MODULE 2: STAPLE-FIBRE BASED PROCESSES

A12: The term intensity of opening is defined by the following expression

$$I_{O[mg]} = \frac{10^6}{60} \frac{P_{[kg \cdot h^{-1}]}}{n_{[min^{-1}]} A_{[cm^2]} \eta_{[cm^{-2}]}}$$

where I_o…intensity of opening of the opener, P…rate of production of the opener, n…angular speed of the opener, A…surface area of the opener, and η...number of spikes or teeth density on the opener.

A13: The volumetric flow rate of air required to flow all fibres can be expressed as follows

$$V_{0[m^3h^{-1}]} = 1.5 \pi l^2_{[mm]} \frac{P_{[kg \cdot h^{-1}]}}{t_{[den]}}$$

where V_0 is the volumetric flow rate of air, l is fibre length, P is the production rate, and t is fibre fineness. The fibre fineness can be expressed as

$$t_{[den]} = \frac{9\pi d^2_{[mm]} \rho_{[kg \cdot m^{-3}]}}{4}$$

where t is fibre fineness, d is fibre diameter, and ρ is fibre density. By substitution, we obtain

$$V_{0[m^3h^{-1}]} = \frac{2}{3}\left(\frac{l_{[mm]}}{d_{[mm]}}\right)^2 \frac{P_{[kg \cdot h^{-1}]}}{\rho_{[kg \cdot m^{-3}]}},$$

where l/d is known as aspect ratio. It is thus clear that higher air flow rate is required to process fibres with higher aspect ratio.

Q14: A carded web of 25 $g.m^{-2}$ basis weight and 2.4 m width is fed to a cross-lapper at a feed rate of 110 $m.min^{-1}$. If the desired basis weight of cross-laid batt is 400 $g.m^{-2}$ and width of cross-laid batt is 3.8 m then what should be the rate of take-off of cross-laid batt?

A14: It is known that

Basis weight of cross-laid batt = Basis weight of carded web × no. of layers

Here, Basis weight of carded web = 25 $g.m^{-2}$; Desired basis weight of cross-laid batt = 400 $g.m^{-2}$; and No. of layers desired = 16

Further it is known that

Production rate of cross-lapper= Rate of feed of card web × width of card web × basis weight of card web

Here, Rate of feed of card web = 110 $m.min^{-1}$ and Width of card web = 2.4 m

Then, Production rate of cross-lapper = (110×2.4×25×60)/1000 $kg.h^{-1}$= 396 $kg.h^{-1}$

As it is known that

No. of layers = (width of card web × rate of feed of card web)/(width of cross-laid batt× rate of take-off of cross-laid batt)

Here, Width of cross-laid batt=3.8 m

Then

Rate of take-off of cross-laid batt= (2.4×110)/(3.8×16) $m.min^{-1}$ =4.34 $m.min^{-1}$