HELICAL MODEL OF YARN

Number of fibres

Yarn retraction

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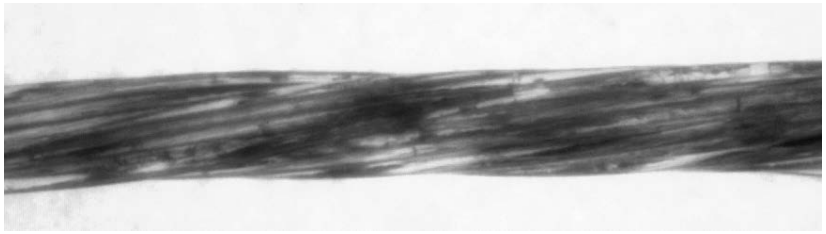
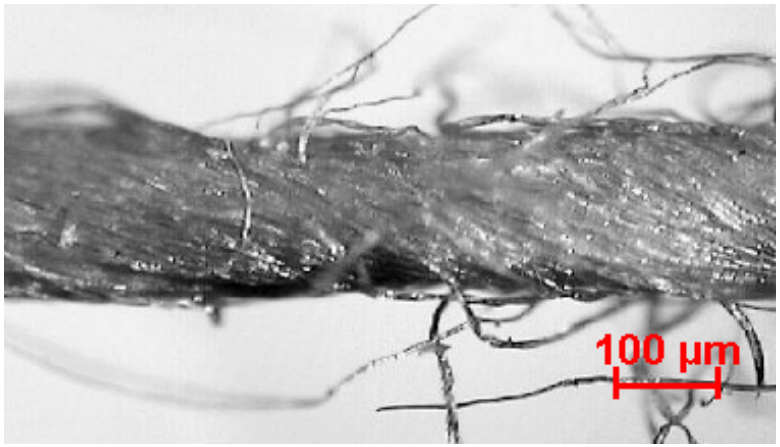
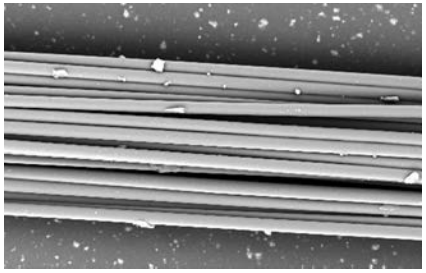
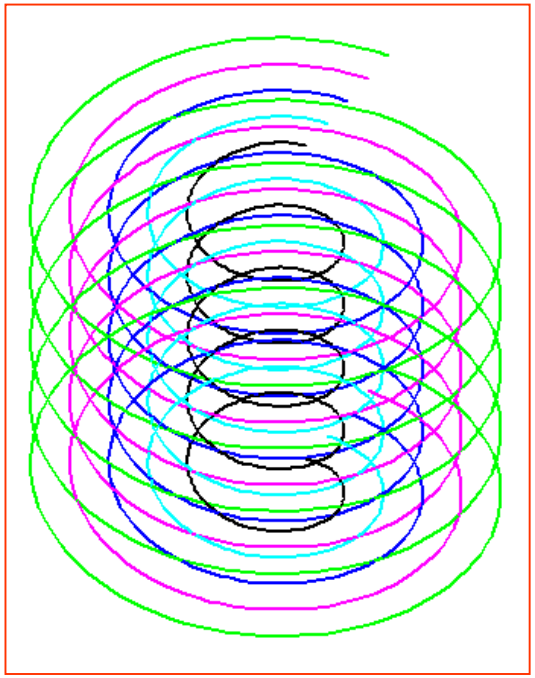






