T1

Draw repeat of given pattern of 100% cotton woven fabric and calculate always for warp, weft and whole woven fabric: crossing factor [-], covering [%], cover factor [$tex^{1/2}mm^{-1}$], areal mass [gm^{-2}] and thickness t [mm]

It is given: Do=278[threads/10cm], Du=278[threads/10cm], do=0.160[mm], du=0.160[mm], hu=0.05[mm], To=16.5[tex], Tu=16.5[tex], so=12[%], su=15.1[%].

Twill $K\frac{1}{3}Z$

$$\kappa_o = \frac{z_o}{n_o n_u} = \frac{8}{16} = 0,5$$

$$\kappa_u = \frac{z_u}{n_o n_u} = \frac{8}{16} = 0,5$$

$$\kappa = \frac{\kappa_o + \kappa_u}{2} = 0,5$$

$$Z_o = D_o d_o = 278 * 0,16 / 100 = 0,44 = 44\%$$

$$Z_u = D_u d_u = 278 * 0,16 / 100 = 0,44 = 44\%$$

$$Z = Z_o + Z_u - Z_o Z_u = 0,44 + 0,44 - 0,44 * 0,44 = 0,69 = 69\%$$

$$Cf_o = D_o\sqrt{T_o} = 278\sqrt{16,5} / 100 = 11,29 mm^{-1} tex^{1/2}$$

$$Cf_u = D_u\sqrt{T_u} = 278\sqrt{16,5} / 100 = 11,29 mm^{-1} tex^{1/2}$$

$$Cf = Cf_o + Cf_u = 11,29 + 11,29 = 22,58 mm^{-1} tex^{1/2}$$

$$G_o = D_o T_o \left(1 + s_o\right) = 278 / 100 * 16,5\left(1 + 12 / 100\right) = 51,4 gm^{-2}$$

$$G_o = D_o T_o \left(1 + s_o\right) = 278 / 100 * 16,5\left(1 + 15 / 100\right) = 52,7 gm^{-2}$$

$$G = G_o + G_u = 104,1 gm^{-2}$$

$$h_o + h_u = \frac{d_o + d_u}{2} \Rightarrow h_o = 0,04 mm$$

$$t = \max\left[2h_o + d_o, 2h_u + d_u\right] = \max\left[0,24; 0,26\right] = 0,26 mm$$

T2

Derive shape factor **q** of ideal fiber with rectangle profile: rectangle with sides equal to **a** and **b.** See the scheme. Calculate shape factor in case **a=4b.**

b

a

$$q = \frac{p}{\pi d} - 1$$

$$s = \frac{\pi d^2}{4} \Rightarrow d = \sqrt{\frac{4s}{\pi}}$$

$$p = 2(a+b)$$

$$s = ab$$

$$d = \sqrt{\frac{4ab}{\pi}} = 2\sqrt{\frac{ab}{\pi}}$$

$$q = \frac{2(a+b)}{2\sqrt{ab\pi}} - 1 = \frac{a+b}{\sqrt{ab\pi}} - 1$$

$$a = 4b$$

$$q = \frac{a+b}{\sqrt{ab\pi}} - 1 = \frac{5b}{\sqrt{4b^2\pi}} - 1 = \frac{5}{2\sqrt{\pi}} - 1 = 0.41047$$

T3

Calculate number of fibers n in cross section of 100% polypropylene yarn. The parameters are given:

T = 45 tex t = 0,19 tex Z = 489 m^{-1} μ = 0,489 ρ = 910 kg/m^3

$$D = \sqrt{\frac{4T}{\pi\mu\rho}} = \sqrt{\frac{4 \cdot 45}{\pi \cdot 0{,}489 \cdot 910}} = 0.356mm$$

$$k_n = \frac{2}{(\pi DZ)^2}\left[\sqrt{1+(\pi DZ)^2} - 1\right] = \frac{2}{\left(\pi \cdot 0.356 \cdot 10^{-3} \cdot 489\right)^2}\left[\sqrt{1+\left(\pi \cdot 0.356 \cdot 10^{-3} \cdot 489\right)^2} - 1\right] = 0.934583$$

$$n = k_n \tau = k_n \cdot \frac{T}{t} = 0.934583\frac{45}{0.19} = 221vl.$$

T4

Calculate relative breaking strength of blended yarn 70POP/30CO, yarn count is 29.5tex, if you know properties of each component:
First component: tenacity = 0.243N/tex, breaking strain = 5.6%
Second component: tenacity = 0.168N/tex, breaking strain = 25%

$$S_2(a_1) = a_1 \frac{p_2}{a_2} = 5{,}6\frac{0{,}168}{25} = 0{,}0376 N/tex$$

$$G_2 = \frac{p_1}{p_1 + p_2 - s_2(a_1)} = \frac{0{,}243}{0{,}168 + 0{,}243 - 0{,}0376} = 0{,}65$$

$$G_1 = 1 - G_2 = 0{,}35$$

$$g_2 = 0{,}3 \Rightarrow p = g_1 p_1 + g_2 s_2(a_1) = 0{,}7 * 0{,}243 + 0{,}3 * 0{,}0376 = 0{,}1814 N/tex$$

T5

For blended yarn **30wool/70PES** calculate mean value of fiber density ρ, mean value of fiber fineness t, if it is given:
t_{vl}=3,5 dtex **t_{PES}=4.8dtex** **ρ_{vl}=1310 kg/m^3** **ρ_{PES}=1360 kg/m^3**

$$\rho = \frac{1}{\sum \frac{g_i}{\rho_i}} = \frac{1}{\frac{0.3}{1310} + \frac{0.7}{1360}} = 1345 kg/m^3$$

$$t = \frac{1}{\sum \frac{g_i}{t_i}} = \frac{1}{\frac{0.3}{0.35} + \frac{0.7}{0.48}} = 0.432 tex$$