THE ANALYSIS OF DIFFERENT CREEL SYSTEMS IN DIRECT BEAMING PLANT

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Tulisan diterima : 29 Desember 2010, Selesai diperiksa : 4 Maret 2011

ABSTRACTS

A research of warping machine has been carried out to investigate the performance of direct beaming plant, that using 5 different creels system. Three of yarn count, i.e. tex 36, 30 and 25 was performed and used warping machine from Benninger Machinary Ltd. The research was conducted in 3 factories for 4,000 hours in two-shift operation that carried out since 2009 to 2010. In addition, 100 % combed cotton material was used.

The aim of this research is to get some datas of performance of warping machine i.e., propered machine, efficiency and productivity. Based on that data, the manufacturer can select the best performance from several warping machines that will affect production cost on weaving process.

The result of experiments show, that for V creel system the batch changing of 30,000 meters for tex yarn count 36, 30, and 25 requires 52,57, and 59 minutes respectively . Then the time of warp processing for these yarn counts, need about 2,098; 2,125 and 2,250 minutes respectively. In addition, the V-creel sistem requires lower number of worker for creeling and doffing the packages, beside that a lower cost is also shown in this system i.e., 63.90; 65.23; and 68.11 for yarn count 36, 30 and 25 respectively; also for the total cost include rewinding remnant packages. It is therefore a good performance has significantly resulted in V-creel system.

Keywords *: creel, warping machine, beam and benninger*

ABSTRAK

Penelitian tentang mesin hani telah dilakukan secara survai khusus dengan variasi 5 (lima) sistem rak (*creel*) yang berbeda dan menggunakan 3 (tiga) macam nomor benang (tex 36, tex 30, dan tex 25) selama 4.000 jam dalam operasi 2 (dua) shift (periode tahun 2009-2010), dan dilaksanakan dalam beberapa mesin hani (*warping machine*) di 3 (tiga) perusahaan. Semua percobaan mencakup sistem analisa yang terdiri dari komparasi tegangan benang, performansi (jumlah lalatan (*beam*) belakang/jam) dan ongkos-ongkos (komparasi *labour wage and beaming costs versus wage costs*). Percobaan ini hanya menggunakan bahan benang kapas sisir 100 % dan mesin hani (*warping machine*) buatan *Benninger Machinary Ltd.*

Adapun tujuan dari penelitian ini untuk mendapatkan data kinerja mesin hani (*warping machine*), yaitu mesin hani yang tepat, efisien, dan produktif. Didasari atas data tersebut, pengusaha dapat memilih kinerja yang paling baik dari beberapa mesin hani yang akan memberikan dampak langsung atas ongkos produksi pada proses pertenunan.

Hasil penelitian menunjukkan bahwa, sistem rak V (*V-creel*) membutuhkan sedikit buruh untuk proses *creeling* dan penggantian dan pemasangan cone pada rak, juga untuk penggantian proses dapat dilakukan dengan waktu singkat (khususnya untuk waktu penyediaan cone per lalatan (*beam*)30.000 meter hanya 52 menit dan untuk proses penghanian per lalatan (*beam*) selama 2.098 menit) dan masing-masing untuk nomor tex 30 selama 57 menit dan 2.125 menit; untuk nomor benang tex 25 selama 59 menit dan2.250 menit.

Performansi dan kalkulasi biaya juga terlihat secara baik pada proses penghanian yang menggunakan sistem rak V (*V creel*), yaitu untuk tex 36 sebesar 63,90; tex 30 sebesar 65,23 dan tex 25 sebesar 68,11 dan ini juga termasuk untuk biaya total pada mesin *rewinding.*

Kata kunci : rak, mesin hani, lalatan dan benninger

BACK GROUND

The preparation process in textile industries is very important, particularly for weaving and knitting industries. there is one main important purpose in preparation system, that how to get a good final product to use for the next process as well as suitable when this result is to be processed. Also an other aim is to improve the quality of yarn product as good as possible. As a matter of fact the warping process will influence directly to the quantity of fabric production as well as its quality.Thus, preparation process on warping should be done properly due to it will affecting of weaving process.Therefore a good quality of warping machine is a must, however, it is not easy to choose and to buy a good machine [1].

