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P.F.V. WIRE ROPE TRIALS

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INTRODUCTION

The effective life and cost of replacement of wire rope has not always been adequately recognised by the logging industry. The need to control costs has prompted logging companies to look at alternative rope constructions, particularly for hauler operations. A construction which is claimed to have an improved wear rate is P.F.V. (plastic filled valley).* John Shaw (N.Z.) Limited has imported 1000 metres of a 19 mm, 6 x 19 P.F.V. construction for trial in New Zealand.

The advantages of P.F.V. rope, over the conventional 6 x 19 construction, are claimed to be :

- reduced wire contact stress
- smoother external wearing surface
- the lubricant is locked into the rope
- internal wear is reduced as the plastic cover acts as a shield to prevent the entry of abrasive material
- the bright orange plastic cover is highly visible, hence safer

ACKNOWLEDGEMENTS

LIRA acknowledges the co-operation of John Shaw (N.Z.) Limited, Steel Rope Industries (N.Z.) Limited and Tasman Forestry Limited, Murupara District.

P.F.V. ROPE

The P.F.V. rope under trial is a 6 x 19 (9/9/1) construction and has thermo-plastic infused around the core and the individual strands during manufacture. The plastic fills the valleys between the strands, and between the strands and the core (Fig. 1a, b).

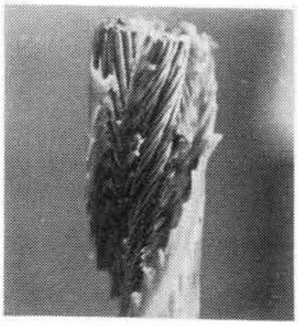

Fig. 1a - 6 x 19 P.F.V.

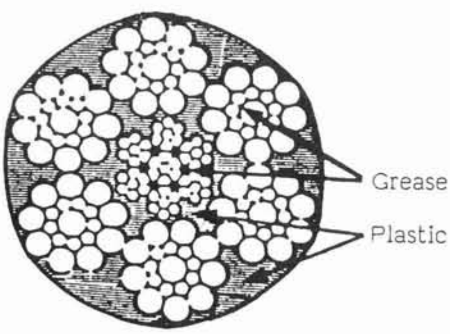

Fig. 1b - 6 x 19 P.F.V.

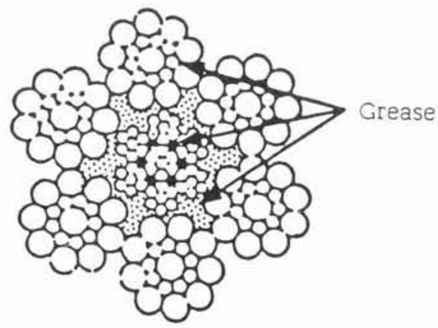

Fig. 1c - Conventional 6 x 19

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* Shearer, B. "PFV Wire Rope", LIRA Technical Release, Vol. 4 No. 1 1982.

WORKSHOP TESTS

The test facilities of Steel Rope Industries (N.Z.) Limited were used to run a number of controlled trials with the P.F.V. rope. These included :

- tensile strength tests of new rope
- an assessment of the ease of splicing and attaching fittings
- destruction tests of the splices commonly used to join wire rope
- destruction tests of the standard logging fittings attached to P.F.V. rope
- accelerated wear tests

These tests have been completed and the results compared against similar tests carried out with a conventional 6 x 19 construction.

Table 1 - Test Rope Specification

Construction	6 x 19	6 x 19 (P.F.V.)
Nominal diameter (mm)	19.00	19.00
Actual diameter (mm)	19.12	19.82
Number of strands	6	6
Strand formation	(9/9/1)	(9/9/1)
Core	Independent wire rope core	
Lay	Right hand ordinary lay	
Tensile grade of wire	180	180
Weight per metre (kg)	1.44	1.57

(a) Tensile Strength Tests

The tensile strength test is a destruction test to determine the actual breaking load of the rope. The minimum breaking load quoted is the New Zealand Standard for a 6 x 19, IWRC, 180 grade RHOL construction.

		6 x 19	6 x 19 (P.F.V.)
Minimum breaking load from Test Certificate	(kgs)	23,200	23,200
Actual breaking load	(kgs)	23,400	24,380

(b) Splicing and Attaching Fittings

P.F.V. rope cannot be spliced, or have fittings attached to it, without removing the plastic from around the strands and the core. This can be done by using a marlin spike to force the strands apart so that the plastic can be cut away. This can be somewhat difficult and time consuming. When the plastic has been removed, the individual strands must be relaid around the core to reform the rope. Once that has been done, the rope can be spliced in the usual way. Tensile strength tests of two commonly used joining splices showed both to be within the expected efficiency range, with no significant variation between P.F.V. and the conventional 6 x 19 construction.

