Modern High Efficiency Flat Belts in Pulp & Paper Mills

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SUMMARY

On the basis of the theoretical and practical considerations, it is evident that the MFBs are excellent alternalives to V-belts because of the technical, design, operational and economic advantages. In the iuterest of energy savings and other advantages, the MFB manufacturers have been trying to get across to engineers and OEMs that rather than automatically turning to one type of belt or indeed to one type of drive when selecting means of power transmission, they shouid at least consider and find cut about the alternatives; they may be pleasantly surprised by the tremendous adventages offered by MFBs.

The continuous development of these MFBs has placed a new, simple, reliable low cost, versatile, effective and powerful medium in the hands of those who are discerning enough to take advantage of the increased flexibility in design and and the economfc profits available with their usage.

The world is going through a major economic crises and the price and availability of energy has a lot to do with it. None of us can afford to waste energy or use it less efficiently than the most energy saving technology available to us. In India, where energy is not only very expensive but often not available, a key element is the relation of the amount of energy wasted and the total loss of additional GNP which could be generated. Recently, Mr. D.Y. Kapoor, Secretary, Heavy Industry, Industry Ministry, made a statement that : crore of energy wasted could be used to generate Rs. 20 crores of additional output.

The paper and pulp industry is one of the largest users of energy after steel, aluminium and cement. The main fuels utilised by the Paper and Pulp Industry are coal, oil and power. Since, there is a substantial differential between coal and oil, almost all large mills and a majority of the small use coal as the primary fuel.

In 1950, the installed capacity in the Paper and Pulp Industry was 0.14 million tonnes. This has increased to 2 million tonnes in 1985 and is projected to reach 4.25 million tonnes by the year 2000. At the production levels of 1985 (average capacity utilization 70%) the projected requirements of energy would be 2 2 million tonnes of coal equivalent and 2200 million units of power.

Power consumption in large integrated paper mills with installed capacity of 33000 to 85000 TPA varies from 1300 to 1950 KWH per tonne of production. Comparative energy consumption for small paper mills vary from 815 to 1800 KWH. Power costs therefore account for 60% of the total energy costs and must be given due consideration from fuel economy point of view.

Typical power consumption in Paper & Pulp Mills is shown in Table 1. In large paper mills, the chippers are highly power intensive requiring 6 to 8% of total mill power. Small units use breakers or beaters for stock preparation and medium/large units use conical or disc refiners. The paper machine uses between 30 to 35% of the total mill power. Approximately 20 to 30% of the paper machine power is used by vacuum pumps. Most paper machines are line shaft driven.

TABLE—1

SPECIFIC POWER CONSUMPTION* IN PAPER & PULP MILLS ON BELT DRIVEN EQUIPMENT

SECTION	LARGE MILLS KWH/TONNE	SMALL MILLS KWH/TONNE	% KWH ON BELT DRIVES	TOTAL KWH/TONNE ON BELT DRIVE LARGE KWH/TONNE	SMALL KWH/TONNE
Chippers	100	—	100	100	—
Digesters	55	60	40	22	24
Washing & Screening	140	140	50	70	70
Bleach Plant	110	60	20	22	12
Soda Recovery	150	—	10	15	—
Stock preparation	205	200	60	123	120
Paper machine	510	550	80	408	440
Utilities & others	230	240	40	92	96
	1500	1250		852	762

*Power consumption KWH/tonne of product.

In many machines, steam turbines are used to drive the line shafts. Very few mills have changed to Thyristor sectional drives. Water and compressed air are primary power users in utilities. Compressed air uses 40 to 60 KWH/Tonne of product. Water pumps average 130-160KWH/Tonne of product

In summary, we see from Table 1, that in large paper plants, 850KWH/tonne of power is consumed by equipment on belt drives. In small power plants this is approximately 750 KWH/tonne of product. Therefore, on an average 60% power is consumed by machines which are belt driven. The balance is largely directly coupled or chain driven. This represents 1320 million units of power in terms of the total projected power consumption by the paper and pulp industry in 1985. Moreover, more than 80% of the belt driven are V—belt driven. Therefore in 1985, V–belt driven equipment in the paper and pulp industry will consume 1000 million units of power. By conservative estimates, the use of Modern Flat Belts (MPB) on these drives will save at least 5% power or a minimum of 50 million units per annum, Moreover, due to ehortage of power on-site generation is 25 to 100% of the total power used. Consequently, the economic advantages available with the use of MFBs are highly significant to the Pulp & Paper Industry.

BELT DRIVES IN MECHANICAL POWER TRANSMISSION.

In prlnciple, the belt drive is one of the simplest transmission systems. Usually, it is also the least expensive, lightest and quietest, and typically unaffected by most common solvents and corrosive influences, Power transmission belts are basically divided into three clear types : Modern Flat Belts (MFB), V—belts and Timing Belts. Rectangular and round belts play only a minor role. While, the first two transmit power solely by the frictional grip between the belt and the pulley and are, therefore, often referred to as 'genuine' belts— Timing belts transmit power in a form-locking way and are, therefore, hybrid between a chain and a belt.

CRITERIA FOR BELT SELECTION.

Belt drives offer numerous advantages over other options : they offer good value for money, require no lubrication and little expense for maintenance, can be used on large transmission ratios and long centre distances, have favourable elastic (dampening) quality, low running noise levels and low weight. Inspite of these advantages, belt drives are all too rarely used. One reason for this may be the mostly unfounded bias of many users against friction drives. The main reason, however, is withont doubt their ignorance of the particular suitability of different belt types for the various applications. As ever, there are no slick or clear cut answers. And, before specifying a drive belt there are always new products to consider, numerous technical claims and counter claims to investigate and fresh financial incentives to explore.