From initial survey in 3 weaving mills, there are many old machines are remain performed. This is caused a lower productivity and higher operational cost compare to a new machine. The producers so often confused how to handle that conditions as mentioned above, as well as in this case there're policy from Indonesia Government about restructuring machines program in textile industries in order to have a increased productivity. One of choice referred to that all of conditions is to change the old machine with the new one system, and step by step in this situation to be activated for the first in preparation section of weaving mill. By the fact and that condition, so it's very important to analyze as a macro model which machines must be chosen and installed in weaving mill, also the production of a fabrics result will increasing included in quality and also in quantity. From so many machines, to be taken 5 kinds of warping machine as a sample for experiments and 3 kinds of yarn count. To the final experiments was to find which equipment (machines) must be taken o for weaving mill with the certainly covering quality, quantity, low cost as well as easy enough to put raw materials on a peg of rack [2].

The result of experiments, in this case is to be hoped become a more special guidance for decision maker (fabric producer) to solve the problem in their factory. Once again what is expected from a beaming plant, as all of us know that economic direct beaming demands not only high production coupled with gentle yarn treatment, but also minimum labour usage. Equally important are high warp quality and versatile application range regardless of the yarn, its make-up and their varying conditions. The problem of beam system, how ever can be not separated from warping condition as a generally and as directly will connect on creel system which seemed one of utmost part of warping it's self. All of model or type of creel which to be used in experiments, can be explained and described just like the following figure 1-5 (result analisys for tex 36 as a sample) [3 & 4].

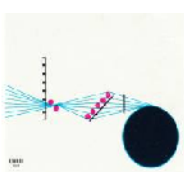


Fig. 1. Magazine Creel-Front Beaming Section (Variant I) [5]

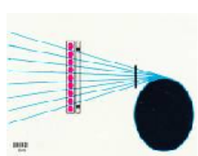


Fig. 2. Truck Creel-Front Beaming Section (Variant II)

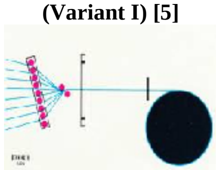


Fig.3. Two Standard Creel-Front Beaming Section (Variant III)

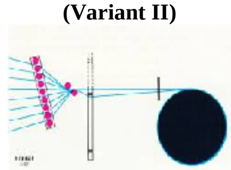


Fig.4. Truck Creel with Automatic Knotting-Front Beaming Section (Variant IV)

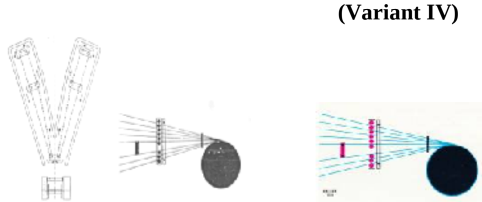
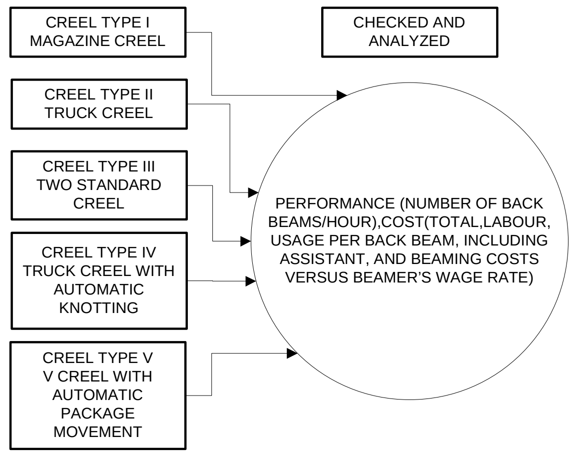


Fig. 5. Creel with Automatic Package Movement-Front Beaming Section (Variant V) [6]

EXPERIMENT METHODE

In order to get the accurate data as long as experiments, arranged 5 variants which to be checked all of result consisted of the comparison of performance (number of back beams per hour), costs (total labour usage per back beam, including assistant, and beaming costs versus beamer's wage rate) respectively and for this conditions can be figured (see Fig. 6) as follows [7 & 8].



Note : costs calculation (4,000 hours in 2-shifl operation)

Fig. 6. Experiment Methode

Basic Data

Description of Equipments [9]

Machine and equipments to be used in this experiment can be explained as follows :

Variant I

Direct beamer with useful width 1,800 mm; 40 back beams with aluminium flanges of 1,000 mm diameter; *magazine creel* for 560 running packages of maximum diameter 260 mm; with fans to keep the thread tension units clean; investment value of equipment about $. 218,000,-; space requirement: 120 m^2, broken ends per mio, metres thread 2.70 (CV 0.45).