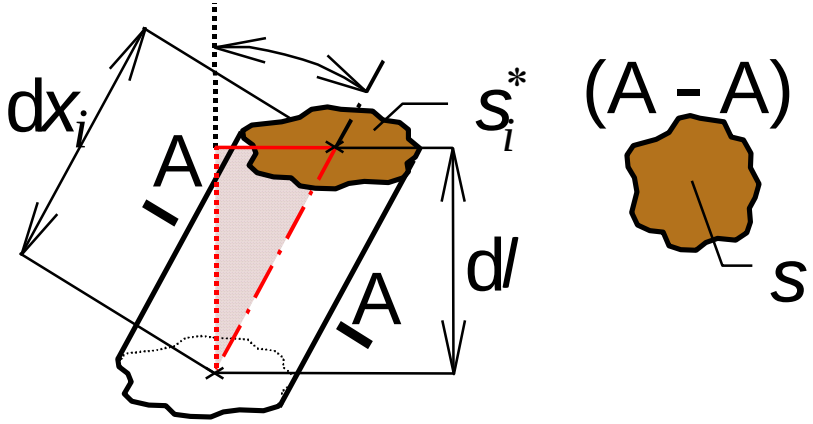
Multifilament yarn

Ring Spun Yarn



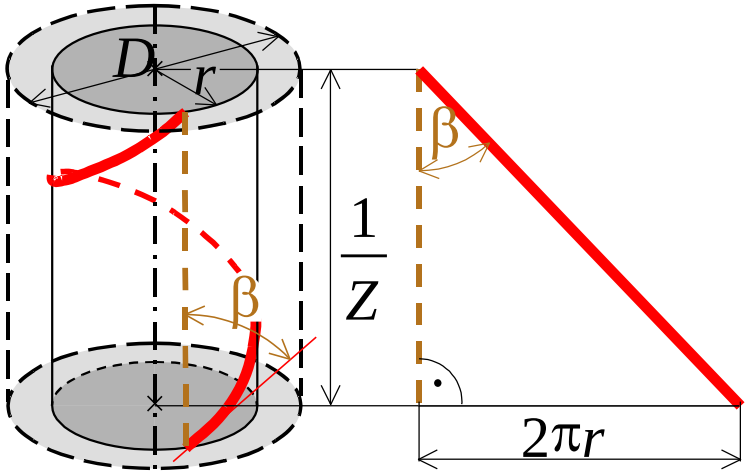
Rotor Spun Yarn

Helical model – basic relations



$$s^* = \frac{s}{\cos\beta}$$

$$s^* = s\sqrt{1+(2\pi rZ)^2}$$



$$tg\beta = 2\pi rZ$$

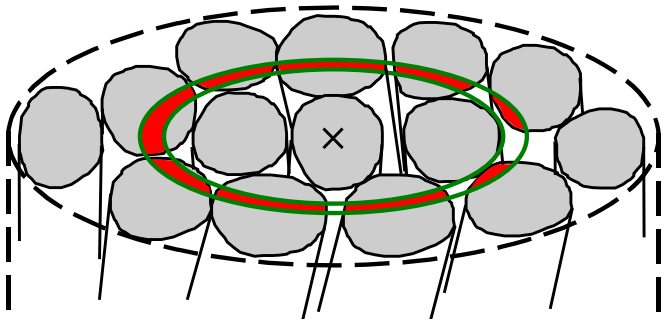
Number of fibers in cross section

$$n = \tau \cdot k_n$$

$$n = \frac{2\tau}{(\pi DZ)^2}\left[\sqrt{1+(\pi DZ)^2} - 1\right]$$

$$k_n = \frac{s}{s^*} \qquad k_n = \frac{2\cos\beta_D}{1+\cos\beta_D}$$

$$k_n = \frac{2}{(\pi DZ)^2}\left[\sqrt{1+(\pi DZ)^2} - 1\right]$$

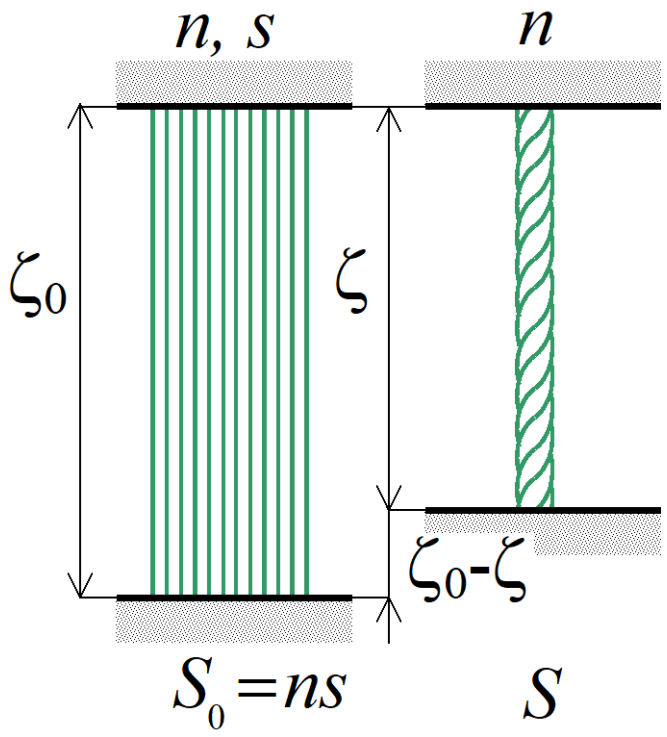


Yarn retraction

$$\delta = 1 - k_n$$

$$\delta = \frac{\sqrt{1+(\pi DZ)^2} - 1}{\sqrt{1+(\pi DZ)^2} + 1}$$

$$\delta = \frac{1-\cos\beta_D}{1+\cos\beta_D} \qquad \delta = \mathrm{tg}^2\frac{\beta_D}{2}$$



Starting yarn count

$$T_0 = T(1-\delta)$$

Latent yarn twist

$$Z_0 = Z(1-\delta)$$

Latent twist coeff.

$$\alpha_0 = \alpha(1-\delta)^{3/2}$$

Task 1

Calculate number of fibers n, coefficient kn and yarn retraction. The parameters are given: T = 29.5 tex, t = 0.16 tex, ρ = 1520 kgm^{-3},D = 0.23 mm, μ = 0.457, Z = 712 m^{-1}.

