Spinning Calculations

Count:-

Count is the measure of fineness or coarseness of yarn.

Systems of Count Measurement

There are two systems for the measurement of count.

1) Direct System
2) Indirect System

1) Direct System

It is used for the measurement of weight per unit length of yarn.
When count increases, fineness decreases. (count↑ fineness↓)

Commonly used units in this system of measurement are:-

1) Tex (1 Tex = 1g/ 1000m)
2) Grex (1 Grex = 1g/ 10,000m)
3) Denier (1 Denier = 1g/ 9000m)

2) Indirect System:-

It is used for the measurement of length per unit weight of yarn.
When count increases, fineness increases. (count↑ fineness↑)

Commonly used subsystems of indirect system are:-

1) English System (1 Ne = 1 Hank/ lb)
2) Metric System (1 Nm = 1 Km/ kg)

For cotton yarn, length of 1 Hank = 840 yards.

Whenever the type of count is not mentioned with the count, it is understood that it is the English count.

Basic Conversions

No	Length	Weight	Time
1.	1 in = 2.54 cm	1 lb = 7000 gr	1 min = 60 sec
2.	1 yd = 36 in	1 lb = 16 oz	1 hr = 60 min
3.	1 m = 1.0936 yd	1 oz = 437.5 gr	1 shift = 8 hr
4.	1 Hk = 840 yd	1 kg = 2.2046 lb	1 day = 24 hr
5.	1 Hk = 7 leas	1 bag = 100 lb	1 day = 3 shifts

Abbreviations:

In [inch(es)], yd [yard(s)], kg [kilogram(s)], m [meter(s)], Hk [hank(s)], lb [pound(s)], oz [ounce(s)], gr [grain(s)] , sec [second(s)], min [minute(s)], [hour(s)].

Count Conversion Table

	Ne	Nm	Tex	Grex	Denier
Ne=	1 xNe	0.5905 xNm	590.5 /Tex	5905 /Grex	5315 /Den
Nm=	1.693xNe	1 xNm	1000 /Tex	10,000/Grex	9000 /Den
Tex=	590.5 /Ne	1000 /Nm	1 xTex	0.1 xGrex	0.111 xDen
Grex=	5905 /Ne	10,000 /Nm	10 xTex	1 xGrex	1.111 xDen
Denier=	5315 /Ne	9000 /Nm	9 xTex	0.9 xGrex	1 xDen

Derivation:-

Ne = 0.5905 Nm

Let us suppose we have,

Total Ne = x Ne
Ne = x Hanks/ lb

This means that,

x Hanks are in ------------------ 1 lb

840x yards in ------------------ 1 lb

$\frac{840x}{1.0936}$ m in ------------------- 1 lb

$\frac{840x \times 2.2046}{1.0936 \times 1000}$ m in---------- 1 lb

$\frac{840x \times 2.2046}{1.0936 \times 1000}$ m/ g

(We know that, Nm= km/ kg = m/ g. Since this value has the units of Nm so it equals Nm.)

$$Nm = \frac{840 \times 2.2046}{1.0936 \times 1000} x$$

Nm = 1.693 x (as x = Ne,)

Nm = 1.693 Ne

Ne = 0.5905 Nm

Yarn Classification

(on the basis of no. of plies)

1) Single yarn

e.g 80/1 (read as 80 single) means 80 fibres twisted to form a single yarn.

2) Plied yarn

e.g. 80/2 (read as 80 double) means 80 fibres twisted to form two individual yarns.
The number of plied yarns may exceed two.

Draft & TPI Formulas

Surface speed = πDN / min

D = dia. of rotating element
N = rpm (no. of revolutions/min)

Mechanical Draft = $\dfrac{\text{S.S of Front roller } (\pi\ D\ N)}{\text{S.S of Back roller } (\pi\ D\ N)}$ > 1

Actual Draft = $\dfrac{\text{count delivered}}{\text{count fed}}$

Indirect system

A. D. = $\dfrac{\text{l / w delivered}}{\text{l / w fed}}$

Actual Draft = $\dfrac{\text{count fed}}{\text{count delivered}}$

Direct system

A.D. = $\dfrac{\text{w / l fed}}{\text{w / l delivered}}$

No. of Twists Per Inch, TPI = $\dfrac{\text{rpm of flyer}}{\text{S.S of F.R}}$ simplex

Numerical Problems

1) Calculate the length of a package of 80/1 and cone weight 2.083 lb.
(Note:- English count is represented as C/N i-e, yarn count/ no. of yarn plies)

Yarn type = 80/1
Cone wt. = 2.083 lb
Cone length = ?

<u>Solution</u>:-

length = Ne x lb x 840 yards

$= 80 \times 2.083 \times 840$ yards

$= \dfrac{139977.6}{1.0936}$ m

= 127997.07 m ------------Ans.

2) Calculate the length of yarn with Ne (80/2) and weight 4.166 lb :-

Yarn type = 80/2
Cone weight = 4.166 lb
Cone length = ?

<u>Solution</u>:-

length = Ne x lb x 840 yards

$= \dfrac{80}{2} \times 4.166 \times 840$ yards

$= \dfrac{139977.6}{1.0936}$ m

= 127997.07 m ---------------Ans.

3) Calculate the draft at drawing frame if the feeding sliver is 68 grains/ yard, delivered sliver is 48 grains/ yard and the number of doublings is 8 :-

Count of feeding sliver = 68 gr/ yd
Count of delivered sliver = 48 gr/ yd
Doubling = 8 (8 sliver cans used)
Draft = ?

Solution:-

$$\text{Actual draft} = \frac{\text{count fed} \times \text{doubling}}{\text{count delivered}} \quad \text{(direct system)}$$

$$= \frac{68 \times 8}{48}$$

= 11.33-------------Ans.