Variant II

Direct beamer with useful width 1,800 mm; 40 back beams with aluminium flanges of 1,000 mm diameter; *truck creel* for 560 packages of maximum diameter 260 mm; with fans to keep the tread tension units clean; investment value of equipment about $. 211,000,-; space requirement : 94 m^2, broken ends per mio, metres thread 2.90 (CV 0.20).

Variant III

Direct beamer with useful width 1,800 mm; 40 back beams with aluminium flanges of 1,000 mm diameter; *two standard creel* for 560 packages of maximum diameter 260 mm: wiih fans to keep the tread tension units clean; investment value of equipment about $. 231,000,-; space requirement : 140 m^2, broken ends per mio, metres thread 2.85

(CV 0.41).

Variant IV

Direct beamcr with useful width 1,800 mm; 40 back beams with aluminium flanges of 1,000 mm diameter; *truck creel with automatic knotting* for 588 packages of maximum diameter 260 mm; with blowing carriage; investment value of equipment about $. 268,000,-; space requirement : 135 m^2, broken ends per mio, metres thread 3,10 (CV 0.51).

Variant V

Direct beamer with useful width 1,800 mm; 40 back beams with aluminium flanges of l,000 mm diameter; *V creel with automatic package movement* for 576 packages of maximum diameter 260 mm; with fans to keep the tread tension units clean; investment value of equipment about $. 268,000,-; space requirement: 116 m^2, broken ends per mio, metres thread 1.50 (CV 0.15).

Warping Data

Warp yarn is cotton 36 tex; package weight 's about 2,300 grams; number package changes're 20, number of back beams're 40; number of ends per back beam're 520; 30,000 m beaming length; 15,600,000 m trhead length on back beam; yarn weight on back beam're 561 kg; package remnants variants II-V are 520 x 20 x 0,1 = 1,040 kg; rewinding costs on automatic winder (abt. $. 0.50/kg) = about $. 500,-

Wage Costs

Beamer : $. 9.50 + 50 % social fringes = $. 14.30 per hour; assistant labourer : $. 8.50 + 50 % social fringes - $. 12.80 per hour; foreman's share (30 % of 190 h/month): (2,900 - 30)/(190 - 100) + 50 % social fringes = $. 6,90 per hour (note : for computing wage costs to be taken according to dollar system).

RESULT AND DISCUSSION

All of data experiments can be shown as to be seen in performance on Table 1.

With the same computing just like to be seen on the table can also to be result for tex 30 and tex 25. The result of experiments showed, that the V creel system requires little labour for creeling and doffing the packages, batch changing can be carried out in a short time (especially for time per back beam of 30,000 metres are 52 minutes only and the time of machine and beamer were 2,098 minutes) and for yarn count tex 30 is 57 minutes and 2,125 minutes also for yarn count tex 25 is 59 minutes and 2,250 minutes respectively.

The performance and cost calculation also works out in favour of the Benninger V creel system, as 63,90 (tex 36), 65,23 (tex 30), and 68,11 (tex 25) for total cost include rewinding remnant packages [10 & 11].

System with Magazine Creel (Type I/Variant I)

This method presupposes the use of the same material over long periods. Ostensibly production is raised by continuous creel operation, while at the same time winding the package remnants together is dispensed with. The first objective is not achieved with spun fiber yam warps, because experience teaches that, depending on the package make-up and core surface, up to 10 % of the changeovers from one package to the next result in an end break. If trouble of this kind is not to occur too frequently, the speed mast therefore be limited. Nevertheless high thread tensions and wide differences in tension between the fore most and rearmost ends on the creel and the conventional thread guiding. Changing from singles to ply yarn or vice versa entails re-threading.

Truck Creel (Type H/Variant II)

The truck creel allows relatively quick batch changes, especially if hand knotters are employed. Due to the conventional thread guiding, relatively high thread tension result, setting a limit to the running speed. Here again, re-threading is necessary when switching from singles to ply yarn or vice versa.

Two Standard Creels (Type Ill/Variant III)

When working with the two-creel-system, the interruption for batch changing is limited to the displacement of the beamer in front of the second creel and to the change of the comb. The preparation, i.e. change of packages and passing the knots, is done by an assistant labourer. As with all conventional creels, the yarn speed is limited here too.