THEORETICAL CONSIDERATIONS

Eytelwein Grashoff Equation.

The transmission of power by a friction belt drive is defined by the Eytelwein-Grashoff Equation. (See figure 1). This equation shows that the frictional force is related to the coefficient of friction and the arc of contact. The above equation is based on the validity of the Coulombs Law of Friction and the power ratio (F_1/F_2) may be applied within the border line before slippage occurs. The Coulombs Law of Friction states that the coefficient of friction is the ratio of the tangential force to the normal reaction and is independent of the area of contact. It is possible to increase the area of contact and at the same time actually decrease the power capacity. It may be pointed out that the coefficient of friction cannot be used as a sole criterion for evaluation a belt drive, since it does not remain constant. It is dependent upon the temperature, surface quality of the pulley, pulley diameter and belt speed.

MFB develop friction tangentially. However, in V-belts the appropriate position in the groove results in an arc of contact (effective pitch diameter) which is smaller by 10 to 20 degrees in comparison to flat belt drives with identical pulleys and centre distances.

In MFB the coefficient of friction between the friction surface of chrome leather or elastomer and the pulley rim reaches 0.7 to 0.8. In V-belts power transmission occurs via the V-belts flanks. The contact pressure on every flank is the normal component of force "Z" which results from the grove angle β and the traction force "Z" as follows :

$$Z^1 = \frac{Z}{2 \sin \beta/2}$$

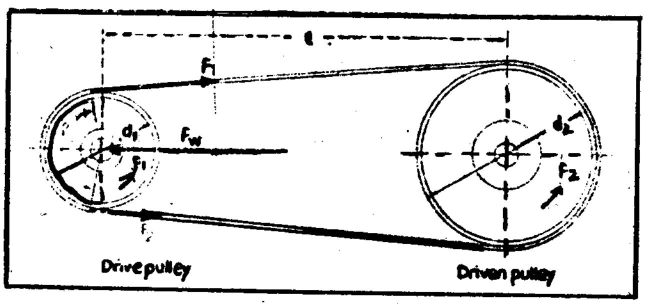
Thus the total frictional force is :

$$F = 2.Z^1.\mu_f = \frac{Z.\mu_f}{\sin \beta/_2}$$

If $\mu_w = \mu_f / \sin \beta/_2$

Then for V-belts the wedge coefficient of friction μ_w occurs which must always be clearly greater than μ_f. Moreover, in order to prevent a braking action (jamming between the V-belt and the groove, the flank coefficient of friction μ_f must not exceed ca 0.15. (See figure 2.)

FIG. 1—EYTELWEIN GRASHOFF EQUATION



F_1 = Power on the tight side

F_2 = Power on the returning side

F_w = Shalt load

The effective pulley $Fu = F_1 - F_2$

The shaft load $F_w = F_1 + F_2$

The geometry and configuration of forces of the belt drive

The Eytelwein—Equation

$$\frac{F_1}{F_2} \leqslant e^{\mu\beta}$$

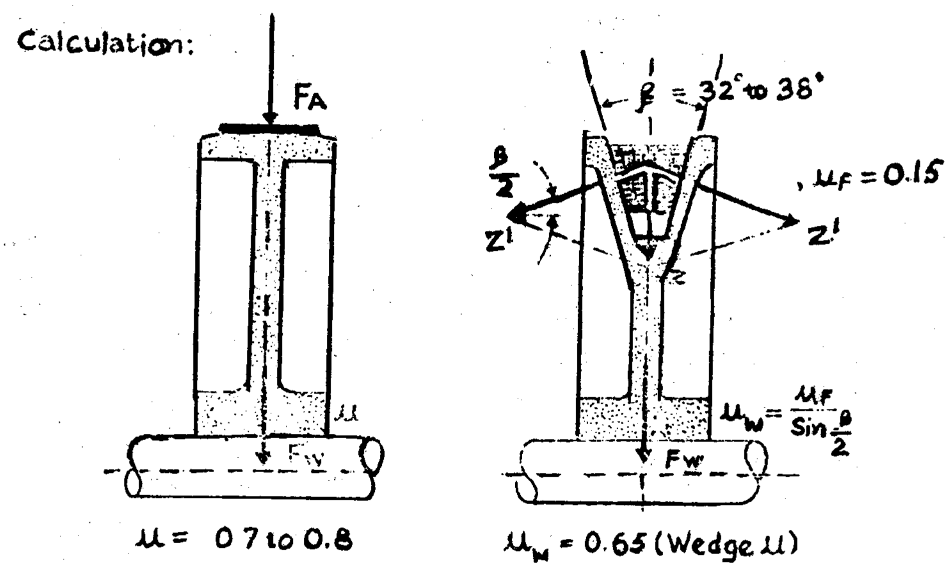
e = 2.718 basis of neutral logarithms

μ = Friction value

β = Arc of contact in angle minutes

The shaft load F_w with an arc of contact of $\beta = 180$ is therefore representing the force F_1 and F_2

FIG. 2 SHAFT LOADS WITH FLAT & V-BELTS



The efficient utilization of belt.