Table 2 - Splicing Strength Test

		6 x 19	6 x 19 (P.F.V.)
Breaking load - new rope	(kgs)	23,400	24,380
- butt splice	(kgs)	22,150	21,090
- cut splice	(kgs)	22,050	21,360

Ferrules or other pressed fittings <u>should not</u> be used unless all of the plastic has been removed. Fittings pressed over the plastic coating started to pull off at half of the normal breaking load (Fig. 2). However, when the plastic was removed, the ferrules held to the rope's breaking load.

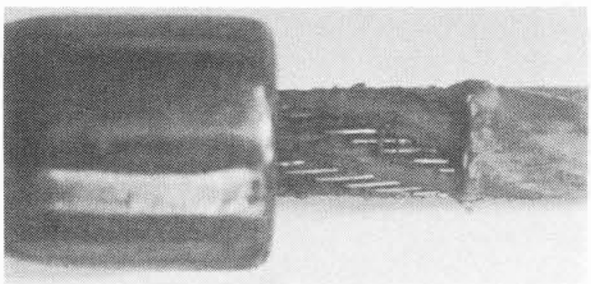


Fig. 2

(c) **Accelerated Wear Test**

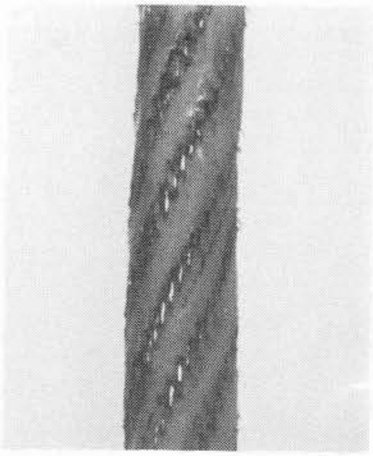
For the wear test, a 3500 kg load was imposed on a fixed 6.1 metre length of P.F.V. rope. A carriage with three offset 14 inch sheaves, grooved for 19 mm rope was run up and down this rope until it broke. Two dimensional caliper measurements of the rope diameter and visual inspections for broken wires and rope wear were made at fixed intervals during the tests.

Test rope specification :

- nominal diameter	(mm)	19.00
- unloaded diameter	(mm)	19.84 x 19.82
- 3500 kg tension diameter	(mm)	19.70 x 19.58

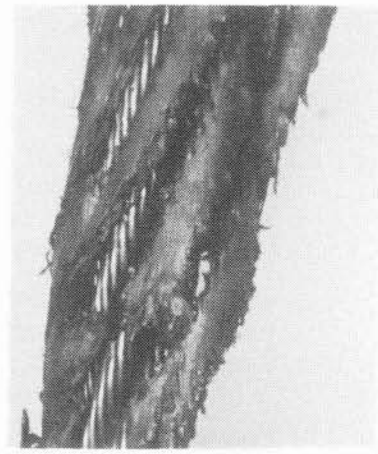
Test results :

The photographs illustrate the number of cycles, rope cross-section diameter (mm), and its condition during the accelerated wear test.

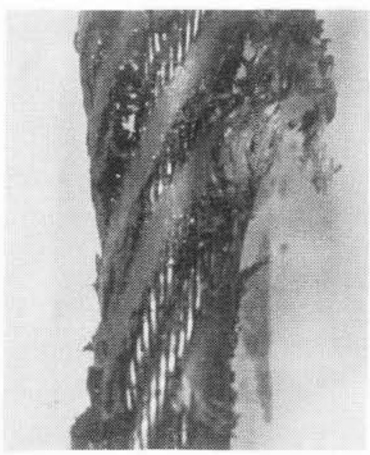


200 cycles 19.34 x 19.90*
Plastic cover worn off the crowns of the outer wires and starting to crack between the strands.

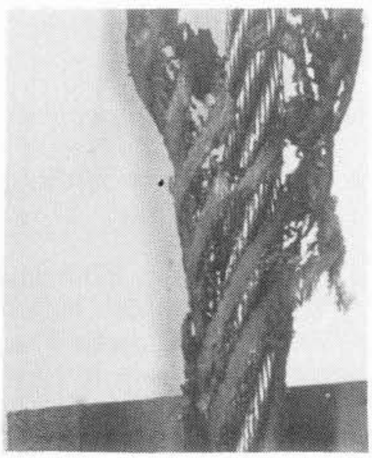
500 19.46 x 21.00
Plastic cover cracked between the strands and starting to lift from the surface of the rope.