Truck Creel with Automatic Knotting

Automation of the truck change and knotting operation saves labour and thus reduces the work load in this area. However , preparing the ends for knotting demands much more care when creeling the packages. Moreover doffing the remnant packages is rendered difficult by the firm fit of the cores on the package holders. Closed package cores (e.g. 9° 15') can not be used.

Batch changes from singles to ply yarn or vice versa are relatively time-consuming (1/2 to 2 hours), because the yarns twist on mutually. Alterations in the number of ends delay batch changing, because the stop motions have to the switched on and oil individually and the appropriate ends drawn in afresh. The knotting devices require careful maintenance and they restricted to a certain yarn range. With this creel system higher thread speeds are possible than with conventional creels, because the thread tension units are raised during beaming. The conventional tiered thread guiding, the square package arrangement (Fig. 7), and the longer creel associated with it entail wide differences in tension between the ends at the front and back ol the creel at high speed.

Table 1. Performance Calculation

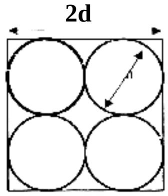
CREEL SYSTEM VARIANT		I			II			III			IV			V		
Activity		n	1/100 min	min	n	1/100 min	min	n	1/100 min	min	n	1/100 mm	min	n	1/100 min	min
1.	Setting-up	-														
1.1.	Preparing the machine	1	150	1.5	1	150	1.5	1	150	1.5	1	150	1.5	1	150	1.5
1.2.	Moving machine to second creel and threading comb	-														
1.3.	Package changing															
1.3.1.	Opening and closing ten -sion frames of creel	-			20.1/2*	100	10									
1.3.2.	Parting ends and knotting	1 . 520/2*	8	20,8	20 . 520/2*	6	31,2				20	760	152			
1.3.3.	Running trucks in and out (assisted by labourer with variant IV)				20 . 7/2*	105	73,5				20	490	98			
1.3.4.	Preparing package change : parting ends, starting up package movement													20.1/2*	440	44
1.3.5.	Inserting ends in tension units and comb													20.520/2*	4,8	249.6
1.3.6.	Clearing knotting faults (3 %)										20.3/100.	520/2*	39			
1.3.7.	Pulling knots through	1	120	1.2	20	80	16				20	80	16			
1.4.	Total 1.1 -1.3.7 set-up			23,5			413			101,5			306.5			295.1
1.5.	Total for setting -up + 15% lost time and resting			27			475			117			352			339
2.	Beaming															
2.1.	Beam changing	40	200	80	40	200	80	40	200	80	40	200	80	40	200	80
2.2.	Clearing broken ends var. 1 1.5permiom +10 % open knots at package change Var. II + III 1,5permiom Var. IV + V 1 per mio m	40.15,6.1,5	120	1123												
		19.520.0,1	120	1186												
					40.15,6.1,5	120	1123	40.15,6.1,5	120	1123						
											40.15,6.1	65	406	40.15,6.1	65	406
2.3.	Beaming hand times			2389			1203			1203			486			486
2.4	2.3 + 16% lost and resting time			2747			1383			1383			559			559
	to carry over			2747			1383			1383			559			559
2.5.	Machine operation Var. I. II + III 600 m/min Var. IV 900 m/min Var. V 1000 m/min	40. 30000. 1/600		2000	40.30000.1/600		2000	40.30000.1/600		2000						
											40.30000. 1/900		1333			
														40.30000.1/1000		1200
2.6	Total beaming 2.4+2.5			4747			3383			3383			1892			1759
2.7	Total 1.5+2.6 Production time = time of machine and beamer			4774			3858			3500			2244			2098
2.8	Time per back beam of 30.000 metres			119			96			88			56			52
2.9	Number of back beams per hour at 80% effeciency			0,403			0,5			0,55			0,86			0,92
3.	Assistant's time															
3.1	Running out tension frames and bringing them together				20.1/2*	100	10	20	100	20						
3.2	Creeling/doffing package	20.520	12	1248	20.520	10	1040	20.520	12	1248	20.520	16	1664	20.520	12	1248
3.3	Parting ends and knotting	1.520/2*	8	20,8	20.520/2*	6	312	20.520	6	624						
3.4	Pulling through knots							20	320	64						
3.5	Tying on reserve package	19.520	7	691,6												
3.6	Running trucks in and out Var.IV running in only				20.7/2*	106	73,5									
											20.7	50	70			
3.7	Clearing knotting faults										20.3.520/2*	25	39			
3.8	Preparing package change													20.1/2*	440	
3.9	Inserting ends in tensioner and comb													20.520/2*	48	
3.10	Total assistant's time 3.1-3.9			1960,4			1435,5			1956			17,73			
3.11	Total assistant's time+15% lost time and resting			2254			1651			2250			2039			
3.12	Assistant's workload as % of production time (2.7)			47%			43%			64%			91%			

