$cmHg := 10\ torr$ $\quad Ba := \frac{cm^3 \cdot cm}{cm^2 \cdot s \cdot cmHg}$ $\quad P2 := 1.5\ bar$ $\quad P1 := 20\ bar$ $\quad r := \frac{P2}{P1}$

$V := 10\ \frac{m^3}{s}$ $\quad xFA := 20.9\%$ $\quad yA := 40\%$

$Z := .1 \cdot 10^{-6}\ m$ $\quad PmA := \frac{500\ Ba}{10^{10}}$ $\quad PmB := \frac{250\ Ba}{10^{10}}$ $\quad \alpha AB := \frac{PmA}{PmB}$

Guess Values

$L := 1\ \frac{m^3}{s}$ $\quad F := 1\ \frac{m^3}{s}$ $\quad xA := 1$

Constraints

$F = L + V$ $\quad xFA \cdot F = xA \cdot L + yA \cdot V$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, \mathbf{xA}) = \begin{bmatrix} -36.555\ \frac{m^3}{s} \\ -26.555\ \frac{m^3}{s} \\ 0.261 \end{bmatrix}$$

$$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = 230.612\ m^2 \qquad stageCut := \frac{V}{F} = -0.377$$

Silicone rubber not feasible

$PmA := \frac{24\ Ba}{10^{10}}$ $PmB := \frac{8.1\ Ba}{10^{10}}$ $\alpha AB := \frac{PmA}{PmB}$

Guess Values

$L := 1\ \frac{m^3}{s}$ $F := 100\ \frac{m^3}{s}$ $xA := .5$

Constraints

$F = L + V$ $xFA \cdot F = xA \cdot L + yA \cdot V$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, xA) = \begin{bmatrix} 209.843\ \frac{m^3}{s} \\ 219.843\ \frac{m^3}{s} \\ 0.2 \end{bmatrix}$$

$$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = (6.539 \cdot 10^3)\ m^2$$

$stageCut := \frac{V}{F} = 0.045$

Natural rubber feasible

$PmA := \frac{.034\ Ba}{10^{10}}$ $PmB := \frac{.008\ Ba}{10^{10}}$ $\alpha AB := \frac{PmA}{PmB}$

Guess Values

$L := 1\ \frac{m^3}{s}$ $F := 100\ \frac{m^3}{s}$ $xA := .5$

Constraints

$F = L + V$ $xFA \cdot F = xA \cdot L + yA \cdot V$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, xA) = \begin{bmatrix} 35.65\ \frac{m^3}{s} \\ 45.65\ \frac{m^3}{s} \\ 0.155 \end{bmatrix}$$

$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = (6.253 \cdot 10^6)\ m^2$ $stageCut := \frac{V}{F} = 0.219$

Nylon 66 feasible

$PmA := \frac{160\ Ba}{10^{10}}$ $PmB := \frac{70\ Ba}{10^{10}}$ $\alpha AB := \frac{PmA}{PmB}$

Guess Values

$L := 1\ \frac{m^3}{s}$ $F := 100\ \frac{m^3}{s}$ $xA := .5$

Constraints

$F = L + V$ $xFA \cdot F = xA \cdot L + yA \cdot V$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, xA) = \begin{bmatrix} -63.942\ \frac{m^3}{s} \\ -53.942\ \frac{m^3}{s} \\ 0.239 \end{bmatrix}$$

$$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = 797.875\ m^2$$

$stageCut := \frac{V}{F} = -0.185$

Silicone polycarbonate copolymer not feasible

$$PmA := \frac{11.2\ Ba}{10^{10}} \qquad PmB := \frac{3.29\ Ba}{10^{10}} \qquad \alpha AB := \frac{PmA}{PmB}$$

Guess Values

$$L := 1\ \frac{m^3}{s} \qquad F := 100\ \frac{m^3}{s} \qquad xA := .5$$

Constraints

$$F = L + V \qquad xFA \cdot F = xA \cdot L + yA \cdot V$$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, xA) = \begin{bmatrix} 69.406\ \frac{m^3}{s} \\ 79.406\ \frac{m^3}{s} \\ 0.181 \end{bmatrix}$$

$$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = (1.572 \cdot 10^4)\ m^2 \qquad stageCut := \frac{V}{F} = 0.126$$

ethyl cellulose feasible

$$PmA := \frac{7.47\ Ba}{10^{10}} \qquad PmB := \frac{2.55\ Ba}{10^{10}} \qquad \alpha AB := \frac{PmA}{PmB}$$

Guess Values

$$L := 1\ \frac{m^3}{s} \qquad F := 100\ \frac{m^3}{s} \qquad xA := .5$$

Constraints

$$F = L + V \qquad xFA \cdot F = xA \cdot L + yA \cdot V$$

$$yA = \frac{\alpha AB \cdot (xA - r \cdot yA)}{\alpha AB \cdot (xA - r \cdot yA) + ((1 - xA) - r \cdot (1 - yA))}$$

Solver

$$\begin{bmatrix} L \\ F \\ xA \end{bmatrix} := \text{find}(L, F, xA) = \begin{bmatrix} 254.094\ \frac{m^3}{s} \\ 264.094\ \frac{m^3}{s} \\ 0.201 \end{bmatrix}$$

$$Area := \frac{V \cdot yA}{\frac{PmA}{Z}(P1 \cdot xA - P2 \cdot yA)} = \left(2.082 \cdot 10^4\right)\ m^2 \qquad stageCut := \frac{V}{F} = 0.038$$

Polystyrene feasible