If one considers the full utilization of the belt as being expressed by the equation

$$\frac{F_v}{F_1} = \frac{e^{\mu\beta}-1}{e^{\mu\beta}}$$ with μ and β as variables (See Figur 3)

The trace of the curve is asymptotic and reaches the value of 1 at $\mu\beta = \alpha$. From the curve, we notice that increasing the coefficient of friction beyond $\mu=0.6$ leads to no noticeable improvement in the belts efficiency. With $\beta=180°$ and an increase of μ from 0.4 to 0.6 the efficiency improves by 18.6%, but increasing μ from 0.6 to 0.8 brings an improvement of only 8.2%. Under the circumstances, MFB with covers having coefficieut of friction of 0.7 to 0.8 represent the ideal situation.

Shaft load as a function of coefficient of friction.

Figure 4 shows how the shaft load F_w depends on the coefficient of friction (where $C=\frac{e^{\mu}\beta+1)}{e^{\mu}\beta-1)}$ i.e. $F_w=C{*}F_u$. Based on the mean coefficient of friction = 0.6, the smallest shaft load developed will be

$$F_w=1.4F_u(\beta=180°)$$
$$F_w=1.8F_u(\beta=120°)$$

The figures quoted above to the fact that under the same operating conditions the shaft load with MFB is usually lower but never higher than that caused by V-belts. These findings have also been confirmed by many practical tests and measurements. The claim made by V-belt manufacturers that "In comparison to flat belt drives, the relation between the effective pull F_u and the corresponding shaft load F_w is more favourable in V-belts because of the wedge effect"; is there fore untrue.

BELT CONSTRUCTION AND MATERIALS.

In principle the construction of MFBs, V-belts and even Timing belts is the same : Tension strands which serve to absorb the tractional forces operating in the belt are covered with an elastomer. The purpose of this elastomer is to hold the tension strands together; with MFBs and V-belts it serves a second function as the friction surface for power transmission : and for Timing belts it serves also as the material for the belt cogs which give rise to the form-lock. Both rubber elastomers and polyurethanes are used here. Special preparation of the tension member is required to ensure satisfactory bonding between the elastomer and the tension member.

Fig. 3. The efficient utilization of the belt

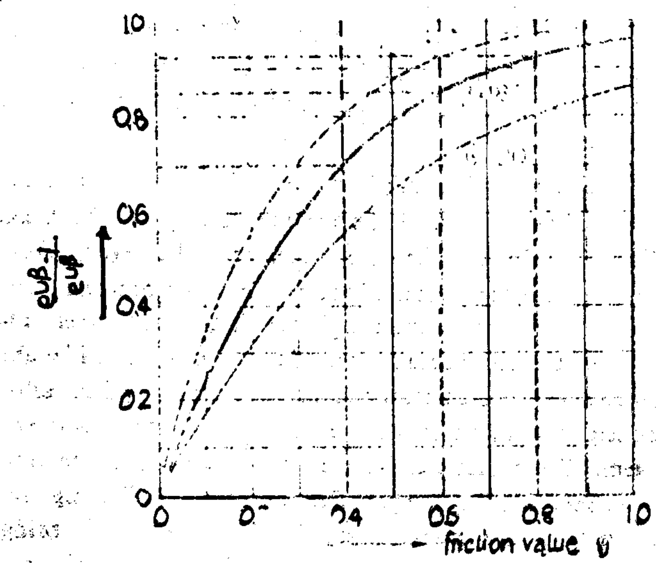
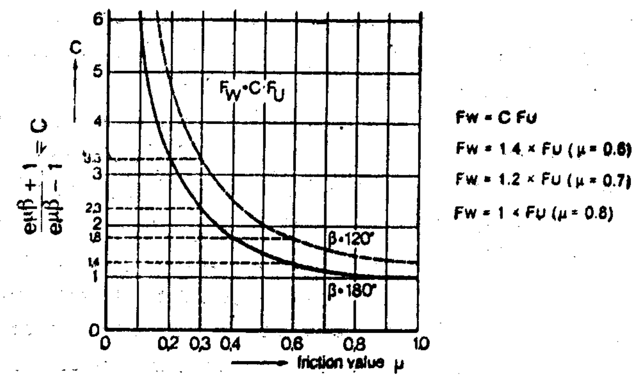


Fig. 4 The shaft load as a function of the coefficient of friction



Polyester cord, polyamide cord or polyamide sheeting are the materials used for the tension members of flat belts while for V-belts the main material is polyester cord. Sometimes rayon cord is used and more recently Kevlar. With Timing belts steel or fibre glass strands or Kevlar strands are used. The difference between the tension member material for MFBs and V-belts on the one hand and Timing belts on the other is determined by the differing elongation properties of the belt types. Belts which transmit power by means of friction grip require—as already shown—a certain amount of creep which produces a shearing force in the tension member. If the tension member cannot be elongated, the elastomer and tension member separate. With Timing belts on the other hand, these shearing forces are prevented from developing by the effect of the form-lock action. In this case, elongation is neither necessary nor desirable, for which reason materials with a high elasticity module are used as tension members.

FELT STRESS.

MFBs develop frictional forces tangantially. In V-belts, the tractional forces in the flanks result in additional lateral forces. Therefore, V-belts must be stiff laterally while being flexible longitudinally. The compression, elongation and flexing of the belts over the pulleys results in heat generation. This depends on the power transmitted, bending frequency and radius and largely upon the thickness or height of the belt. Consequently, under the same conditions V-belts, with their larger cross-section and inflexibility will heat much more than MFBs or Timing belts. In addition frictional heat must be added coming from the flanks due to the wedge effect. As rubber is a fairly bad conductor of heat, this causes the rubber to harden and become brittle with marked drop in its frictional grip and ultimately results in V-belts failure due to 'HEAT DEATH'.

