Understanding the Growth in Production and Use of "Clupak" Extensible Paper

By

Henry L. Hamrick, Technical Director

Clupak, Inc. 530 Fifth Avenue, New York 10036, USA

Commercial production of CLUPAK extensible paper started in early 1958. Since then the production and use of this paper has grown steadily until it now is produced in twenty-eight countries on approximately eighty paper machines. Installations for additional production continue to be made and planned.

With more than sixty companies already having chosen to produce this paper, and still more production being planned, one may well ask why? It is the purpose of this paper to explain why by discussing some of the unique properties of CLUPAK extensible paper, the equipment used for its production, certain process advantages, and some of the general categories of use for this paper.

CLUPAK extensible paper can be simply defined as a non-creped paper with substantially parallel faces, having no bodily folds and being characterized by high stretch and substantial increases in Tensile Energy Absorption (T. E. A.), these values being up to five times that of regular paper. Visually, the sheet has the same appearance as regular paper, but it is slightly less stiff. We'll discuss later in more detail some of the special properties of this paper.

Extensible paper is produced in an extensible unit[1], or compactor, which is installed within the dryer section of the paper machine so that the partly dried paper web passing through the unit is subjected to the recoil action of an endless rubber surface. As the rubber surface recoils within the nip area formed by the rubber and a metal cylinder, the plastic, moist, paper web trapped within the nip is subjected to a longitudinal compressive force by the frictional effect of the recoiling rubber. This results in compaction of the web without any radial buckling or creping and the paper fibres are thus pushed and crowded together in an interlocked and rearranged form which results in a potential elongation proportional to the amount of compactor nip pressure. The compaction process does not limit production speed; it is still the paper machine that determines the maximum speed.

An extensible unit is a relatively simple self-contained piece of equipment which requires the approximate space of four dryer cylinders, two top and two bottom, within the paper machine dryer section. Such units are built and sold under licence by many of the world's major paper machinery builders. Operation of an extensible unit is comparatively easy, usually being capably handled by the machine crew after only a two or three day training period by a CLUPAK service engineer. The simplicity of the equipment and its operation thus prove to be one of the advantages of CLUPAK extensible paper production.

A second and very significant advantage of extensible paper production is the compaction process itself. The process is entirely mechanical, that is, no chemical changes are made to the furnish or to the paper, and the amount of stretch added to the sheet can be mechanically controlled by the operator as desired merely by pushing control buttons. The additive nature of the process adds strength to, and improves, the base sheet characteristics irrespective of furnish. This has led to increasing use in geographical areas which have an abundance of fibres such as bagasse, bamboo, waste paper, and temperate and tropical hardwoods but which have very little or no long fibred wood. The perform ance of extensible papers containing mixtures of such fibres has not only proven this paper to be an economical replacement for ordinary kraft but in many cases has also reduced the end use breakage rate.

Commercial Non-wood Fibre Usage

Producer Code	*M.D. Stretch Average*	*B/W Range Produced GSM.*	*Approx. Percentage Long Fibre*	*Approx. Percentage Short Fibre*
1. A	7-8	70-100	25% Pine	75% Waste
2. B	9	65-100	50% Pine	50% Bagasse
3. C	9	70-120	60% Pine	40% Eucalyptus
4. D	9	80-90	60% Pine	40% Eucalyptus
5. E	9	80-150	60% Pine	40% Eucalyptus
6. F	8.5-9	70-100	25% Pine	75% Waste
7. G	8.5	85-95	80% Pine	20% Eucalyptus Plus Groundwood
8. H	9+	95	20% Pine	80% Hardwood
9. I	11-12	100	30% Pine	70% Bagasse
10. J	10	80-125	25% Pine	75% Waste

Table 1. List of commercial extensible paper producers showing ranges of stretch, basis weights and percentage utilization of short and non-wood fibres.

Multiwall Sacks
Progressive Height Drops to Failure

Reg. Kraft 25% Hardwood	*No. of Drops*	*Extensible Kraft 75% Hardwood*	*No. of Drops*
24-30-36	3	24	1
24-30-36-42	4	24-30-36-42	4
24-30-36-42-48	5	24-30-36-42	4
24-30-36-42	4	24-30-36-42	4
24	1	24-30-36-42	4
24	1	24-30	2
24	1	24-30-36-42-48	5
24-30-36-42-48	5	24-30-36-42-48	5
Average :	3	Average :	3.62

Table 2. Comparison of multiwall sack drop test results for regular and extensible paper sacks. Progressive height drops were used starting at 24" height and increased by 6" intervals until failure.