4) Calculate the grains/ yard of delivered sliver if feeding sliver is 68, doubling is 6 and the draft is 7 :-

Count of F.S = 68
Count of D.S = ?
Doubling = 6
Draft = 7

Solution :-

$$A.D = \frac{F.S \times D}{D.S}$$

$$7 = \frac{68 \times 6}{D.S}$$

$$D.S = \frac{68 \times 6}{7} = 58.28 \text{ grains/ yard}$$ ----------Ans.

5) Calculate the draft if feeding sliver is 60 gr/ yd, delivered sliver is 1 HS and doubling is 6 :-

Count of F.S = 60 gr/yd
Count of D.S = 1 HS
Doubling, D = 6
Draft = ?

Solution :-

60 gr in-------------------- 1 yd

$\frac{60}{7000}$ lb in-------------------- 1 yd

$\frac{60}{7000} \times 840$ lb in----------- 840 yd

$\frac{60}{7000} \times 840$ lb/ Hank (direct count)

7000

$\frac{7000}{60} \times \frac{1}{840}$ Hank/ lb (indirect count)

= 0.139 Hank/ lb

= 0.139 Ne

Actual Draft = $\frac{\text{count del.}}{\text{count fed}}$ = $\frac{1}{0.139/6}$ = 43.6 ----------Ans.

6) Calculate the English count of delivered sliver on drawing frame when doubling is 6, count of feeding sliver is 70 gr/ yd, diameter of front roller is 30 mm and its rpm is 100, whereas the diameter of back roller is 15 mm and its rpm is 10 :-

Count of D.S = ?
Count of F.S = 70 gr/ yd
Doubling, D = 6
Dia. of F.R, DF = 30 mm
Dia. of B.R, DB = 15 mm
Rpm of F.R, NF = 100
Rpm of B.R, NB = 10

Solution :-

F.S. = 70 gr/ yd = 70 grains in--------------- 1 yd

= $\frac{70}{7000}$ lb in------------------ 1 yd

= 0.01 lb in------------------ 1 yd

= (0.01 x 840) lb in---------- 840 yd

= 8.4 lb in--------------------- 840 yd

= 8.4 lb in--------------------- 1 Hank
= 1/ 8.4 Hanks/ lb

= 0.119 Hanks/ lb = 0.119 H.S (Ne).

$$\text{Mechanical Draft} = \frac{\text{S.S of F.R}}{\text{S.S of B.R}} = \frac{\pi\ D_F\ N_F}{\pi\ D_B\ N_B} = \frac{30 \times 100}{15 \times 10} = 20$$

On drawing frame, neither twist is inserted nor the waste is produced so we have;

Mechanical draft = Actual draft = 20

Now in case of indirect count, $\text{A.D} = \frac{\text{count delivered}}{\text{count fed}}$

$$\text{A.D} = \frac{\text{D.S}}{\text{F.S/ D}}$$

$$20 = \frac{\text{D.S}}{0.119 / 6}$$

$$\text{D.S} = \frac{20 \times 0.119}{6}$$

= 0.396 H.S (Ne)---------------Ans.

7) Calculate the TPI (twists per inch) produced on a simplex with diameter of front roller 28 mm and its rpm be 30. The rpm of flyer is 1000.

TPI on simplex = ?
Dia. of F.R = 28 mm = 2.8 cm
Rpm of F.R = 30
Rpm of flyer = 1000

Solution :-

Dia. of Front roller = 2.8 cm / 2.54 (1 in= 2.54 cm)

= 1.1023 inch

Surface speed of F.R, ^DN = π x dia. of F.R x rpm of F.R

= π x 1.1023 x 30
= 103.88 "/ min.

$$\text{TPI} = \frac{\text{rpm of flyer}}{\text{S.S of F.R}} = \frac{1000}{103.88} = 9.63$$ -----------------Ans.

8) Calculate the TPI on simplex if the diameter of back roller is 15/16”, rpm of B.R is 10, rpm of flyer is 1000 and draft is 6 :-

TPI on simplex = ?
Dia. of B.R = 15/16”
Dia. of F.R = ?
Rpm of B.R = 10
Rpm of flyer = 1000 rpm
Draft, D = 6

Solution :-

S.S of B.R = πDN = π x 15/16” x 10 = 29.45”/ min

$$D = \frac{\text{S.S of F.R}}{\text{S.S of B.R}} \Rightarrow 6 = \frac{\text{S.S of F.R}}{29.45}$$

S.S of F.R = 6 x 29.45 = 176.71”/ min

$$TPI = \frac{\text{rpm of flyer}}{\text{S.S of F.R}} = \frac{1000}{176.71} = 5.66$$ -----------------Ans.

Production calculations

- Production

The output of a m/c per unit time is called its production. The production is usually calculated in the units of weight/time or length/time e.g, oz/hr, lb/shift, yd/hr, Hk/day etc.

The most commonly used unit of time for production calculation is hour. So if the unit is not mentioned, it is understood to be a production/hr.

- Efficiency

It is the ability of a material to perform its task.
In other words, it is the ratio of the output of a m/c to the input of that m/c.

Mathematically,

$$\text{Efficiency} = \frac{\text{output}}{\text{Input}}$$

Its value ranges from 0→1. it has no units.

- ## Efficiency Percentage

It is the %age performance of a m/c.
Mathematically,

$$\text{Efficiency} = \frac{\text{output}}{\text{Input}} \times 100$$

Its value ranges from 0→100.

If the efficiency of a m/c is 0.8, its percentage efficiency 80. The word ‘percent’ means ‘per 100’ which suggests that the efficiency is $\frac{80}{100}$.

- ## Cleaning Efficiency (%)

It is the ratio of the trash extracted to the total trash content in a material.
For any m/c, mathematically,

$$\text{Cleaning eff.} = \frac{\text{trash in fed material - trash in del. material}}{\text{trash in fed material}}$$

- ## Beating action

The regular hard hits or strikes made by a rotating beater through a material (for its opening or cleaning) are known as beating action.

