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CHAINSAW CHAIN TESTING

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Controlled testing of chainsaw chain

INTRODUCTION

The performance of a chainsaw, regardless of power, is strongly influenced by the cutting efficiency of the chain used. This efficiency is determined by - the chain type, the quality of the construction materials, and the filing technique of the user.

Most chain is made of heat treated alloy steel with a thin layer of chromium plating on top of each cutter. Regardless of brand, the life of a chain is dependent on the application it is used in, and the care and maintenance it receives from the operator.

In an effort to improve the durability and efficiency of chainsaw chains, some companies have applied different materials and treatment processes to the cutters. This report looks at two such chains, and summarises the results of LIRA's trials with them.

ACKNOWLEDGEMENTS

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THE CHAINS

All chains were brand new when received and had to be modified to fit a 15"(38.1 cm) bar. As two of the chains were introduced specifically for evaluation purposes, no cost comparisons between them was possible.

Chain No. 1 was an A2 Carlton 3/8" pitch, .058" gauge, super chisel chain which had undergone a titanium-carbide hardening process. The Williams Company, U.S.A. were marketing it as superchain and claimed that the hardening extended chain life with a balanced layer of hard carbide applied to the wear surface of the cutters. It was delivered with the correct 35° top plate angle and .025" depth gauge setting. The Carlton Company, U.S.A., do not endorse the Williams hardening process.

Chain No. 2 was an Oregon chain, 3/8" pitch, .058" gauge which had 4.5 mm x 3.4 mm tungsten carbide tips instead of the normal cutters. These tips formed a solid cutting face unlike the conventional cutter (refer diagram) and were set at a 10° angle. The depth gauges were .030" below the cutting edge.

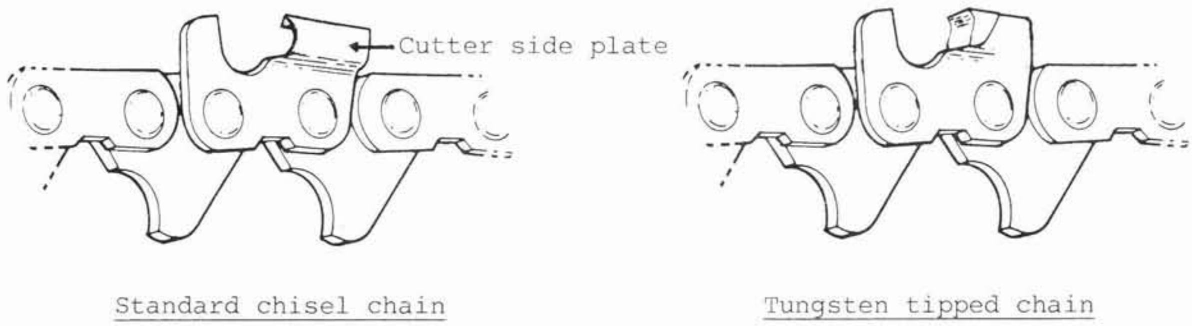

Fig. 1 - Diagram of two different cutter types

Chain No. 3, included as a control, was an Oregon 73LP chisel chain with 3/8" pitch and .058" gauge. The top plate angle was set at 35° and depth gauge .025". The Oregon chain was selected as a control because it was considered by retailers to be the one most commonly used by loggers at the time of the trials.

THE TRIALS

A two-pronged approach was taken to testing the chains, the first step being to evaluate them under controlled conditions and monitor specific operating characteristics, and the second to put them through a more comprehensive trial in a production situation. Each chain was well lubricated and run in before the testing began.

The controlled testing involved felling and delimbing a 26 year old 31 cm butt diameter pinus radiata with each chain then cutting a series of 450 discs per chain. At 50 disc intervals cutting speeds were monitored by recording time against cross-sectional area for five cuts. During the first 20 discs, the three cutting techniques, namely - downcuts (pulling chain); undercuts (pushing chain); and bore cuts, were tried and performance assessed accordingly. The rest of the controlled testing was done using the downcut technique. The same 62 cc chainsaw was used for all three chains tested.

To avoid any variance in filing techniques, all chains were machine sharpened before the field trials were undertaken.

The field trials were carried out in Kaingaroa Forest on the skids of a clearfelling operation in sixty-five year old p. corsican. The chains were used on a 77 cc chainsaw with the same 15" (38.1 cm) bar. Each chain was studied in detail for one day's cutting then left with the operator until worn out.

RESULTS

The results of the controlled tests are shown in Fig. 2.