Task 2

Calculate coefficient kn of cotton carded spun yarn with parameters: T = 35.5 tex, D = 0.26 mm, Z = 635 m^{-1} .

Task 3

Calculate coefficient kn and number of fibers of cotton combed spun yarn with parameters: T = 20 tex, t = 0.15 tex, $\beta_D = 25^\circ$.

Task 4

Calculate number of fibers n. The parameters are given: T = 25 tex, t = 0.17 tex, Z = 792/m, μ=0.47.

Task 5

Let's assume helical assembly of fibers in yarn. Calculate radial progress of angle β . Parameters of yarn and fibers in yarn:

D = 200mm,

Z = 900 m^{-1},

T = 20 tex,

t = 0,16 tex.

What value has slope angle of surface fibers?

Further calculate parameter k_n[-], number of fibers n[-], retraction δ [%], latent twist Z_0[m^{-1}], latent Koechlin's twist coefficient α_0[$m^{-1}ktex^{1/2}$] and fineness of fiber bundle before twisting into the yarn T_0[tex].

β_D

r [μm]	0	10	20	30	40	50	60	70	80	90	100
β [°]	**0**	**3,24**	**6,45**	**9,63**	**12,75**	**15,79**	**18,74**	**21,60**	**24,34**	**27,00**	**29,49**

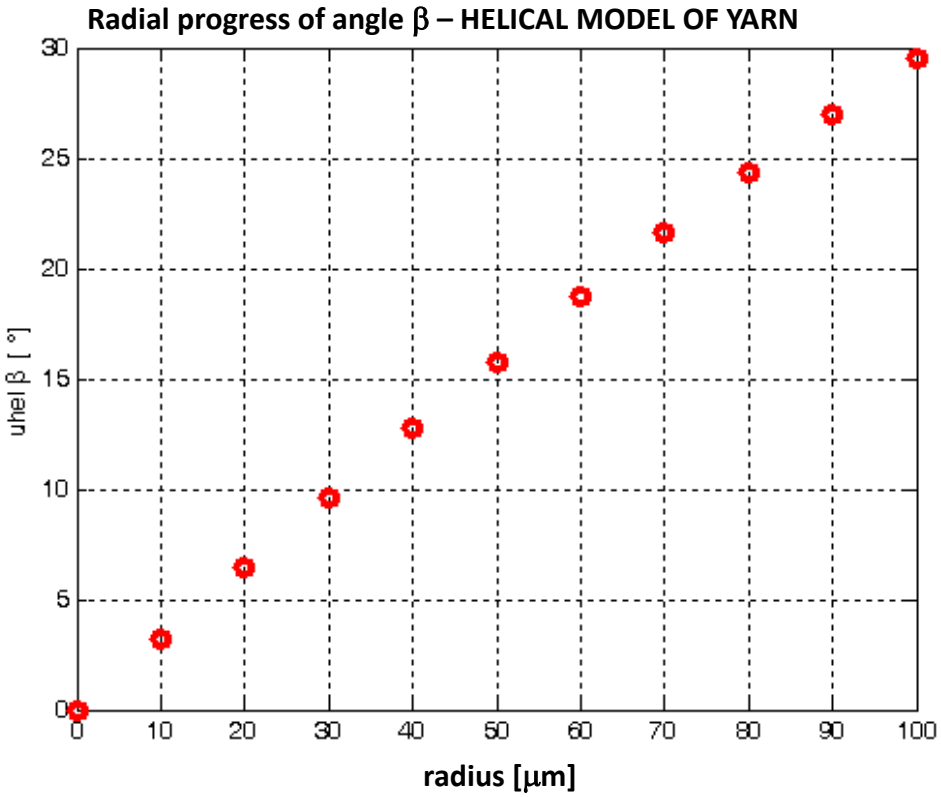
$$n = k_n \tau$$

For helical model:

$$n = \frac{2\tau}{(\pi DZ)^2}\left[\sqrt{1+(\pi DZ)^2} - 1\right] = 116$$

$$k_n = \frac{2}{(\pi DZ)^2}\left[\sqrt{1+(\pi DZ)^2} - 1\right]$$

$$= 0{,}93$$



$$\delta = 1 - k_n = 0{,}07 = 7\%$$

$$T_0 = T\left(1 - \delta\right) = 18{,}6\,\text{tex}$$

$$Z_0 = Z\left(1 - \delta\right) = 837\,\text{m}^{-1}$$

$$\alpha_0 = Z_0\sqrt{T_0} = 114{,}15\,\text{ktex}^{1/2}\text{m}^{-1}$$

For repetition

$$\alpha_0\left[\text{ktex}^{1/2}\text{m}^{-1}\right] = Z_0\left[\text{m}^{-1}\right]\left(T_0\left[\text{tex}\right]\right)^{1/2}10^{-3/2}$$