- ## Beats per inch

The no. of beats made by a beater per inch of a material surface is known as beating action.
Mathematically,

$$\text{Beats/inch} = \frac{\text{beater rpm x no. of arms}}{\pi \text{ x feed roller dia'' x feed roller rpm}}$$

- Twists per inch

Twist insertion & draft in a sliver gives roving and further twisting and drafting of roving gives yarn.
So the no. of twists in one inch of yarn (or roving) is known as TPI (twists per inch).

Mathematically,

$$\text{TPI} = \frac{\text{spindle speed (rpm)}}{\text{Front roller delivery (in/min)}}.$$

Also,

$$\text{TPI} \quad \sqrt{\text{count}}$$
$$\text{TPI} = \text{TM x } \sqrt{\text{count}}$$

Hank:

The word ‘Hank’ is used in two ways. Literally, it is a unit of length, i-e;
1 Hank = 840 yard but practically, we take it as a unit of English count, i-e;
1 Hank = 840 yd/lb
2 Hank = 1680 yd/lb

Roller Speeds:

In spinning calculations, we deal in two kinds of roller speeds, i-e; surface speed and rotating speed (rpm). So when the speed of a roller is mentioned without any units, this means that it is the rpm of the roller, e-g;
speed = 20 means
speed = 20 rpm

PRODUCTION FORMULAS

1. Production of Scutcher

$$P = \frac{\pi DN}{36} \times 60 \times \text{lap ct.(oz/yd)} \times \eta \quad \text{[oz/hr]}$$

2. Production of Card m/c

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times \text{tension draft} \quad \text{[lb/hr]}$$

3. Production of Draw frame

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{del. sliver ct.(gr/yd)}}{7000} \times \eta \times \text{no. of heads} \times \text{no. of m/c} \quad \text{[lb/hr]}$$

4. Production of Lap Former

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{lap ct.(gr/yd)}}{7000} \times \eta \times \text{no. of m/c} \quad \text{[lb/hr]}$$

5. Production of Comber

$$P = \frac{f\,(\pi DN)}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times N \times \text{no. of heads} \times \text{no. of m/c} \times \left| 1 - \frac{w}{100} \right|$$

[lb/hr]

6. Production of Simplex

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{roving ct.(gr/yd)}}{7000} \times \eta \times \text{no. of spindles} \quad \text{[lb/hr]}$$

7. Production of Ring frame

$$P = \frac{\pi DN \times 60}{TPI \times 36} \times \frac{16 \times 8}{840 \times ct.} \times \eta \quad \text{[oz/shift/spindle]}$$

$$P = \text{P [oz/shift/spindle]} \times \text{no. of spindles} \times \text{no. of frames} \quad \text{[oz/shift]}$$

1. Production of Scutcher

$$\mathbf{P = \frac{\pi DN}{36} \times 60 \times lap\ ct.(oz/yd) \times \eta \quad [oz/hr]}$$

DERIVATION:

Let D = dia. of lap roller (in inches)
N = rpm of lap roller
η = efficiency of m/c
P = production

Production = surface speed of lap roller x lap ct. (wt/l)

$$= \pi DN \text{ (in/min)} \times \text{lap (oz/yd)}$$

$$= \frac{\pi DN}{36} \text{ (yd/min)} \times \text{lap (oz/yd)}$$

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{ (yd/hr)} \times \text{lap (oz/yd)}$$

Since the efficiency of a m/c is always less than 1 so,

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{ (yd/hr)} \times \text{lap (oz/yd)} \times \eta$$

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{ (yd/hr)} \times \text{lap (oz/yd)} \times \eta \quad \text{[oz/hr]}$$

The value $(\pi DN/36) \times 60$ may be taken as a production constant when working on a m/c with a fixed dia. and rpm of delivery roller.
The delivery speed of a pair of rollers is the same as its surface speed. So the value πDN can also be mentioned as delivery speed.

$$P = \frac{P\text{ [oz/hr]}}{16} \quad \text{[lb/hr]}$$

P = P [lb/hr] x 8 [lb/shift]
P = P [lb/hr] x 24 [lb/day]

P = P [oz/hr] [kg/hr]

$$16 \times 2.2046$$

Also,

$$P = \frac{\pi DN}{36} \times 60 \times \frac{1}{840\ Ne} \times \eta \quad [lb/hr]$$

but let us not use this formula to avoid confusions.

Q:1—Calculate the production of scutcher if the lap wt. is 13 oz/yd, and the dia and speed of shell roller are 11 rpm and 240 mm respectively. Furnish the production in lb/hr, kg/hr, lb/shift, kg/shift and bag/day when the efficiency of the m/c is 75%:-

Lap wt/l = 13 oz/yd
Shell roller speed, N = 11 rpm
Shell roller dia., D = 240 mm = 9.5"
Efficiency, η = 75% = 75/100 = 0.75
P [lb/hr], P [kg/hr] , P [lb/shift], P [kg/shift] & P[bag/day] = ?