Use of so called inferior indigenous fibres in extensible papers to replace more expensive long fibred kraft pulps can be quite profitable to the paper producer. He cannot only reduce his raw material costs by this change but usually his paper quality will improve with added extensibility. For countries which must import long fibre pulps, the reduction in foreign exchange expenditures for pulp purchases can have an important positive influence on the international balance of payments. Domestically, of course, increased use of indigenous fibres creates new jobs for the citizens of that country rather than depriving them of jobs through foreign exchange expenditures for pulp and paper.

Simple, easily operated equipment and a cost reducing process alone cannot justify the production of extensible paper. The ultimate justification is made in the marketplace by thousands of customers who, by their purchasing decisions, demonstrate their preference for, and choice of, this product. CLUPAK extensible paper has not only passed the marketplace test but continues to grow in use and applications as old customers increase their consumption and new ones discover its advantages. Indeed, the product itself has proven to be the main advantage of CLUPAK extensible paper production.

In the early fifties researchers such as Burgstaller and Krauss[2] drew attention to the importance of tensile energy absorption (T.E.A.) for improved performance in a packaging paper. Later, work of McKee and Whitsitt[3] confirmed the value of high stretch, high T.E.A., and tear in packaging paper performance, and these are the properties most significantly improved in extensible paper. Machine direction stretch can be varied at will during production so that extensible papers can be produced with stretch levels as high as 15% and with increases in T.E.A. up to 500%. Tear values are improved, usually by approximately 5% in the machine direction and 15% in the cross machine direction. Customers quickly recognized these improvements in paper quality and have used them to improve their packaging performance.

Property	*Sheet Direction*	*North American Paper (1)*		*European Paper (2)*	
		Regular	*Extensible*	*Regular*	*Extensible*
Basis weight, g/m²	—	81	81	80	80
Caliper, mm	—	0.130	0.124	—	—
Tensile strength,	Machine	8.67	6.23	9.21	7.73
kg/15mm	Cross	5.37	5.02	6.04	4.97
Stretch, per cent	Machine	1.9	9.6	3.2	10.8
	Cross	4.2	5.6	6.0	7.3
T.E.A., cm-kg/100 cm²	Machine	6.27	25.09	16.13	48.38
	Cross	10.75	12.54	26.43	24.49
Tear strength,	Machine	130	136		
grams	Cross	150	172		
Air permeability, sec/100cm³	—	7	9	—	—
Air permeability, cm³/min	—	—	—	260	240

(1) Tested at 50 per cent rh. (2) Tested at 65 per cent rh.

Table 3. Comperative physical test results on regular and extensible papers.

		Reg.	*X10*	*Reg.*	*X10*
Basis Wt. (G/M²)		82.7	83.1	103.8	97.7
Stretch (%)	M.D.	1.97	9.5	2.7	9.5
	C.D.	3.74	5.3	4.1	5.5
T.E.A.	M.D.	6.45	19.57	10.3	22.1
(cm. kg./100 cm²)	C.D.	6.17	8.94	9.3	11.9
Tensile	M.D.	7.83	4.7	8.9	5.51
(kgs/15 mm)	C.D.	3.22	4.0	3.7	4.12
Tear (gms)	M.D.	82.8	114.6	136	143.5
	C.D.	106.7	126.5	188	181.4

Table 4. Physical qualities of commercially made regular and extensible sack kraft utilizing a 40% bagasse, 60% long fibre furnish.

The increased tensile energy absorption and tear strength of extensible paper have enabled industry to construct more economical packages and obtain improved performance. Perhaps this can be shown most clearly in the area of shipping sack usage. For a variety of products and sack constructions in regular and extensible paper grades, a savings in paper plus an improvement in drop performance is obtained when regular paper is replaced by CLUPAK extensible paper.

Turning now to some of the major uses of, and markets for, extensible paper we shall first mention multiwall sacks. Not surprisingly, the largest consumption of this paper is in the multiwall sack field because this use places the most strenuous demands on a flexible packaging paper. CLUPAK extensible paper has been used to replace ordinary paper in sacks used for packaging virtually every product normally shipped in such containers. This replacement usually results in a saving on the amount of paper used per sack plus an improvement in field performance for the new sacks.

