Proracun performansi i geometrije

Ulazni podaci:

Maseni protok goriva:	$mg := 1$
Odnos mesanja oksidator/gorivo:	$OF := 5$
Pritisak u komori:	$P := 100 \cdot 10^5$
Karakteristicna duzina:	$Lkar := 1$
Karakteristicna brzina:	$Cstar := 2000$
Stepen sirenja mlaznika:	$\varepsilon i := 6$
Odnos precnika komore i grla mlaznika:	$dkdkr := 2.5$
Gasna konstanta:	$R := 546$
Odnos specificnih toplota pri konstantnom pritisku i zapremini:	$\kappa := 1.2$
Atmosferski pritisak:	$Pa := 101325$

Proracun

Maseni protok oksidatora:

$mox := OF \cdot mg$ $\quad mox = 5$

Kriticni presek i precnik mlaznika:

$$Akr := \frac{Cstar \cdot (mg + mox)}{P} \qquad Akr = 1.2 \times 10^{-3}$$

$$dkr := \sqrt{Akr \cdot \frac{4}{\pi}} \qquad dkr = 0.039$$

Zapremina komore:

$Vkom := Lkar \cdot Akr$ $\quad Vkom = 1.2 \times 10^{-3}$

Precnik i duzina komore:

$dk := dkdkr \cdot dkr$ $\quad dk = 0.098$

$$lk := \frac{Vkom}{dk^2 \cdot \frac{\pi}{4}} \qquad lk = 0.16$$

Izlazni presek i precnik mlaznika:

$Ai := \varepsilon i \cdot Akr$ $\quad Ai = 7.2 \times 10^{-3}$

$$di := \sqrt{Ai \cdot \frac{4}{\pi}} \qquad di = 0.096$$

Odredjivanje Mahovog broja na izlazu mlaznika:

given

$$Miter := 2.8$$

$$\varepsilon i = \frac{\left(1 + \frac{\kappa - 1}{2} \cdot Miter^2\right)^{\frac{\kappa+1}{2\cdot(\kappa-1)}}}{Miter} \cdot \frac{1}{\left(\frac{\kappa + 1}{2}\right)^{\frac{\kappa+1}{2\cdot(\kappa-1)}}}$$

$$Mi := find(Miter) \qquad Mi = 2.917$$

Staticki pritisak na izlazu iz mlaznika:

$$pi := \frac{P}{\left(1 + \frac{\kappa - 1}{2} \cdot Mi^2\right)^{\frac{\kappa}{\kappa-1}}} \qquad pi = 2.486 \times 10^5$$

Optimalni stepen sirenja mlaznika (do atmosferskog pritiska od 1bar) i njemu odgovarajuci izlazni precnik:

$$Miopt := \sqrt{\left[\left(\frac{P}{Pa}\right)^{\frac{\kappa-1}{\kappa}} - 1\right] \cdot \frac{2}{\kappa - 1}} \qquad Miopt = 3.391$$

$$\varepsilon iopt := \frac{\left(1 + \frac{\kappa - 1}{2} \cdot Miopt^2\right)^{\frac{\kappa+1}{2\cdot(\kappa-1)}}}{Miopt} \cdot \frac{1}{\left(\frac{\kappa + 1}{2}\right)^{\frac{\kappa+1}{2\cdot(\kappa-1)}}} \qquad \varepsilon iopt = 11.753$$

$Aiopt := \varepsilon iopt \cdot Akr$ $\qquad Aiopt = 0.014$

$diopt := \sqrt{Aiopt \cdot \frac{4}{\pi}}$ $\qquad diopt = 0.134$

Totalna temperatura u komori:

$\Gamma(\kappa) := \sqrt{\kappa} \cdot \left(\frac{2}{\kappa + 1}\right)^{\frac{\kappa+1}{2\cdot(\kappa-1)}}$ $\qquad \Gamma(\kappa) = 0.649$

$T := \frac{(Cstar \cdot \Gamma(\kappa))^2}{R}$ $\qquad T = 3.081 \times 10^3$

Brzina isticanja pri zadanom i optimalnom stepenu sirenja:

$Vi := \sqrt{2 \cdot \frac{\kappa}{\kappa - 1} \cdot R \cdot T \cdot \left[1 - \frac{1}{\left(\frac{P}{pi}\right)^{\frac{\kappa-1}{\kappa}}}\right]}$ $\qquad Vi = 3.047 \times 10^3$

$Viopt := \sqrt{2 \cdot \frac{\kappa}{\kappa - 1} \cdot R \cdot T \cdot \left[1 - \frac{1}{\left(\frac{P}{Pa}\right)^{\frac{\kappa-1}{\kappa}}}\right]}$ $\qquad Viopt = 3.286 \times 10^3$

Potisak pri zadanom i optimalnom stepenu sirenja:

$F := (mox + mg) \cdot Vi + Ai \cdot (pi - Pa)$ $\qquad F = 1.934 \times 10^4$

$Fopt := (mox + mg) \cdot Viopt$ $\qquad Fopt = 1.972 \times 10^4$

$\frac{F}{Fopt} = 0.981$

Koeficijent potiska:

$$Cf := \frac{F}{P \cdot Akr} \qquad Cf = 1.612$$

Specificni impuls pri zadanom i optimalnom stepenu sirenja:

$$Isp := \frac{F}{(mox + mg)} \qquad Isp = 3.223 \times 10^{3}$$

$$Ispopt := \frac{Fopt}{(mox + mg)} \qquad Ispopt = 3.286 \times 10^{3}$$