<u>Solution:</u>-

$$P\,[oz/hr] = \frac{\pi DN}{36} \times 60 \times \text{lap ct.(oz/yd)} \times \eta \quad [oz/hr]$$

$$= \frac{\pi \times 9.5 \times 11}{36} \times 60 \times 13\,(oz/yd) \times 0.75 \quad [oz/hr]$$

$$= 9.12 \times 60 \times 13\,(oz/yd) \times 0.75 \quad [oz/hr]$$

$$= 5334.82 \quad [oz/hr]$$

$$P\,[lb/hr] = \frac{P\,[oz/hr]}{16} = \frac{5334.82}{16} = 333.43 \quad [lb/hr]$$ -----Ans

$$P\,[kg/hr] = \frac{P\,[lb/hr]}{2.2046} = \frac{333.43}{2.2046} = 151.24 \quad [kg/hr]$$ -----Ans

$$P\,[lb/shift] = P\,[lb/hr] \times 8 = 333.43 \times 8 = 2667.44 \quad [lb/shift]$$ -----Ans

$$P\,[kg/shift] = P\,[kg/hr] \times 8 = 151.24 \times 8 = 1209.92 \quad [kg/shift]$$ -----Ans

$$P\,[bag/day] = P\,[lb/hr] \times \frac{24}{100} = 333.43 \times \frac{24}{100} = 80.02 \quad [bag/day]$$

Ans

Q:2—The fluted lap roller of a scutcher of 9” dia. makes 10 revolutions per minute. If the lap count is 0.00136 Hk, calculate the production of scutcher in one shift at 80% efficiency:-

Lap count = 0.00136 Hk

= 0.00136 x 840 (yd/lb)

$= \frac{1}{0.00136 \times 840}$ (lb/yd) x 16 = 14 (oz/yd)

Lap roller speed, N = 10 rpm

Lap roller dia., D = 9”

Efficiency, η = 80/100 = 0.8

P [lb/shift] = ?

Solution:-

$$P\,[oz/hr] = \frac{\pi DN}{36} \times 60 \times \text{lap ct.(oz/yd)} \times \eta \quad [oz/hr]$$

$$= \frac{\pi \times 9'' \times 10}{36} \times 60 \times 14 \times 0.8 \quad [oz/hr]$$

$$= 5277.88 \quad [oz/hr]$$

$$P\,[lb/shift] = \frac{P\,[oz/hr]}{16} \times 8 = 2639 \quad [lb/shift]$$ -------Ans

2. Production of Card m/c

$$\mathbf{P = \frac{\pi DN}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times \text{tension draft} \quad [lb/hr]}$$

DERIVATION:

Let D = dia. of coiler calendar rollers (in inches)

N = rpm of coiler calendar rollers

η = efficiency of m/c

Production = surface speed of doffer x carded sliver ct. (wt/l)

As the sliver has a lesser wt/l than a lap it is easier to observe its gr/yd rather than its lb/yd.

$$= \pi DN \text{ (in/min)} \times \text{sliver (gr/yd)}$$

$$= \frac{\pi DN}{36} \text{ (yd/min)} \times \text{sliver (gr/yd)}$$

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{(yd/hr)} \times \text{sliver (gr/yd)}$$

Since the efficiency of a m/c is always less than 1
and 1lb = 7000 gr so,

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{(yd/hr)} \times \left| \frac{\text{sliver (gr/yd)}}{7000} \right| \text{(lb/yd)} \times \eta \quad \text{[lb/hr]}$$

$$P \text{ [lb/hr]} = \frac{\pi DN}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \quad \text{[lb/hr]}$$

Although mainly dispersion drafting takes place on card m/c but there is a very small tension draft b/w calendar rollers and coiler calendar rollers. Theoretically, this is ignored but is included in mathematical calculations.
In a case when the dia. and speed (rpm) of coiler calendar rollers are given instead of doffer or calendar rollers, then the tension draft is already included in those values and we need not include that in our formula. So,

$$P \text{ [lb/hr]} = \frac{\pi D'N'}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times \text{tension draft} \quad \text{[lb/hr]}$$

Here D’ & N’ are assumed to be the dia. & rpm (respectively) of doffer or calendar rollers.

Q:3—What will be the production of a carding engine in 8 hours at 84% efficiency and 5% waste, if the speed of 2” coiler calendar rollers is 125 rpm with the carded sliver weighing 58 gr/yd ?

Carded sliver wt/l = 58 gr/yd
Coiler calendar rollers speed, N = 125 rpm
Coiler calendar rollers dia., D = 2”
Efficiency, η = 84% = 0.84
Waste %age = 5%
P [lb/shift] = ?

Solution:-

$$P\,[lb/hr] = \frac{\pi D'N'}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \quad [lb/hr]$$

$$= \frac{\pi \times 2'' \times 125}{36} \times 60 \times \frac{58(gr/yd)}{7000} \times 0.84 \quad [lb/hr]$$

$$= 9.11 \quad [lb/hr]$$

P [lb/shift] = P [lb/hr] x 8 = 72.9 [lb/shift] -------Ans

Here the waste percentage is not concerned as the given count is of carded (cleaned) sliver and not of lap. Hence it was just a value given to create confusion.

3. Production of Draw frame

$$\mathbf{P = \frac{\pi DN}{36} \times 60 \times \frac{\text{del. sliver ct.(gr/yd)}}{7000} \times \eta \times \text{no. of heads} \quad [lb/hr]}$$

DERIVATION:

Let D = dia. of calendar rollers (in inches)
N = rpm of calendar rollers
η = efficiency of m/c

Production = surface speed of calendar rollers x drawn sliver ct. (wt/l)

$$= \pi DN \text{ (in/min)} \times \text{sliver (gr/yd)}$$

$$= \frac{\pi DN}{36} \text{ (yd/min)} \times \text{sliver (gr/yd)}$$

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{(yd/hr)} \times \text{sliver (gr/yd)}$$

$$= \left| \frac{\pi DN}{36} \times 60 \right| \text{(yd/hr)} \times \left| \frac{\text{sliver (gr/yd)}}{7000} \right| \text{(lb/yd)} \times \eta \quad [lb/hr]$$

$$= \frac{\pi DN}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \quad [lb/hr]$$

Since a drawing frame may have more than one delivery ends or heads and also we may use one or more m/cs at a time for drawing the same kinds of slivers, so to calculate the total production,

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{del. sliver ct.(gr/yd)}}{7000} \times \eta \times \text{no. of heads} \times \text{no. of m/c} \quad \text{[lb/hr]}$$

Q:4—The 3” diameter calendar rollers of a 6 delivery drawing frame revolves 125 rpm. Calculate the production in pounds if the drawn sliver is 60 gr/yd and the m/c works for 8 hrs at 70% efficiency:-

Drawn sliver wt/l = 60 gr/yd
Calendar rollers speed, N = 125 rpm
Calendar rollers dia., D = 3”
Efficiency, η = 70% = 0.7
P [lb/shift] = ?

