

THE SUITABILITY OF THE ROD MILL IN BEATING COTTON LINTER PULP

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Introduction

Preliminary beating trials in the rod mill have shown that rapid hydration without much cutting of the fibers can be obtained on sulphite and kraft pulps. An opportunity for studying the effect of the mill on beating the very "free" cotton linter pulp was afforded through the cooperation of a large cotton oil company in Tennessee.

Equipment

The semicommercial rod mill installed at the Forest Products Laboratory was used in the tests. It is 3 feet in diameter, 5 feet long, inside measure, and rubber lined. The rods are of steel, 2 inches and 2-1/2 inches in diameter and 4 feet 8 inches long. The total weight of rods was 3700 pounds. Rotating speeds of 28 r.p.m. and 18 r.p.m. were used during the tests.

The rod mill is normally operated continuously. The ends are open and the pulp is fed in by a screw conveyor. In order to simplify the study of the effect of beating time and consistence, the ends of the mill were blocked, and the tests run on the batch system similar to a ball mill beating test.

Material

The cotton linter pulp used in the trials was dried and pressed in bales.

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Procedure

Three trials were made at consistences of 3.6, 10, and 14 per cent at a speed of 28 r.p.m. A fourth trial was then made at a consistence of 10 per cent at a speed of 18 r.p.m. Machine runs were made of the pulp beaten at 14 per cent at a speed of 28 r.p.m., and at 10 per cent at a speed of 18 r.p.m.

Samples of the pulp were taken from the rod mill at 15 and 30 minute intervals during the beating, and hand sheets were made from these on the Laboratory sheet mold. Mullen pop tests were made on the hand sheets at 65 per cent relative humidity.

Results of Tests

The Mullen tests, made on the hand sheets of the pulp taken from the mill during the tests gave the following results:

Rod Mill Runs

Run No.	Charge : oven-dry : pulp	Consistence :	Rotating : speed	Horse- : power	Time in : mill	Bursting : strength (Mullen)
	<u>Pounds</u>	<u>Per cent</u>	<u>R.p.m.</u>		<u>Minutes</u>	<u>Pts./lb./</u> <u>ream of</u> <u>24x36-500</u>
I	10.9	3.6	28	11.9	15	0.082
I	10.9	3.6	28	11.9	30	.090
I	10.9	3.6	28	11.9	45	.112
II	32	10	28	12.8	15	.063
II	32	10	28	12.8	30	.089
II	32	10	28	12.8	45	.118
II	32	10	28	12.8	60	.139
II	32	10	28	12.8	75	.172
II	32	10	28	12.8	90	.209
III	47	14	28	11.6	30	.069
III	47	14	28	11.6	60	.078
III	47	14	28	11.6	90	.088
III	47	14	28	11.6	120	.099
III	47	14	28	11.6	150	.118
III	47	14	28	11.6	180	.147
IV	32	10	18	8.0	75	.110
IV	32	10	18	8.0	135	.186
IV	32	10	18	8.0	180	.292

The appearance of the hand sheets and the strength curves indicate that the 4 per cent and 10 per cent pulps were probably left in the mill too long, although the pulp was not greatly hydrated. The 10 per cent consistence showed the highest pop test, and the fiber appeared to be cut very short. The pulp beaten in the rod mill after being run over the paper machine, compares with that prepared in the beater as shown in the following table:

Machine run No.	Average : bursting strength : per pound : per ream :	Average : breaking length : per ream :	Average : folding tests : per ream :	Average : tearing strength : per 10 pounds : per ream :	Average : age stretch
	<u>Lbs. per</u> <u>sq. in.</u>	<u>Meters</u>	<u>Double</u> <u>folds</u>	<u>Pounds</u>	<u>Per</u> <u>cent</u>
I-Cotton linter pulp: beaten 3 hours in: rod mill at 14 per cent consist- ence and 28 r.p.m.	0.275	1825	5.5	6.6	2.88
II-Cotton linter pulp: beaten 3 hours in: rod mill at 10 per cent consist- ence and 18 r.p.m.	.250	2182	3	7.4	1.60
III-Cotton linter pulp: beaten 1-3/4 hours in Marx beater	.367	2299	11	7.7	1.99

The pulp beaten in the rod mill has approximately the same tearing and tensile strength as that prepared in the beater. It is, however, much lower in folding and bursting strength, and stretch. The pulp beaten at 14 per cent at 28 r.p.m., after 3 hours, appears to be still underbeaten, the fiber being neither cut nor hydrated to any great extent. That beaten at 10 per cent is more hydrated, and is cut much shorter. It is probably overbeaten.