Table 2. Costs Calculation

Creel system variant		I		II		III		IV		V	
		$./h	$./beam	$./h	$./beam	$./h	$./beam	$./h	$./beam	$./h	$./beam
Production cost											
1.	Variable cost										
1.1	Wages										
1.1.1	Beamer $.14.30	14.30		14.30		14.30		14.30		14.30	
1.1.2	Assistant $.12.80	6.00(47%)		5.50(43%)		8.20(64%)		11.65(91 %)		10.90(85 %)	
1.2	Operating cost										
1.2.1	Energy	0.45		0.45		0.45		0.65		0.65	
1.2.2	Maintenance	0.50		0.50		0.50		0.95		0.60	
	Total Variable costs(1)	21.25	52.73	20.75	41.50	23.45	42.64	27.55	32.03	26.45	28.75
2.	Fixed cost										
2.1	Wages										
2.1.1	Foreman(30%)	6.90		6.90		6.90		6.90		6.90	
2.1.2	Workshop,spares	0.60		0.60		0.60		0.80		0.65	
2.2	Other shared cost										
2.2.1	Space,air conditioning etc., $./m2 98.-	2.95		2.30		3.40		3.30		2.85	
	Total fixed costs (2) Excl.capital charges	10.45	25.93	9.80	19.60	10.90	19.81	11.00	12.79	10.40	11.30
	Total costs(1) and (2) Excl. Capital charges	31.70	78.66	30.55	61.10	34.35	62.45	38.55	44.82	36.85	40.05
	Capital charges : 10 years amortization at 8% interest	8.10	20.14	7.85	15.70	8.60	15.65	10.00	11.63	10.00	10.87
	Total costs	39.80	98.80	38.40	76.80	42.95	78.10	48.55	56.45	45.05	50.90
	Remnant package rewinding : 25 kg/beam at 5. 0. 50				13.00		13.00		13.00		13.00
	Total cost incl. rewinding remnant packages		98.80		89.80		91.10		69.45		63.90

This might be compensated only by substantially increasing the thread tension generally, since of course the tensions could only be brought into line with the higher values. This would then lead inevitably to reduced working speed or more broken ends. In order to shorten the time taken by re-threading, after end breakages for example, there is a temtation to accept a lung distance from thread guide to thread guide. This encourages contact between ends, resulting in double ends. Special care is dictated when clearing end breakages. Squared Package Creeling can be shown as a schematically in Fig. 7.

2d



2d

Fig. 7. Squared Package Creeling

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Truck Creel with Automatic Knotting (Variant IV)

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Creel with Automatic Package Movement (Variant V)

The BENNINGER V creel with its automatic package movement and simple package mounting, plus group wise threading in the tensioner rails and comb, allows package changing to be effected with little time and effort involved. Changes in the number of ends, yarn type and package make-up have practically no effect. Automatic release of the thread tension units whilst beaming permits high thread speeds in combination with low tension. This is also assisted by the open thread run, i.e. the absence of thread guides and deflection. The creel is kept short by the space-saving diagonal arrangement (Fig. 8), with the result that differences in thread tension are also minimized by the short distance exposed to air drag. Diagonal Package Creeling can be shown as a schematically in Fig. 8.

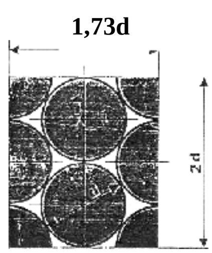


Fig. 8. Diagonal Package Creeling

COMPARISON OF THREAD TENSION

Thread tension influence beaming quality and hence the downstream processes, as well as the beaming performance, i.e. the attainable thread speed. Every tension stressing during processing robs the thread of some of its work capacity, which is then no longer available for subsequent processes. Consequently it is fundamentally desirable to keep the tension as low as possible. It must not be allowed to exceed a certain level, depending on the material. This explains why lower thread speeds must be accepted from the outset on standard magazine and truck creels with conventional thread tension units (maximum 600 m/min).