Solution:-

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{del. sliver ct.(gr/yd)}}{7000} \times \eta \times \text{no. of heads} \times \text{no. of m/c} \quad \text{[lb/hr]}$$

$$= \frac{\pi \times 3'' \times 125}{36} \times 60 \times \frac{60\ \text{(gr/yd)}}{7000} \times 0.7 \times 6 \times 1 \quad \text{[lb/hr]}$$

$$= 32.725 \times 2.16 \quad \text{[lb/hr]}$$

$$= 70.69 \quad \text{[lb/hr]}$$

P [lb/shift] = P [lb/hr] x 8 = 565.52 [lb/shift] --------Ans

4. Production of Lap Former

$$\mathbf{P = \frac{\pi DN}{36} \times 60 \times \frac{\text{lap ct.(gr/yd)}}{7000} \times \eta \times \text{no. of m/c} \quad \text{[lb/hr]}}$$

1—Sliver Lap M/c

Q:5—The speed and dia. of the fluted lap drum of a sliver lap m/c are 30 rpm and 16” respectively. If 24 card cans having 0.15 Hk sliver are fed to the m/c, what will be the production in one shift at 70% efficiency?

Feeding sliver count = 0.15 Hk
Lap roller speed, N = 30 rpm
Lap roller dia., D = 16”
Efficiency, η = 70% = 0.7
P [lb/shift] = ?

Solution:-

No. of yards of each sliver delivered in 1 shift at 70% efficiency

$$= \frac{\pi DN}{36} \times 60 \times 8\text{ hr} \times \eta \quad \text{[yd/shift]}$$

$$= \frac{\pi \times 16'' \times 30}{36} \times 60 \times 8\text{ hr} \times 0.7 \quad \text{[yd/shift]}$$

$$= 14074.34 \quad \text{[yd/shift]}$$

No. of pounds of each sliver delivered in 1 shift at 70% efficiency

$$= \frac{\text{[yd/shift]}}{\text{sliver count}} = \frac{14074.34\text{ yd}}{\text{shift}} \times \frac{\text{lb}}{0.15 \times 840\text{ yd}} = 111.7 \text{ [lb/shift]}$$

No. of pounds/yard of each sliver delivered

$$= \frac{\text{[lb/shift]}}{\text{[yd/shift]}} = \frac{111.7}{14074.34} = 0.00794 \text{ [lb/yd]}$$

No. of [gr/yd] of each sliver = [lb/yd] x 7000 = 55.55 [gr/yd]

No. of [gr/yd] of 24 slivers = 55.55 x 24 = 1333.33 [gr/yd]

Now total production;

P = $\underline{\pi DN}$ x 60 x $\underline{\text{lap ct.(gr/yd)}}$ x η x no. of m/c [lb/hr]

36 7000

$$P = \frac{\pi \times 16'' \times 30}{36} \times 60 \times \frac{1333.33\ (gr/yd)}{7000} \times 8 \times 0.7 \times 1 \quad [lb/shift]$$

= 2680 [lb/shift] ------Ans

2—Ribbon Lap M/c

Q:6—Calculate the production of a ribbon lap m/c in 8 hours at 70% efficiency if the speed of 16" dia. lap drum is 48 rpm and hank of ribbon lap is 0.0119.

Feeding sliver count = 0.0119 Hk
Lap roller speed, N = 48 rpm
Lap roller dia., D = 16"
Efficiency, η = 70% = 0.7
P [lb/shift] = ?

Solution:-

No. of yards of lap delivered in 1 shift at 70% efficiency

$$= \frac{\pi DN}{36} \times 60 \times 8\ hr \times \eta \quad [yd/shift]$$

$$= \frac{\pi \times 16'' \times 48}{36} \times 60 \times 8\ hr \times 0.7 \quad [yd/shift]$$

= 22519 [yd/shift]

No. of pounds of lap delivered in 1 shift at 70% efficiency

$$= \frac{[yd/shift]}{sliver\ count} = \frac{22519\ yd}{shift} \times \frac{lb}{0.0119 \times 840\ yd} = 2253.7\ [lb/shift]$$

Ans

5. Production of Comber

$$P = \frac{f\ (\pi DN)}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times N \times \underset{\text{heads}}{\text{no. of}} \times \underset{\text{m/c}}{\text{no. of}} \times \left| 1 - \frac{w}{100} \right|$$

[lb/hr]

Here,
f = feeding rate
N = nips/ min of m/c
w = waste %age

Q:7—The cylinder of a 6 head comber is running at a speed of 100 nips per minute and each nip feeds 0.25" lap. The hank of lap is 0.0166. calculate the production of comber in 8 hours at 70% efficiency and 12% waste:-

Feeding rate = 0.25"/min
Count of lap = 0.0166 Hk
= 0.0166 x 840 (yd/lb)
= 1 / 13.94 (lb/yd) = 0.0717 (lb/yd)

No. of heads = 6
Nips/min = 100
No. of m/c = 1
Efficiency = 70% = 0.7
Waste %age = 12%

Solution:-

$$P = \frac{f\ (\pi DN)}{36} \times 60 \times \frac{\text{sliver ct.(gr/yd)}}{7000} \times \eta \times N \times \underset{\text{heads}}{\text{no. of}} \times \underset{\text{m/c}}{\text{no. of}} \times \left| 1 - \frac{w}{100} \right|$$

[lb/hr]

$$P = \frac{0.25}{36} \times 60 \times 0.0717\ (\text{lb/yd}) \times 0.7 \times 100 \times 6 \times 1 \times \left| 1 - \frac{12}{100} \right|$$

[lb/hr]

= 11.04 [lb/hr]

= 88.33 [lb/shift] ------Ans

6. Production of Simplex

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{roving ct.(gr/yd)}}{7000} \times \eta \times \text{no. of spindles} \quad \text{[lb/hr]}$$

Also,

$$P = \frac{\pi DN}{36} \times 60 \times \frac{\text{roving ct.(gr/yd)}}{7000} \times \eta \quad \text{[lb/hr/spindle]}$$

This formula is used when the production of a single spindle is concerned.