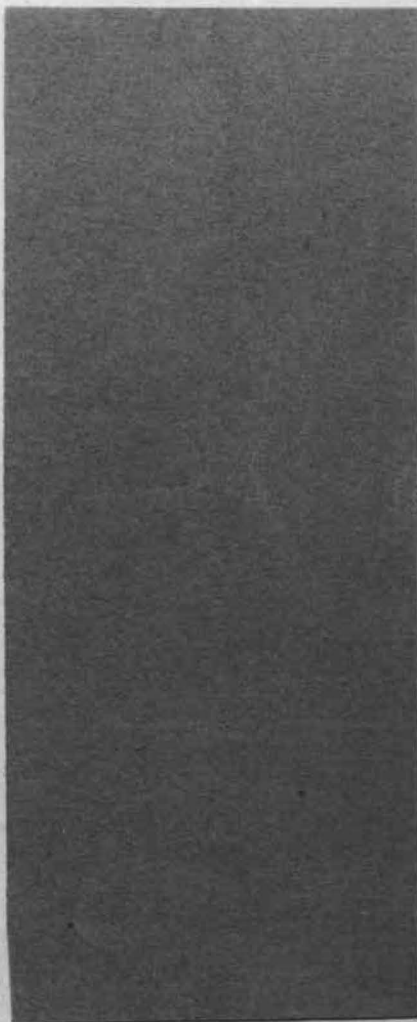
The dark color of the rod mill pulp is due to the steel rods. The intermittent operation gives an opportunity for the formation of a comparatively large amount of rust to be taken up by a small batch of pulp. This dark coloring can be prevented by the use of rods of bronze or stainless steel.

The pulp showed a tendency to ball up and form small knots during the beating, especially at the higher consistences.

Conclusions

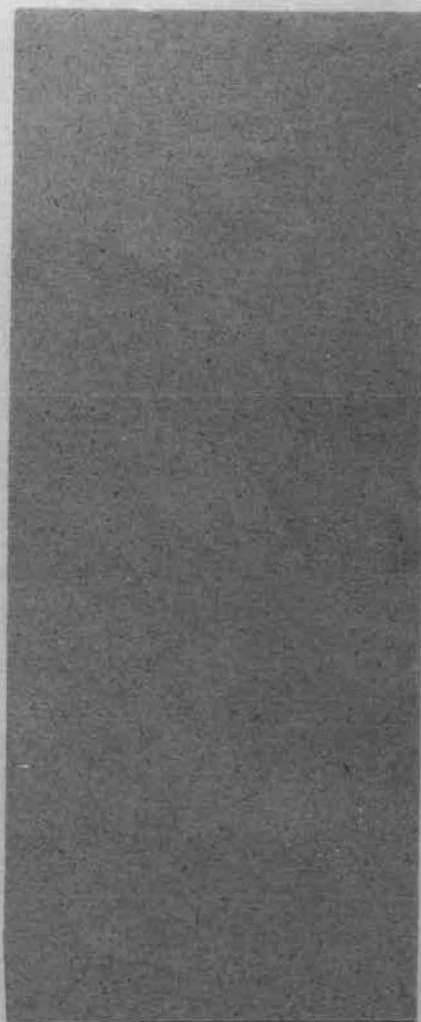
The results of these tests are not particularly encouraging for the use of the rod mill in beating cotton linter pulp. Hydration was not obtained to any great extent without cutting the fiber, and the pulp prepared in the rod mill appears inferior to that prepared in the usual manner. The pulp beaten for an hour and 45 minutes at 10 per cent consistence and 18 r.p.m., however, would probably have compared favorably with that prepared in the beater, had it been run on the machine.

The pulp prepared in this manner required 0.018 horsepower per pound of pulp per 24 hours as beaten in the small mill. Commercial installations, however, have shown a power consumption of approximately one-third of that for the semicommercial mill in the laboratory.



Rodmilled at
10% consistence

M19242F



Rodmilled at
14% consistence



Prepared
in beater

Cotton Linter Samples