The change from ordinary paper to CLUPAK extensible paper in sacks should be carefully done. Normally a sack manufacturer will keep a record of sack drop test results recorded against the total, for all plies, of the combined machine direction plus cross direction T.E.A. This information is usually compiled by the sack maker for his range of normal sack constructions and products packaged.

Weight filled sack	*Product filling the sack*	*Original construction*— regular paper*	*New construction*— extensible paper*	*Paper saving per cent*	*Flat drop of 4 ft†*	
					Original	*Extensible*
94 lb	Cement	2/65 2/81	3/81	17	3.8	11
94 lb	Mortar	4/65	2/65 1/81	19	3.0	5.7
50 lb	Animal Feed	2/65 1/81	2/98	8	9.0	18
80 lb	Fertilizer	1/145 AL 2/65 1/81	1/162 AL 1/65 1/81	14	4.0	8

* Construction details give plies with their basis weights in g/m², the inside plies being listed first.
† Conducted under standard laboratory conditions of 50 per cent rh, 73°F. AL—Asphalt-laminated.

Table 5. Drop test results for regular and extensible kraft multiwall sacks.

On changing over to extensible paper, the new sack construction is chosen such that the total combined T.E.A. is the same or higher than before. A series of drop tests is used to prove out the new sack. Test shipments are then made and breakage percentages compared with the breakage record of the ordinary paper sacks being replaced. When test shipment records show a consistently better breakage record than the ordinary paper sacks then routine use of the extensible sacks can begin. By following this procedure the introduction of a new sack design is most easily accomplished and the risk of disappointing a potential new customer by unexpected breakage losses is considerably reduced.

Refuse sacks are special purpose multiwall sacks which are used for collection and disposal of household, institutional, and industrial garbage and refuse. Production of these sacks is already comsuming large quantities of extensible paper and the market is growing. The largest present use in Scandinavia with additional growing markets in Northern Europe, the United States and Japan.

Refuse sacks are open mouth style containers which are made in various sizes to suit the end use requirements. Wet strength or polyethylene coated extensible paper is frequently used for the inner ply. Bottoms are as leakproof as possible. In some cases a grease resistant treatment is also used.

Another special type multiwall sack which requires, and is made from, CLUPAK extensible paper is the disposable dunnage bag. This is a multiwall sack which contains a sealed inflatable plastic liner as the inner ply. The dunnage bag, when inflated with air, is used to brace and cushion cargo during shipment in rail cars, trucks, containers, planes and ships' holds. On arrival at its destination the dunnage bag is deflated and discarded.

The versatility of CLUPAK extensible paper is unusual. It folds and drapes well and has less springback when folded or rolled than ordinary kraft paper. This makes extensible paper easy to handle while at the same time providing a neat, tight wrapping. Wrapping has thus become an important use and today hundreds of products — boats, auto parts, wire and cable, bathtubs, electronic components, books, lumber and metal—are being wrapped in this tough flexible paper.

Extensible paper can be treated in any way that conventional kraft can. It can be coated with asphalt, polyethylene or wax for moisture protection. It can be made with urea formaldehyde or other resins for wet strength. And industrial or decorative laminates may be made with it when impregnated with suitable resins.

There is scarcely a job too tough or too delicate for extensible paper. It can be made in bleached, natural or an assortment of colors and the smooth surface is well suited to printing delicate color work on solid

colors. It is used not only for multiwall sacks and wrapping paper but also for envelopes, gummed and reinforced tapes, catalogue and magazine wrap, and even for labels.

Even some pressboard is made in extensible grades in basis weights as high as 600 gsm. Some of these pressboards are made from high grade cotton cuttings, others are 100% long fibred kraft pulp. The major uses for extensible pressboard are for dielectric insulation papers, gasket material and for flexible book covers.

We have mentioned some of the advantages and many of the more important uses for CLUPAK extensible paper. Most future extensible unit installations on existing paper machines will probably be in countries, and in paper machines, which must use large proportions of so-called second class fibres and waste paper in their furnish. Extensible units have already become an almost basic component in new paper machines built for packaging paper production.

An entirely new field for use of the compaction process is in the production of newsprint. Added extensibility in a newsprint web could reduce web breaks in the printing press, thus reducing labor and paper costs. The newsprint producer could perhaps reduce his production costs by using more groundwood or second class fibres in his furnish yet still produce a stronger sheet than before.

Some extensible newsprint has already been produced and used in daily newspapers. The results have been encouraging. You may be hearing more about extensible newsprint in the future.

You will certainly be hearing more about CLUPAK extensible paper.

References

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