Q:8—A simplex frame working at 80% efficiency prepares a full doff in 3½ hours. The wt. of roving on full bobbin is 3 lb and 4 oz. The hank of roving is 1.0. Calculate the production of a frame of two doffs in hanks and the speed of the front roller of 1⅛ " diameter:-

(When the required production of a m/c on its output package is complete, it is said to be one doff and the process of replacing these full packages with the empty ones to get further output is known as doffing)

Efficiency, η = 80% = 80/100 = 0.8
Time to complete one doff = 3½ hr
Wt. of roving on full bobbin = 3 lb + 4 oz
= 3 lb + 4/16 lb
= 3.25 lb
Hank of roving = 1.0
Dia. of Front Roller, D = 1⅛ " = 1.125"
Production of a frame of two doffs, P_2 = ?
Speed (rpm) of Front Roller, N = ?

<u>Solution:</u>-

1 doff (3½ hr) makes a bobbin of roving wt--------------------------------3.25 lb
2 doffs (7 hr) make a bobbin of roving wt----------------------------------3.25 x 2
= 6.5 lb

Production, P_2 (Hk/ 2 doffs) = wt. of 2 doffs (lb) x Hk of roving
= 6.5 x 1
= 6.5 Hk in 7 hr---------Ans

Production, P (Hk/hr) = 6.5 / 7 = 0.93 Hk / hr

On simplex we have,

P (Hk/hr) = <u>π DN</u> x <u>60</u> x <u>no. of spindles</u> x η

36 840 roving Hk

$$N = P \times \frac{36}{\pi D} \times \frac{840}{60} \times \frac{1}{\eta} \times \frac{1}{1}$$

$$= 0.93 \times \frac{36}{1.125\,\pi} \times \frac{840}{60} \times \frac{1}{0.8}.$$

= 165.4 rpm------Ans

7. Production of Ring frame

$$P = \frac{\pi DN \times 60}{TPI \times 36} \times \frac{16 \times 8}{840 \times ct.} \times \eta \quad \text{[oz/shift/spindle]}$$

P = P [oz/shift/spindle] x no. of spindles x no. of frames [oz/shift]

DERIVATION

Let D = dia. of front rollers (in inches)
N = rpm of front rollers
η = efficiency of m/c

Production = surface speed of front rollers x yarn ct. (wt/l) or,

= delivery speed of F.R. x yarn (oz/yard) [oz/hr]

Now let us calculate the delivery speed of F.R.

On a ring frame,

$$TPI = \frac{\text{spindle speed (rpm)}}{\text{F.R. delivery (in/min)}}$$

$$\text{F.R. delivery} = \frac{\text{spindle speed (rpm)}}{TPI} \quad \text{[in/min]}$$

F.R. delivery = | sp. speed x 60 | [yd/hr]

$$\text{TPI} \times 36$$

Now substituting this value in the production formula,

$$P\ [oz/yd] = \left| \frac{\text{sp. speed} \times 60}{\text{TPI} \times 36} \right| [yd/hr] \times \text{yarn ct.}\ [oz/yd]$$

$$= \left| \frac{\text{sp. speed} \times 60}{\text{TPI} \times 36} [yd/hr] \times \text{yarn ct.}\ [oz/yd] \times \eta \right| [oz/yd]$$

As 1 shift = 8hr and this is the calculation for a single spindle so,

$$P\ [OPS] = \left| \frac{\text{sp. speed} \times 60}{\text{TPI} \times 36} \times 8 \times \text{yarn ct.}\ [oz/yd] \right| \times \eta \quad [oz/shift/spindle]$$

However, in some cases the English count is given instead of oz/yd of yarn. For that purpose, let us make some changes in the above formula,

$$= \left| \frac{\text{sp. speed} \times 60}{\text{TPI} \times 36} \times \frac{8}{840 \times \text{ct.}} \times \eta \right| \quad [lb/shift/spindle]$$

$$= \left| \frac{\text{sp. speed} \times 60}{\text{TPI} \times 36} \times \frac{8 \times 16}{840 \times \text{ct.}} \times \eta \right| \quad [oz/shift/spindle]$$

This formula helps to calculate the production of one spindle. For the production of a full ring frame,

$$P\ [oz/shift] = P\ [oz/shift/spindle] \times \text{no. of spindles} \quad [oz/shift]$$

The no. of spindles in one ring frame is 480. This is a fixed value and can be used when spindle capacity of the ring frame is not mentioned. Also, if the production of more than one ring frames is to be calculated, then

$$P\,[oz/shift] = P\,[oz/shift/spindle] \times 480 \times \text{no. of frames} \quad [oz/shift]$$

As 1 day = 3 shifts and 1 bag = 100 lb,

$$P\,[bag/day] = P\,[oz/shift/spindle] \times 480 \times \frac{3}{16 \times 100} \times \text{no. of frames} \quad [bag/day]$$

$$= 0.9 \times P\,[oz/shift/spindle] \times \text{no. of frames} \quad [bags/day]$$

Q:9—Calculate the production of yarn in oz/spindle/shift on a ring frame if the spindle speed is 16000"/min, TM is 3.8, yarn is 30/1 and efficiency of the m/c is 93%:-