Belt wear depends to a great degree on the pulley material. Cast iron is primarily used because of its wear resistance since with too soft a pulley material fine, abraded particles settle on the belt surface with the result that the combination is no longer belt material/metal but rather belt material+metal/metal. Warnins against the use of aluminium pulleys are often given but the important factor is not the material but its hardness. If its Brinall hardness is equal to that of cast iron then it is generally suitable for use as pulley material. There are also aluminium alloys which meet these requirements and, which can be successfully used. Caution is, however, often advisable with synthetic pulleys, especially for MFBs and V-belts. As a general rule synthetic materials are poor heat conductors which, if they are used, means that one important method for heat dissipation is no longer possible.

MODERN FLAT BELTS (MFBs) DESIGN FEATURES

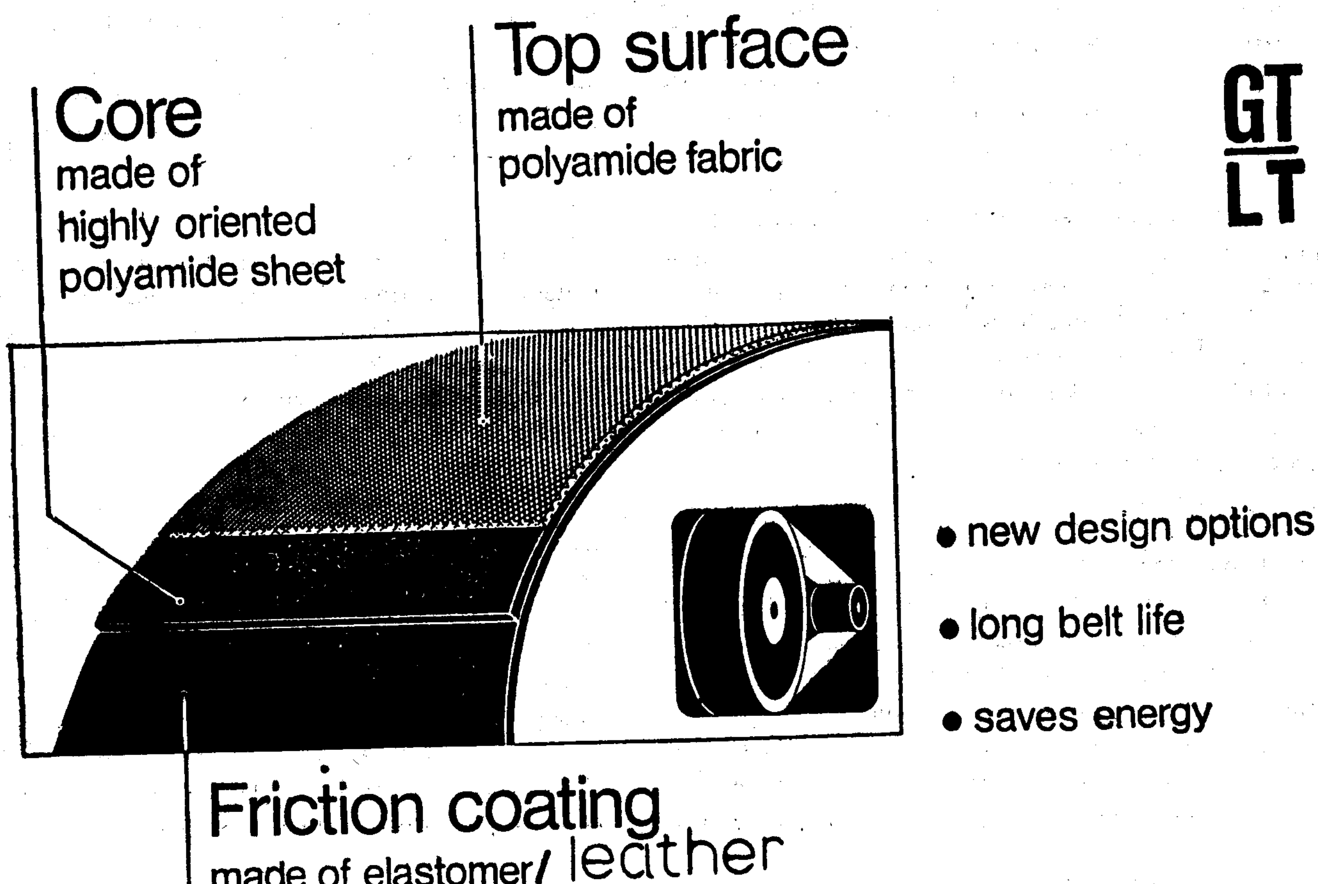
MFBs combine the outstanding properties of man-made and natural materials-nylon (super polyamide) and chrome leather or elastomer. The nylon tension member of extraordinary tensile strength and very high modulus of elasticity is particularly valuable for its ability to transmit very high loads without stretching and the chrome leather for its high coefficient of friction—even when oily and for its resistance to abrasion. The elastomer driving surface of synthetic rubber is specially suited for dry operations and high speed tangential belts in textile industry. These belts can be cut to the required length and width from the parent roll. The two belt ends are then joined in a reliable, endless splice in a heated press.

PERFORMANCE AND ADVANTAGES OF MODERN FLAT BELTS

MFB drives are of a simple and inexpensive design. Several shafts may be driven in opposite or same directions at one and the same time, MFBs are noticeable for their favourable elastic (dampening) quality, their low running noise levels, their very high belt speeds up to 100 m/s, their highly precise and uniform running performance and their high degree of transmission efficiency (98-99%). Up to 60 Kw/cm belt width can be transmitted.

