3.5 m long 13 mm wire rope connected to logging rings, sliding on a 3 m long wire rope butt rigging. Extraction was uphill over a short convex slope (140 m maximum) with an 18° slope at the top and increasing to 25° at the bottom. The average extracted piece size was .19 m^3, ranging from .09 m^3 to .28 m^3.

Undergrowth in the area was very heavy and stocking levels low at around 700 stems per hectare. A 54 cycle study was conducted on the existing operation, then the system changed to accommodate the roundslings. The changes necessary were :

(1) Replacing the wire rope butt rigging with a 4 m length of 19 mm 80 grade chain.

(2) Connecting by hammerlock four logging rings to the butt rigging at .75 m intervals from the front. (These logging rings were modified to enable the roundslings to be attached (see Figure 2)).

(3) Changing the three wire rope strops for twelve 4 m long roundslings and convincing the breakerout to prestrop them.

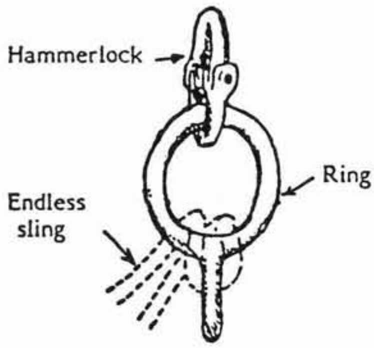

Figure 2 - Modified logging ring for use with roundslings

The system worked as follows. Four strops were always connected to the butt rigging of the hauler. These slings were removed when the rigging reached the bush and thrown either to one side or to respective logs for the next drag. Four slings, prestropped during the previous drag, would then be attached to the rings on the butt rigging (see Figure 3).

It was not uncommon to see two, and sometimes three, slings attached to the one ring. If the breakerout had not had the opportunity to prestrop, the whole process of strop attachment was done during the breakout cycle.

Simultaneously with this, the hauler operator was disconnecting the roundslings from the logs from the previous drag at the landing. Once the breakerout was clear, the drag would be extracted to the landing and then while the hauler operator was taking the roundslings off the rings on the butt rigging,

Table 2 - Strop Options

Type	Construction	MBS (Specifications)	Weight per Usable Metre	Cost for 4m Strop	Cost of Attachments
		kg	kg	$	$
13 mm wire rope	6 x 31 SC	10,800	.68	19.98	50.59
8 mm chain	100 grade	10,000	1.38	113.80	32.22
20mm polypropylene	3 braided strands	5,330	.18	12.47	17.35
BRS 1 roundsling	Polyester cord	6,000*	.26*	45.24	14.10

* Roundslings are doubled when in use so that measurement refers to two linear metres of sling

Figure 3 - Attaching roundslings to the rings on the butt rigging

the breakerout would be attaching the empty slings to the logs in the bush. The method of attachment was to feed the slings around the logs and through themselves in a noose configuration. When the rigging was returned to the bush, the whole sequence was repeated.

After about five hour's operation, a brief 25 cycle study was conducted to assess the potential of the slings.

STUDY RESULTS

During the two production studies, a 15% sample of extracted piece sizes was scaled. Table 3 compares the cycle times recorded with the two different configurations. *(All the times in this Report are expressed in decimal minutes.)*

Table 3 - Cycle Times

Parameter	Roundslings	Wire Rope
Cycle time (mins)	6.87	4.82
Average haul distance	85 m	90 m
No. of pieces/cycle	3.00	2.23
Productivity pcs/PMH	26	28

From the above chart, it is obvious that overall cycle times with the roundslings were considerably slower than with wire rope (by 2.05 minutes). However taking the increased number of pieces hooked on with the slings, the difference in productivity is not significant. More detail on individual elements in the cycles is shown in Table 4.

It can be seen from Table 4 that strop handling times in the bush during breakout were 2.90 minutes per cycle for roundslings, and 1.41 minutes per cycle for wire rope. When this is broken down into minutes per

Table 4 - Analysis of Mean Element Times in the Extraction Cycle

Element	Roundslings		Wire Rope	
	Minutes	*Standard Deviation*	Minutes	*Standard Deviation*
Outhaul	.50	.15	.46	.21
Move in	.29	.16	.28	.10
Move clear	.34	1.38	.27	.10
Breakout	.29	.12	.26	.16
Inhaul	.57	.17	.80	.32
Delays	.58	.78	.48	.90
Sub-Total	2.57		2.55	
Strop handling :				
Detach empty slings	.54	.31	-	-
Attach prestropped slings	.51	1.02	-	-
Strop on logs	1.71	1.19	1.41	.53
Sort strops	.14	.28	-	-
Unstrop at landing	.81	.72	.86	.37
Prestrop slings*	.59	.64	-	-
Sub-Total	4.30		2.27	
Total cycle time	6.87	2.19	4.82	1.63