Yarn count = 30/1
Efficiency = 93% = 0.93
No. of spindles = 480
TM = 3.8

<u>Solution:</u>-

$$TPI = TM \sqrt{ct.}$$
$$= 3.8 \sqrt{30}$$
$$= 20.78$$

Now,

$$P\,[OPS] = \left| \frac{\text{sp. speed} \times 60}{TPI \times 36} \times \frac{8 \times 16}{840 \times ct.} \times \eta \right| \quad [oz/shift/spindle]$$

$$= \frac{16000 \times 60}{20.78 \times 36} \times \frac{8 \times 16}{840 \times 30} \times 0.93 \quad [oz/shift/spindle]$$

$$= 6.06 \quad [oz/shift/spindle]$$

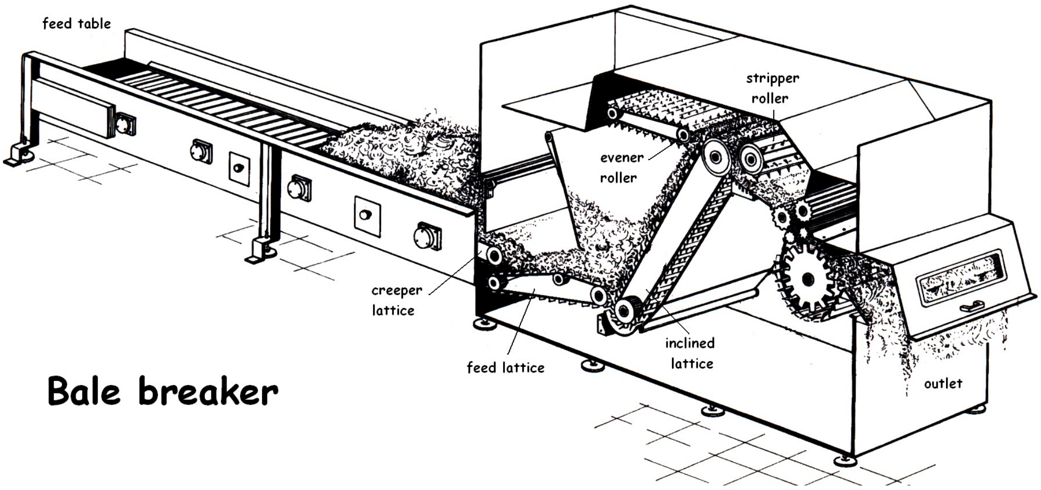
$$P\,[bag/day] = P\,[oz/shift/spindle] \times 480 \times \frac{3}{16 \times 100} \times \text{no. of frames} \quad [bag/day]$$