As a rule of thumb it can be said that above a belt speed of ca. 10 m/s, MFBs are equivaleut to V-belts and that above 30 m/s, they are superior. However, above 50 m/s, they are a class of their own. By contrast with V-belts they can tolerate high bending frequencies and very high load fluctuations. They permit considerably smaller pulley diameters and in addition to this, allow contra-rotating pulleys to be driven without any problems. Their heat build-up is much less and therefore their service life is longer. Compared with Timing belt drives, they are characterised by their ability to bridge large centre distances and, because of their elastic properties, by very uniform transmission of rotary motion which is put to good use, for example, in machine tools calenders etc. They are excellently suited for multi-positon drives, e. g. as tangential belts on textile machines.

FIG. 5
MODERN FLAT BELTS



The production costs of belts capable of transmitting the same power are approximately equal for MFBs and V-belts if only the belt itself is taken into account. Thanks to their simple shape, however, MFB pulleys are considerably cheaper to manufacture then V-belt or Timing belt pulleys, so that of the three belt types the cost of the total drive package is cheapest with MFBs. The required tensioning for MFBs (1.3—2 times) is equal (See figure 4). With Timing belts, of course, it is much lower,

ENERGY SAVINGS WITH MODERN FLAT BELTS

Over the years, numerous technical claims and counter-claims have been made by various belt manufacturers over the relative merits of one type of belt over another. Such debates have taken an added dimension after the energy crises, especially in the cause of energy savings. The arguments presented by the MFB manufacturers are not based on theoretical assumptions but on carefully logged data obtiained from real life field studies.

Scientific tests conducted by Bombay Textiles Research Association, Mafatlal Engineering Industries Ltd., Elgi Equipments Ltd, have shown impressive energy of 8 to 12% when V-belts were replaced by modern NTB EXTERMULTUS flat oriented belts.

In figure 6, the relative efficiencies of the MFB and V-belt drives are plotted against input power as based on actual reported cases, The average power transmission efficiency of the MFB is 98% as compared to 86% for V-belt drives.

FIELD STUDIES OF MFB APPLICATIONS

BTRA (Bombay Textile Research Association) and the R & D Centre of Mafatlal Engineering Industries Ltd., conducted energy tests on 20 HP main motor drives in textile ring spinning frames. BTRA obtained power savings of 8% while MEI R & D Centre obtained savings of 12%. These tests were conducted with energy meters and the results were presented at the 24th Joint Technological Conference in Coimbatore by Dr. Balasubramaniam of BTRA.

Another study was conducted at New Haven Industries, Bombay, manufacturers of Steel Balls used in bearings and bicycle wheels, Tests were conducteded with different size balls on their 50 HP Ball Grinding

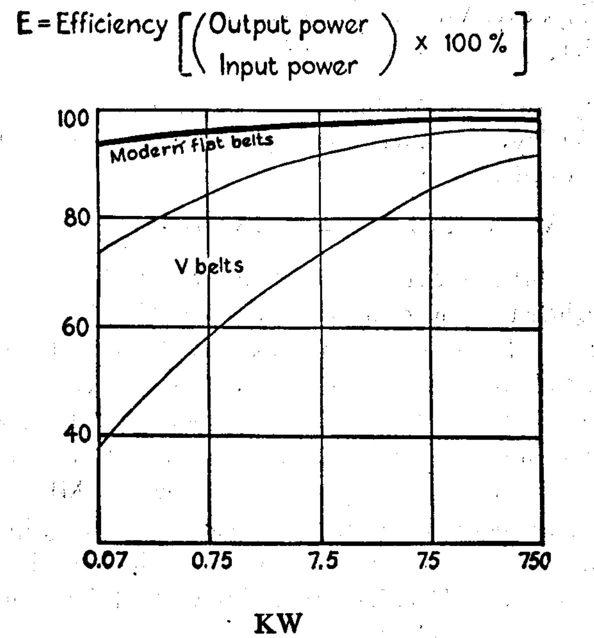


FIG. 6 :

Relative efficiencies of modern flat belts and V-belt drives plotted against input power, as based on actual reported cases.

Machines. Savings were established by using energy metres. Savings of 10-15% were obtained with the various sizes of steel balls from 5mm to 20 mm when all other parameters were kept constant.

Hindustan Lever, Bombay, have conducted energy tests on several refrigeration and air compressors ranging from 25 HP to 125 HP. Under identical conditions of output (pressure and volume flow-rate) and temperatures, energy saving of 8-10% were obtained.

At Ballarpur Paper Mills, tests were conducted on Vacuum pumps and Blowers. Average savings of 12% in the case of Blowers and 8% in the case of Vacuum pumps were observed.

Standard Alkalies & Chemicals, Madras, have conducted tests on compressor and blower drives and observed savings of 6 to 10%. These savings were presented by Mr. M.M. Bhandari, Chief Engineer, at a recent Energy Conference in Madras.

Elgi Equipments, Coimbatore, tested these MFBs on their 10 KW Portable Compressors. During a 400 hour test they obtained impressive 7 to 8% power savings over V-belt. They have also reported negligible elongation of these MFBs.

In all these cases the pay-back period was less than 150 days even after including the additional cost of new flat belt pulleys.