* Additional to unstrop time, hauler operator waiting for the breakerout to prestrop slings.

piece, the average time to attach prestropped slings was .69 minutes (sample size = 9 cycles). Added to that, should be the time taken to prestrop the logs while the hauler operator is unstropping at the landing - .84 minutes per piece (including move in and move clear), plus the detaching and sorting of strops, .23 minutes per piece. This gives a total breakout time of 1.76 minutes for prestropping with roundslings.

When not using the prestropping system, roundslings took .96 minutes per piece (including .23 minutes for detaching and sorting). Note that these elements did not occur in every cycle. The times expressed here are per occasion, not per cycle.

Using the wire rope strops permanently attached to the butt rigging, stropping on took .63 minutes per piece. Understandably, it was difficult to persuade the breakerout to persevere with prestropping, especially as it required him to move in and out over the heavy slash twice in the cycle instead of once. Strop handling times at the landing were also significantly longer when using roundslings (.47 minutes per piece compared with .39 minutes for wire rope. This includes detaching roundslings from the logs while the breakerout is attaching strops to the butt rigging.)

OPERATIONAL COMMENTS

In the trial with roundslings, only one failure occured in the first 1½ days of operation. By that stage, however, it was impossible to get sufficient clearance to operate the skyline system, so it was changed to highlead and the roundslings were replaced with wire rope. Past experience had shown that the slings were highly susceptible to the shock loading and abrasion inherent in highleading. The slings were re-introduced to the operation when the hauler moved into a new setting, better suited to skyline logging. They lasted as a system for 7½ days before more than half of them had failed and the rest were damaged to the extent of being unusable.

Failure of the outer casing was the most common type of damage experienced. Usually this occurred when the strops caught up in the fall block or got snagged in the tailrope splice. Even with the outer casing completely severed, the slings still had sufficient strength to be used but the exposed polyester cord would frequently catch in slash and eventually it would break in enough places that the sling would become unusable. Two slings could not be linked together to make a long strop without damaging the outer casings. The friction generated by the moving strands inside the slings would firstly cause failure to the outer casings and then of the central strands.

Violet was a difficult colour to see on the cutover and the breakerout had to be careful not to lose track of them when sorting and throwing them to the next logs to be stropped up. The slings also tended to tangle during outhaul and hence the relatively long "detach and sort slings" element in the cycle (.54 and .14 minutes respectively).

At the landing, detaching the slings went relatively smoothly as the hauler operator simply flicked the slings out of the modified rings and attached the three or four empty slings into the rear-most ring on the butt rigging (this prevented the strops from catching up on the fall block during outhaul). In spite of the apparent ease of releasing the slings from the rigging, element times were still longer than with wire rope. Operator familiarisation would no doubt reduce this time. There was the occasional problem with removing the slings from logs sitting on the landing. Provided the noose was accessible, the hauler could be used to free the slings on the next drag.

CONCLUSIONS

The polyester roundslings displayed surprising strength as strops, even with the outer casing completely severed, but they were not easy to use with the polyester strands exposed. The outer casing was susceptible to damage through contact with the sprags in a splice, or catching up in the fall block. They could not be joined together as long strops and tended to tangle when hanging empty on the butt rigging. The violet colour was not suitable for logging as it was hard to see, but John Edward Butler New Zealand Limited has indicated that they would produce a specific florescent colour for logging if required.

Considering their sensitivity to damage, and some of the operational problems described in this Report, it is unlikely that polyester roundslings will become very popular as strops. With a total cost of $59.34 per sling, compared with $70.57 for wire rope and $146.02 for chain, the slings would want to last considerably longer than 7½ days. They would, however, have application in situations where contact with splices or moving blocks could be avoided, for example as strops in helicopter logging or as block strops for intermediate supports or hanging blocks in tail trees. Provided due consideration is given to the sensitivity of the outer casing, they should work successfully in these applications.

For further information, contact:

N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O. Box 147,
ROTORUA, NEW ZEALAND.

Telephone: (073) 87-168

RP 10506/10/86