On more recent types (V creels or creels with automatic knotting) the tension units are raised during beaming, so that no excessive tensions occur even at high speeds. The best results are obtained with the BENNINGER V creel:

a. because the direct thread run from tensioner to comb means fewer deflections, and
b. because the creel is about 25 % shorter for the same number of packages, with commensurately less air drag.

The tension differences between the foremost and rearmost ends on the creel are therefore smaller (Fig. 9). And so on the BENNINGER creel there is a generally lower tension level for the same speed. In other words, to obtain the same tension level on a creel automatic knotting, the thread speed must be reduced, at the cost of a corresponding loss of performance. In Fig. 9a and 9b can be seen the comparison of thread tension on V creel (Variant V) and truck creel with tiered thread guiding (Variant IV) measured with released thread tension units in both cases. Material: Cotton tex 36 Thread speed 1000 m/min [13].

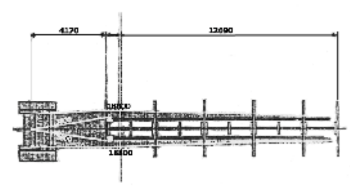


Fig. 9a.

Variant IV (Height of first row : 2,120 mm) :
Rear bottom end, contact are 88° + 34,4°
thread length 16,6 m tension 26 P
Front bottom end, contact are 100 ° + 36 °
thread length 3,8 m tension 9.0 P

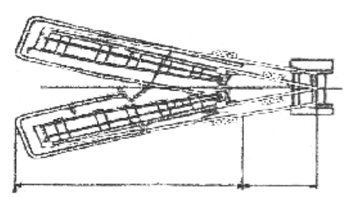


Fig. 9b.

Variant V (Height of first row : 2205 mm) :
Rear bottom end, contact are 87 ° + 18,5 "
thread length 12,3 m tension 19 P
Front bottom end, contact are 87° + 37,5 °
thread length 3,8 m tension 8.5 P

Influence of Package diameter on Run-off Behaviour

Incidence of end breakages

In V creel (variant V). there is no change in the frequency of broken ends with yarns of tex 36 and coarser if the package diameter is increased to 320 mm. For another creel system, the situation of end break were absolutely bad, especially at package diameters between 230 and 250 mm: this is due to patterning in the winding.

Thread tension

From values determined for various creel systems and package forms it can be stated that the tension conditions are roughly the same order in 250-320 mm diameter range as they are between 80-250mm. In Figure can be shown 5 various tension which to be result from 5 creel system as experiment done it. The result of variant V experiment showed, that yarn tension were more better than the other one.

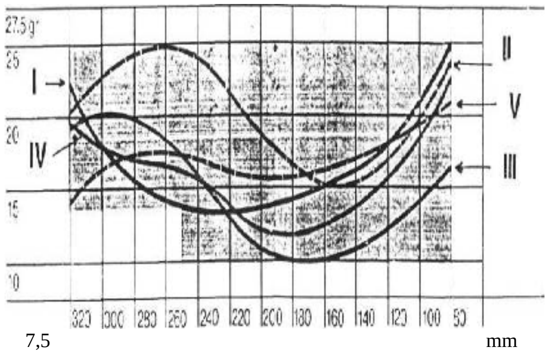


Figure 10. Yarn Tension Result

Exp.for Figure 10 :

I. Cotton 36 Tex (Package : cylindrical cheese; Traverse : 6")
II. Cotton 36 Tex (Package : cylindrical cheese: Traverse : 6")
III. Cotton 36 Tex (Package : cylindrical cheese; Traverse : 6")
IV. Cotton 36 Tex (Package : cone 4° 20': Traverse : 6")
V. Cotton 36 Tex (Package : cone 4°20'; Traverse : 6")

COMPARISON OF PERFORMANCE AND COSTS

The exact performance and cost calculations are set out for the various systems, based on a particular beaming assignment. For evaluation three graphs have been plotted , namely Fig. 11 : Performance, i.e. number of back beams per hour. Fig. 12 : Total labour usage per back beam, including assistant. Fig. 13: Beaming costs versus beamer's wage rate [14].