REASONS FOR POWER SAVINGS

MFBs are much more flexible and substantially lighter than the comparable V-belt needed for the drive Thick rigid sections of V-belts absorb a great deal of useful power and add to running costs. These power losses are typically dissipated in the form of heat, which in turn has a deleterious effect on the belt life. The explanation for the greater efficiency of MFBs over V-belts lies in the method of achieving pully grip. The wedging action of V-belts involves an irreversible energy loss, as each belts is continuously wedged into the pulley groove and pulled out again. (see Figure 7). This loss is aggravated by misalignment and unmatched V-belts in a set. Further loss of energy occurs in the flexing of solid rubber and in the shuffling of power between V-belts in a set. Force is required to bend the belt over the pulleys. MFBs being much more flexible than the V-belts require less energy for this travel around the pulleys and thus overall energy savings occur.

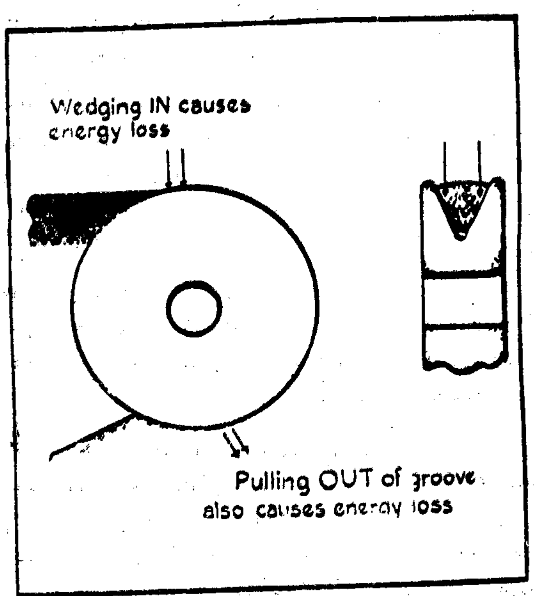


FIG. 7

V-belts give irreversible loss of energy; wedging generates heat and pulley wear. Flexing and load shuffling absorb energy.

Another favourable factor for MFBs is the lighter weight of the belt. Lightness helps to combat the arch enemy of all belt drives, centrifugal force. Theoretically, the power transmitted by any width of belt increases in direct proportion with its speed. In practice, this does not happen because centrifugal force increases in proportion with the belt's weight and the square of its speed. Thus, it is possible to reach the situation where all the belt's strength is required to counteract centrifugal force and very little is left to transmit power. Typically, MFBs are one-third the weight of comparable V-belts, Energy required to move a heavier cross-section to a given distance is greater than that raquired for modern lighter weight flat belts. thus contributing to further energy savings for MFBs.

Another disadvantage with the V-belt drive system is the irregular wear of pulley grooves which causes a set of V-belts to run on different pitch circle diameters. This is shown by a straight chalk line drawn across the V-belt set which disintegrates immediately when the drive is again started, thus proving the unbalanced loans taken by individual V-belts.

In V-belts misalignment is quite often ignored since the effects of misalignment are not very visible. In MFBs, when pulleys are misaligned, the belts tend to run towards one edge of the pulley, Also. MFBs act like a fuce, under extreme overloads the MFBs will tend to run-off the pulley costly face preventing costly damage to the equipment

The above are the theoretical and practical reasons why the MFBs have repeatedly shown 5 to 15% energy savings over savings over V-belts on fractional HP to 2000 HP drives.

OTHER ADVANTAGES OF MFB OVER V-BELT

LOWER NOISE LEVELS

Typically, as speed increase, so do the noise levels, Chrome leather has much better sound absorbing qualities as compared with the partrner rubber driving surface of a V-belt. Tests run overseas show that there is an absolute difference of about six decibals between the chrome leather flat belts versus the V-belts (see figure 8).

Since MFBs are able to withstand shock loads without permanently stretching, they do not need to be retensioned or adjusted. In case of V-belts, shock loads

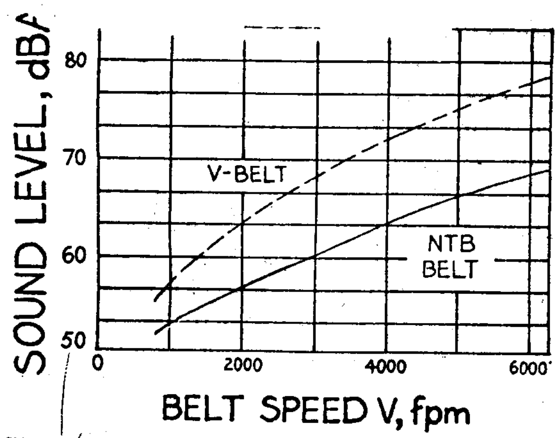


Fig 8. Graph showing running noise as a function of belt speed

cause elongation. This in turn causes the V-belts to start slipping. Belt slippage is one of the major causes of the noise pollurion for drive systems. With the very high tensile strength and the high modulus of elasticity (which make MFBs virtually strechless), MFBs do not slip and thus do not contribute to noise pollution.

FIXED CENTRES

One of the vital factors in satisfactory belt service is freedom from frequent adjustment of tension. Since these MFBs do not have any inelasic (permanent) elongation, no retensioning is required after the initial installation. This also allows their use on fixed centre line shaft sectional cone drives in paper machines. Due to the high horse powers and cone pulleys, additional design factors on conicity transmission ratio, maximum belt width and minimum centre distances must be rigorously observed. This is specially critical in erection of old and rebuilt paper machines. (See figures 9).

if the above design directives are compromised, then one edge of the belt is overly stressed resulting in faster edge wear and premature belt failure.