$$= 6.06 \times 480 \times \frac{3}{16 \times 100} \times 1 \quad [bag/day]$$

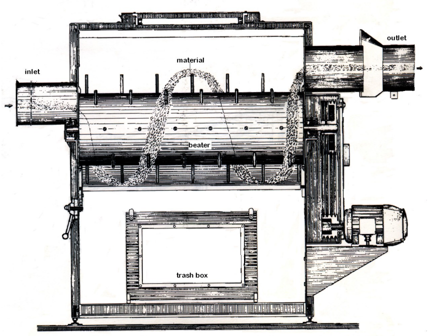
= 5.45 [bag/day] --------Ans

THE PROCESS FLOW OF

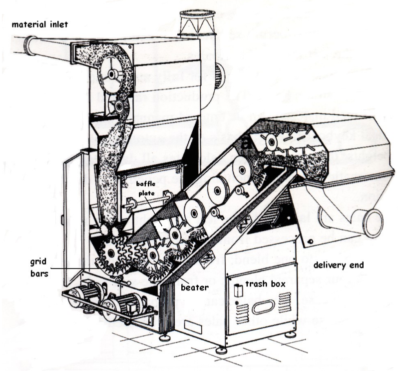
YARN MANUFACTURING



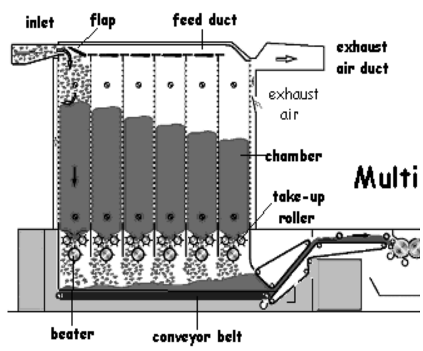
Bale breaker



Axi-flow Cleaner

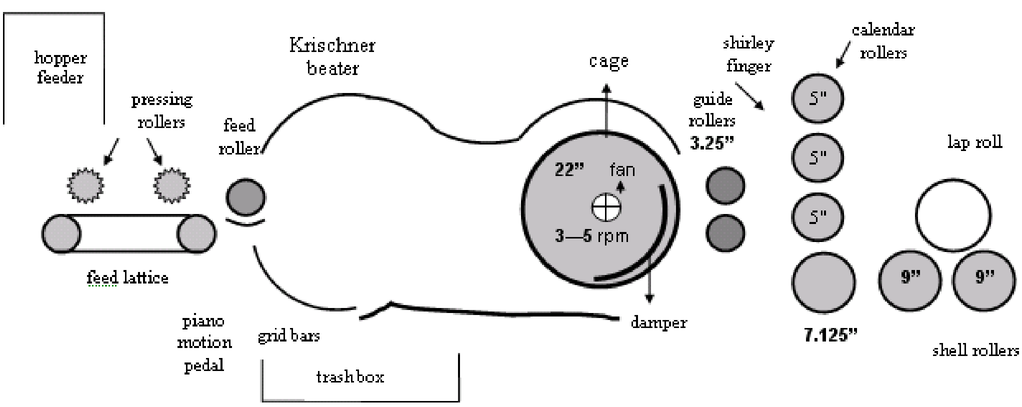


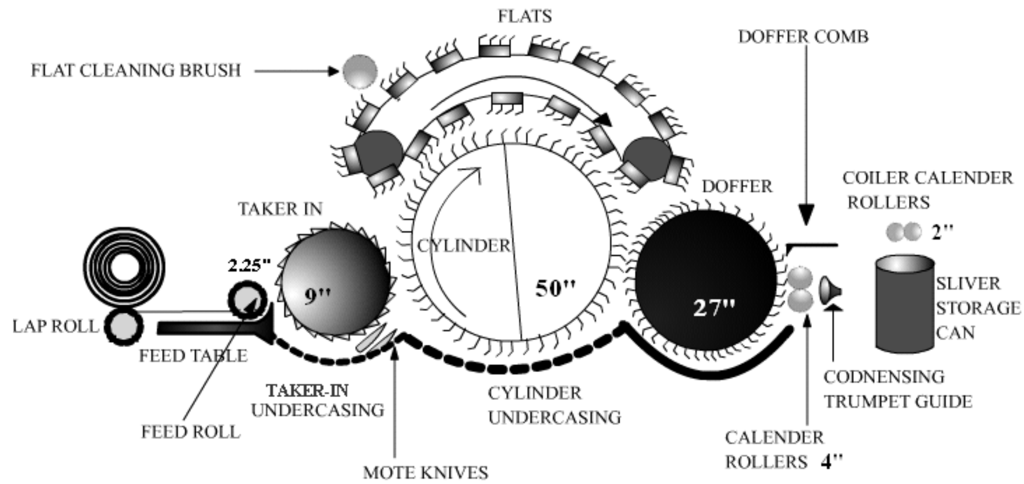
Step Cleaner



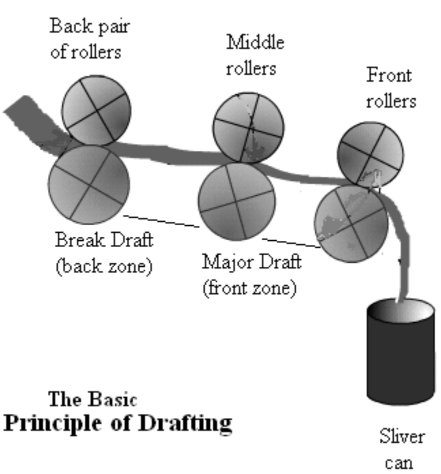
Multi-mixer

Scutcher

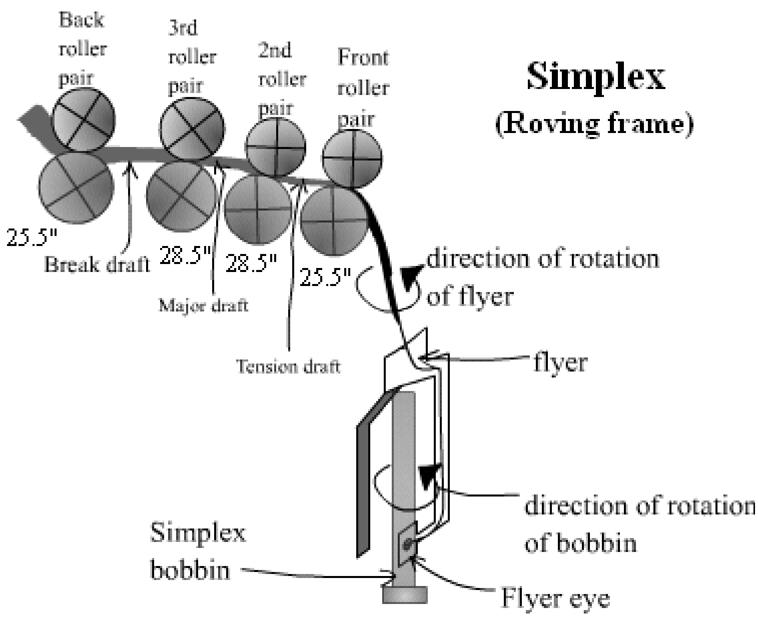




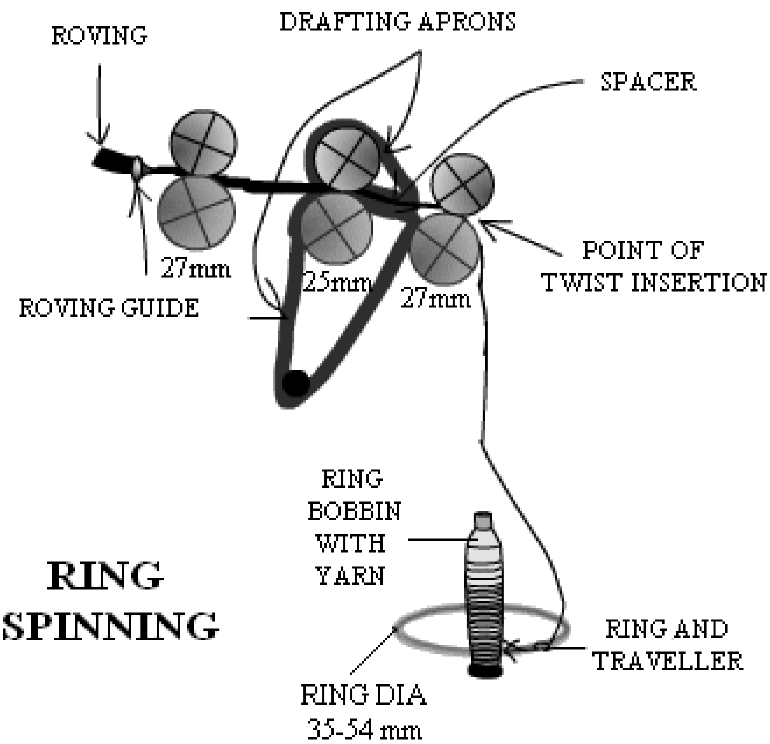
Card Machine



The Basic
Principle of Drafting



Simplex
(Roving frame)



RING SPINNING

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