Blown Film Modeling Quiz

Solutions

1.) $$BUR = \frac{\text{blown up circumference}}{\text{die circumference}} = \frac{2(25\,cm)}{2\pi(2.5\,cm)} = 3.2$$

2.) $$DR = \frac{\text{die opening}}{BUR\,(\text{final thickness})} = \frac{200\,\mu m}{3.2(25\,\mu m)} = 2.5$$

3.) Increasing the draw ratio increases the orientation in the machine direction. Increasing the blowup ratio increases the orientation in the transverse direction. To maximize the barrier properties of the film, the film would need to have a random orientation to create a more "torturous path" for the permeating water molecule.

4.) $$Q = \frac{\text{production rate}}{\text{density}} = \frac{14\,kg}{hr} \cdot \frac{cm^3}{0.8g} \cdot \frac{1000g}{kg} \cdot \frac{1\,hr}{60\,sec} = 292\ cm^3/sec$$

$$\frac{H_o}{H} = \frac{200\,\mu m}{25\,mm} = 8$$

From figure 10.3 of Middleman

$B = 0.06 \quad T = 0.7$

$$F_z = \left[T + B(BUR)^2\right]\frac{4Q}{R_o} = \left[0.7 + 0.06(3.2)^2\right]\left[\frac{(3\times10^4 N\cdot s/m^2)\,292\,cm^3/sec}{2.5\,cm} \cdot \frac{1\,m^2}{10{,}000\,cm^2}\right]$$

$F_z = 461$ Newtons

5.) $$\Delta P = \frac{B\,4Q}{\pi R_o^3} = \frac{(0.06)(3\times10^4 N\cdot s/m^2)(292\,cm^3/sec)}{(3.14)(2.5\,cm)^3} = 10{,}712\ Pa$$