ACCURATE TENSIONING

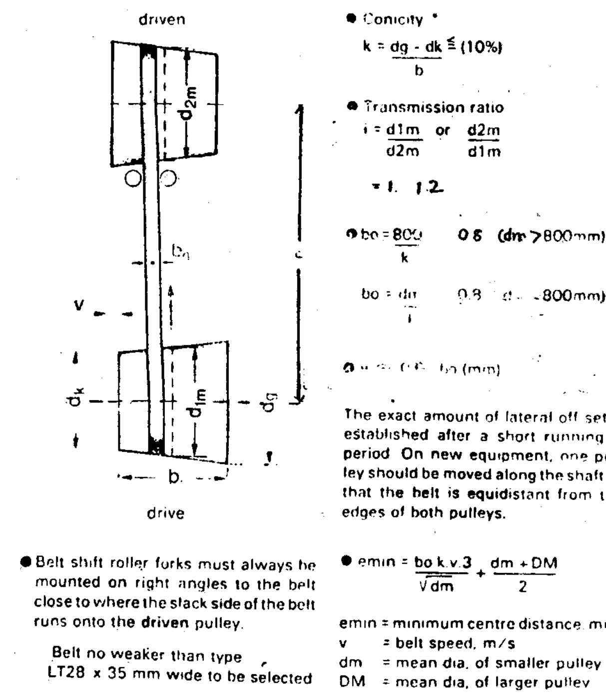
In V-belts tensioning is typically done of 'feel'. It is often too much or too little, resulting in unnecessary loss of energy due to higer shaft loads or slippages.

In MFBs the desired contact pressure can be accurately measured very simply.

READY AVAILABILITY

In India, these MFBs are especially cost effective due to lower labour costs involved in customs designing

FIG. 9 DESIGN DIRECTIVES (PAPER MILLS)



and manufacturing of these belts. Moreover, for high HP drives, delivery of mached V-belt sets in 'C', 'D', 'E' sections are typically 2-4 months whereas these MFBs can be delivered in a day if needed. Lastly the MFBs available in India represent the latest technology, while even the recently introduced Polyester Card Neoprone Jacketed V-belts are obsolete as compared to the wedge, poly-V and banded reduced section belts available in developed countries. Even when compared to these latest wedge belts, the MFBs show impressive savings of 3.5 to 11%. A recent article presented in Engineering, Materials & Design, U. K., February 83, issue 'SAVINGS IN BELT DRIVES' discussed several specific example and comes to the same conclussion reached by our studies.

A recent study conducted by BAM (Bundesanstalt fur Materialprufung,) shows the overall efficiency of of EXTREMULTUS GT belts at 98.6% as compared to SP multi-V-belts at 95.8% (See figure 11).

LOWER INITIAL COSTS

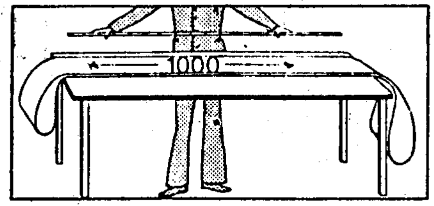
A comparison drive costs for V-belts and MFBs is given in figure 12. Initial capital costs of drives with MFBs are typically 20% lower than the corresponding V-belt drives.

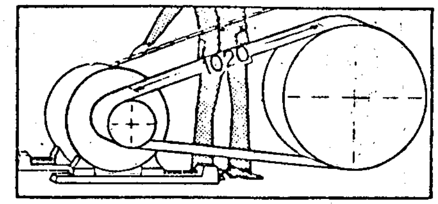
IMPORTANT! Clear drawings, no mistakes

Fig. 10

Simple belt tensioning by means of elongation

Elongating (tensioning)





To be able to transmit a given torque the EXTREMULTUS belt has to be elongated sufficiently.

With the belt placed flat on a table, draw two lines 1000 mm apart – 500 mm or 250 mm if the belt is very short – on the upper surface.

Mount the EXTREMULTUS belt on the drive and then elongate the belt by increasing the centre distance until the space between the measuring marks reaches the proper value.

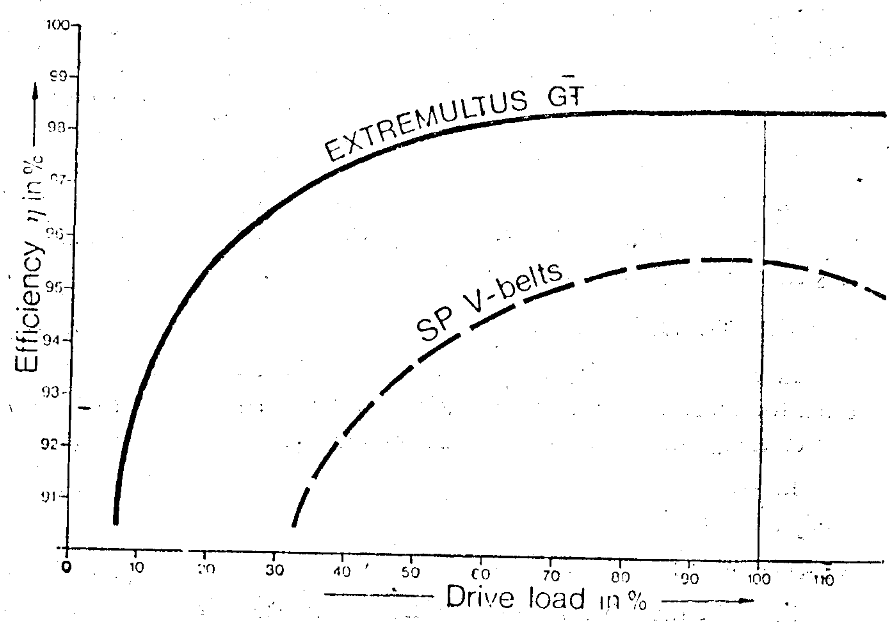
Example:
When the elongation required is 2%, the distance between the measuring marks will become 1020 mm (510 or 255 mm).