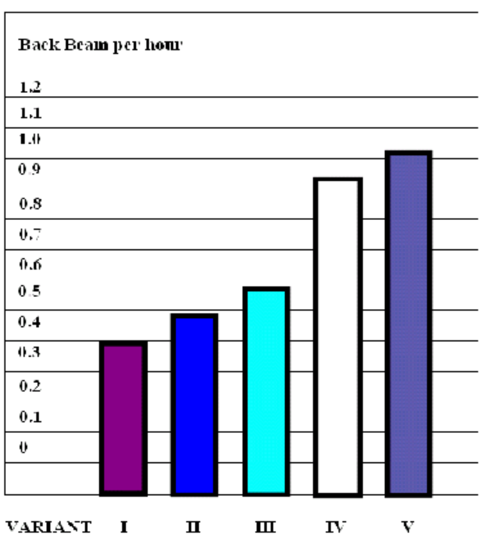
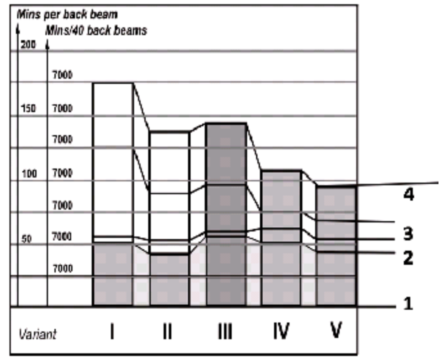


Fig. 11. Performance Comparison (Number of Back Beams per Hour) (Variants I-V)



4 *Production supervision by hearner (with machine running)*
3 *Work of beamer depending on production (with machine stopped)*
2 *Setting-up time for beamer (batch change)*
1 *Time for assistant labourer (creeling, doffing and helping at batch change)*

Fig. 12. Comparison of Labour Usage (Variants I-V)

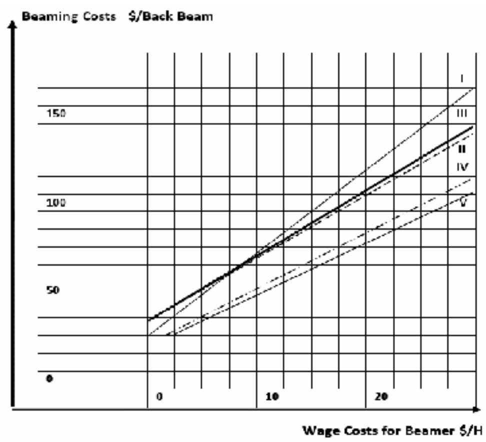


Fig. 13. Beaming Costs versus Wage Cost (Variants I-V)

CONCLUSIONS

After explaining all of item and to do the problem solving as well as discussions as mentioned beforehand, it's time to conclude as follows :

1. On magazine and truck creels relatively high beaming costs per production unit result, primarily as a function of the wage costs. The higher production of the two-creel-system in comparison with a single creel covers to a large extent the higher costs for bigger space requirements and higher investment value however only for medium to coarse yarns. Although automation of the truck change and knotting operation eases the work here, it involves more labour when creeling and doffing the packages, so that on balance the labour input still relatively high.
2. Use of knotters dictates various requirements in the way of yarn material and package make-up as well as square arrangement. The latter calls for

long creels, entailing inevitably wide tension variations between the ends from the front and rear of the creel owing to the different air distances. Basically higher thread speeds than with the conventional systems are made possible by raising the tension units.

3. The V creel system requires little labour for creeling and doffing the packages. Batch changing can be carried out in a short time, because two persons can thread the ends group wise into the tensioner rails and comb. This is not affected by changes of yarn type , package make-up or number of ends. During beaming, the tension units are released after reaching a certain speed, permitting absolute control of the thread tension, whether at high or low speed or with the machine stopped . The short creel made possible by diagonal package arrangement also makes for relatively low thread tension and concomitantly narrow tension variations even high speed.
4. The performance and cost calculation also works out in favour of the BENNINGER V creel system . The data result of experiment from all this is that the automation of sub-operations is questionable economics if, at the same time, it necessitates more work in the preceding operation.
5. From the evaluation it is clear that the modern high-performance beaming plants are far ahead of conventional equipment, and that their technological capability and low labour usage are reflected in the costs. It should be noted that the Benninger V creel system is also superior to automatic knotting.

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