Fig. 2 - Results of controlled tests

STAGE A TYPE OF TESTING			CUTTING RATE cm^2/sec		
No. of cuts sampled	No. of cuts completed	Type of cut *	Williams superchain	Tungsten tip chain	Oregon chisel chain
10	10	DC	47.7	26.7	61.4
5	15	UC	54.4	21.5	61.5
5	20	BC	45.5	21.1	56.1
5	50	DC	54.5	-	57.4
5	100	DC	59.7	-	48.1
5	150	DC	58.2	-	64.7
5	200	DC	59.1	-	52.7
5	250	DC	55.5	-	49.5
5	300	DC	54.7	-	49.7
5	350	DC	52.6	-	52.4
5	400	DC	60.5	-	45.2
5	450	DC	55.0	-	46.7
AVERAGE CUTTING RATE cm^2/sec			54.8	23.1	53.8

* DC= Downcut; UC = Undercut; BC = Borecut

Due to excessive vibration, and severe kickback reaction when executing borecuts, the tungsten tipped chain tests were abandoned after 20 discs. The slow cutting rate - 43% of the other two chains - and finely ground chips produced indicated that the tungsten tipped chain was not suitable for use in softwood. When tested in a eucalypt log later, the chain's performance improved by 38% but it was still 40% slower than the Oregon under the same conditions.

The cutting performance of the Williams superchain started 22% slower than the Oregon but by the 100th disc, it was 19% faster. Throughout the remainder of the controlled tests, the superchain maintained a higher average cutting rate and finished up 1 cm^2/sec faster overall. Compared to the Oregon, an increased level of vibration was evident when using the superchain and the shorter, more jagged chip produced suggested that fibre shatter was occurring. Otherwise, it handled well in all three cutting techniques used.

The Oregon chisel chain cut smoothly from the outset and was efficient in all three cutting methods. During the tests, a greater fluctuation in cutting rate was noted with it and as the number of discs cut increased, performance slowly tapered off. A longer more cleanly sliced chip was produced with the Oregon chain.

As the tungsten tipped chain did not perform satisfactorily in the controlled tests, it was not included in the field trials. Machine sharpening the other two chains prior to the field trials proved to be a mistake and consequently both needed hand filing soon after starting. A summary of the data from the one day studies is shown in Fig. 3.

Fig. 3 - Summary of study on two chains

BRAND OF CHAIN	WILLIAMS SUPERCHAIN					OREGON CHISEL CHAIN				
Element	Total time	Ave. time*	Ave. diam cm	Obser-vations of diam	Cutting rate cm^2/sec	Total time	Ave. time*	Ave. diam cm	Obser-vations of diam	Cutting rate cm^2/sec
Downcut	27.75	.16	26.0	160	62.1	16.73	.13	23.1	130	63.4
Undercut	1.57	.07	16.3	19	43.8	.98	.09	16.4	11	45.2
Borecut	.23	.12	26.0	1	68.1	.11	.11	-	-	-
Angle cut	.50	.25	36.0	2	70.7	1.42	.47	35.7	3	49.4
Down and undercut	3.53	.25	32.9	14	57.1	4.67	.23	27.3	20	44.9
Down and borecut	1.11	.28	25.7	3	29.2	.28	.28	27.0	1	34.1
Trim	20.95	.17	-	-	-	19.86	.20	-	-	-
Idle	46.60	.21	-	-	-	33.49	.18	-	-	-
Jammed	.47	.47	-	-	-	1.34	.45	-	-	-
Stopped	247.46	3.87	-	-	-	159.18	3.62	-	-	-
File cutters	12.76	1.82	-	-	-	8.14	1.63	-	-	-
File drags	4.95	2.48	-	-	-	2.05	2.05	-	-	-
Production delays	69.25	34.63	-	-	-	183.96	91.98	-	-	-
TOTAL TIME	437.13	Ave. cutting rate cm^2/s 59.6				431.93	Ave. cutting rate cm^2/s 59.5			

* Times expressed in 100ths of a minute

Over an average cross-sectional area of 25.7 cm, the Williams superchain had a cutting rate of 59.6 cm^2/sec. This was marginally above the Oregon chisel chain which had a rate of 59.5 cm^2/sec. over an average cross-sectional area of 23.4 cm. During the study the Williams chain was observed cutting into the surface of the skid fourteen times while the Oregon cut dirt sixteen times. To determine the comparative life of each chain, they were both left with the operator to use until worn out.

The Williams superchain worked a total of 27.5 hours and was considered worn out when the cutter side plates were filed down to an average of 4.4 mm long. The Oregon chisel chain operated for 25.4 hours before breaking and at that stage, cutter side plate lengths averaged 5.2 mm. Although the study results indicate slightly better performance from the superchain, the operator in the field trials preferred the Oregon chain because, towards the end of the trial, it held its cutting edge longer.

CONCLUSION

It was considered that the tungsten tipped chain was not suitable for use in exotic softwoods.

Overall, the Williams superchain did have a higher cutting speed than the Oregon but this was offset by its lack of cutter-edge durability during the latter stages of the trial. Unfortunately, the direct comparison of life between the two chains was not possible once the Oregon had broken. It was felt that the titanium carbide hardening process did not significantly increase the life of the Williams superchain and the additional cost of applying the hardening would be difficult to justify.

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