Turn the drive over several times and then check the distance between the measuring marks.

FIG. 11

Comparsion of efficiency (BAM)

West Germany.



MAJOR DESIGN ADVANTAGES AND VERSATILITY

Due to the above advantages, in many applications, several machine designers have been able to use higher belt velocities on shortcentred high ratio drive, **allowing the use of high rpm** motors and in many cases designing their system without expensive gear boxes direct couplings and jack-shaft arrangements. This has resulted in considerable savings in initial capital investment and recurring operating costs for energy and materials.

CASE STUDY

HINDUSTAN DORR-OLIVER

The drive details of the earlier V-belt drive and MFB recommendations are shown in Table II. The advantages are :

i) Use of lower cost and higher efficiency 1440 rpm motor.
ii) Reduction in centre distance and pully widths.
iii) Elimination of Jack-shafts and special guide rails for tensioning.
iv) Minimum energy sarvings of Rs. 50,000/–per annum at Rs- 0.75/KWH and 20 hrs/day, 300 days/ year running.
v) Lower initial capital investment of Rs. 1.25 lakhs.
vi) Recurring savings due to longer life and reduced maintenance costs.

KAKATI KARSHAK INDUSTRIES LTD., HYDERABAD

The drive recommendations and major advantages for Kakati Karshak Vacuum Pumps, 9000 series are shewn in Table III.

TABLE—II

HINDUSTAN DORR-OLIVER LIMITED, BOMBAY

EXISTED V-BELT DESIGN WITH JACK-SHAFT.

MOTOR	: 250 KW/960 RPM—210 mm shaft extension.
MOTOR PULLEY	: D Section 465 mm PCD, 11 Grooves, Face Width 420 mm.
PUMP PULLEY	: D Section 400 mm PCD, 11 Grooves, Face Width 420 mm.
V-BELT USED	: D 204—11 nos.
CENTRE DISTANCE REQUIRED	: 1775 mm.

NTB's RECOMMENDATION

A. CENTRIFUGAL

SLURRY PUMP	: 250 KW/960 RPM
MOTOR PULLEY	: Dia. 550 mm, Face Width 200 mm, Crown Height 1.2 mm.
PUMP PULLEY	: Dia. 605 mm, Face Width 220 mm, Crown Height 1.2 mm.
CENRE DISTANCE	: Minimum 1500 mm, Maximum 1600 mm.
NTB EXTREMUSTUS	: Type LT 54 : 4800×180 mm belt.
RADIAL SHAFT LOAD	: 2235 daN.

B. CENTRIEUGAL

SLURRY PUMP	: 250 KW/1450 RPM
MOTOR PULLEY	: Dia. 475 mm, Face Widh 230 mm, Crown Height 1.2 mm.
PUMP PULLEY	: Dia. 790 mm, Face Width 230 mm, Crown Height 1.5 mm.
CENTRE DISTANCE	: Minimum 1500, Maximum 1600 mm.
NTB EXTREMULTU3	: Type LT 40 : 5000 × 190 mm belt.
RADIAL SHAFT LOAD	: 1748 daN.

TABLE—III

KRAFT KARSHAK INDUSTRIES LTD. HYDERABAD

VACUUM PUMP	: 9000 series
MOTOR HP	: 150 to 210
MOTOR RPM	: 1440
VACUUM PUMP RPM	: 500, 450, 500 and 590
OVERLOAD FACTOR	: 45%

NTB's RECOMMENDATIONS :

NTB EXTREMULTUS : Type LT 40, : 4650×150 mm

MOTOR HP	PUMP RPM	MOTOR PULLEY DIAMETER IN MM	FLY-WHEEL DIAMETER IN MM	CENTRE DISTANCE IN MM
150	400	320	1150	1100
165	450	360	1150	1075
180	500	400	1150	1050
210	590	470	1150	1000

ADVANTAGES

1. Single belt—type & size for entire series.
2. Same Flywheel size for entire series.
3. 20% lower radial shaft loud than V-belts.
4. 30/50% narrower pulley widths.
5. Substantial energy savings.
6. Lower recurring maintenance costs.
7. Lower recurring maintenance costs.
8. Belt velocities of 35 metres per second.

APPLICATIONS

In Paper & Pulp Industry, MFB can be used on motor drives on Chippers, Rag Breakers, Beaters, Refiners, Pulpers, Vacuum Pumps, compressors, Dryer Fans, Chemical Tower Drives, Rewinders, etc., sectional cone drives in paper machines on Couch, Presses, Dryers, Calender and Reeler Sections. Carrier and Layboy belts on cross-cutters, sheeters, embossing, Sac and Packing machines.

CONCLUSION.
SUMMARY OF ADVANTAGES.

The outstanding characteristics which make MFBs the most efficient /belt for power transmission are :

a) Elastic powe transmission at 98% efficiency, as compared to 85/8% for V-belts.

b) Narrower pulley widths of 25/50% less than those required for V-belts. Jack-shaft arrangements are eliminated in some drives.

c) Higher belt velocities of 60 mtrs/sec. allow use of standard rpm motors.

d) Modern Flat Belts do not elongate and thus no shortening or retensioning is required. Consequently, can be used on Fixed Centre Drives.

e) Very high frictional coefficient, narrower widths, light weight and high elasticity result in lower shaft loads than V-belt drives.

f) Permanent Antistatic property allow use in explosion-proof areas.