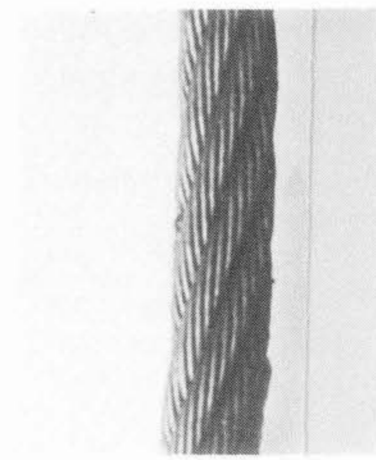
700 No accurate measurement
Plastic cover starting to break up. Minimal surface wear on the crowns of the outer wires.



1000 No accurate measurement
Plastic cover starting to peel away from the rope.



1250 18.30 x 18.70
Plastic has lifted but is still acting as a cushion. Minor surface wear on crowns of the outer wires.



1500 18.34 x 18.50
Plastic cover has been worn and broken off. Surface wear on the crowns with one broken wire.

Cycles	Diameter (mm)	Comments
1750	18.32 x 18.38	Surface wear on the crowns of all the outer wires. Three broken wires.
2000	18.04 x 18.36	Eleven broken wires
2250	-	Numerous broken wires - no longer meets the Department of Labour guidelines.
2310	-	Three strands and the core broken.

* Rope cross-section diameter measured at right angles in mm.

By contrast, in a similar accelerated wear test run under the same conditions, a conventional 6 x 19 construction deteriorated faster as Table 3 illustrates :

Table 3 - 6 x 19 Wear Test Result

Rope construction	No. of cycles	Rope diameter	Remarks
6 x 19	800	18.64 x 18.30	Five broken wires
	1000	18.62 x 18.26	Fourteen broken wires
	1118	-	Four strands and the core broken

Although the outer plastic cover of the P.F.V. rope started to break up at an early stage in the wear test, it provided enough of a "cushion effect" to slow the wear rate on the crowns of the outer wires. The plastic inside the rope also acts as a cushion between the individual strands and the core, and helps to retain the lubricant within the strands.

A combination of the cushion effect between the strands, and the retained lubricant within the strands, reduces wire to wire contact, hence wear (Fig. 3).

There were no significant differences between 6 x 19 P.F.V. and the conventional 6 x 19 construction in diameter distortion and elastic stretch.

The wear test was repeated with no significant variation in results.

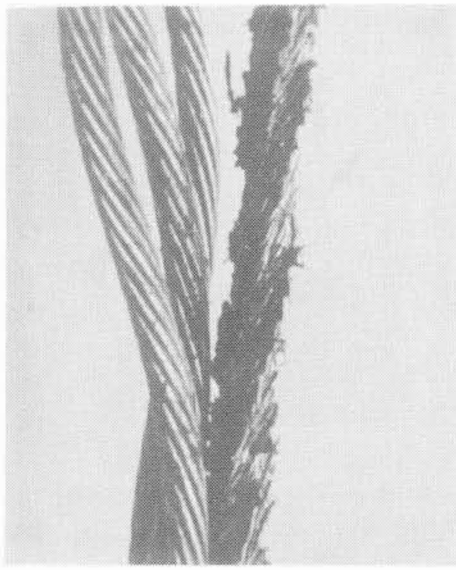


Fig. 3 - Residual plastic cover around the core.

CONCLUSION

P.F.V. rope is significantly better than the conventional 6 x 19 construction in resistance to accelerated wear, marginally better in tensile strength, similar in elastic stretch and diameter distortion, and inferior for splicing and attaching fittings.

P.F.V. is not made in New Zealand and an indicative price for 19 mm, IWRC, 180 grade RHOL, is $825/100 metres, which includes the 35% import duty. This compares with a price of $551/100 metres for the conventional 6 x 19, IWRC, 180 grade RHOL construction made in New Zealand.

The workshop tests did show that it is reasonable to expect an increase in rope life with P.F.V., but whether the increased life will compensate for the price premium, can only be determined from field trials. A long term field trial is in progress, with the P.F.V. rope being used as a mainrope on a Madill 071 hauler.

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