Semana 6

(1)

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$P_{amb} = 101325\ Pa$

$E = 1\ KN$ (sin desprendimiento)

$t_{comb} = 20\ s$

$A_s = 80\ cm^2$

$A_g = 4\ cm^2$

$m_p = 10\ kg$

$\eta = 0{,}7$

$a = 1{,}20e-7$

$\gamma = 1{,}22$

a) E_{vac}

$$E_{vac} = E + \cancel{P_c} \cdot Ag \cdot \underset{\frac{As}{\cancel{Ag}}}{\varepsilon} \cdot \frac{P_{amb}}{\cancel{P_c}} = E + As \cdot P_{amb} = \boxed{1{,}81\ KN}$$

b) Relación de presiones (P_s/P_c)

A partir de la relación de áreas $\rightarrow \varepsilon = \frac{As}{Ag} = f\left(\frac{P_s}{P_c}, \gamma\right)$

- $\Gamma(\gamma) = 0{,}6524$
- $As / Ag = 20$

con el SOLVER de la calculadora resolvemos:

$$\frac{\Gamma(\gamma)}{\left(P_s/P_c\right)^{1/\gamma}\sqrt{\frac{2\gamma}{\gamma-1}\left[1-\left(\frac{P_s}{P_c}\right)^{\frac{\gamma-1}{\gamma}}\right]}} = \varepsilon$$

Obtenemos: $\left(P_s/P_c\right) = \boxed{4{,}74 \times 10^{-3}}$

c) $C_{E,vac}$ y a sea-level

$$C_{E,vac} = \Gamma(\gamma)\sqrt{\frac{2\gamma}{\gamma-1}\left[1-\left(\frac{P_s}{P_c}\right)^{\frac{\gamma-1}{\gamma}}\right]} + \varepsilon\frac{P_s}{P_c} = \boxed{1{,}804}$$

Obtenemos P_c de $C_{E_{vac}} = \frac{E_{vac}}{P_c\ Ag} \rightarrow P_c = \frac{E_{vac}}{C_{E_{vac}} \cdot Ag} = \boxed{2.508{,}3\ KPa}$

Podemos obtener C_E a sea-level de:

$$C_E = \frac{E}{P_c\, A_g} = \frac{1000\ N}{2508314{,}9\ Pa \cdot 4 \frac{1}{100^2} m^2} = \boxed{0{,}997}$$

d) $I_{sp,vac}$

$$I_{sp} = \frac{E_{vac}}{\dot m} = \frac{1{,}81\ kN}{0{,}5\ kg/s} = \boxed{3620\ m/s}$$

donde $\dot m = \frac{M_p}{t_b} = \frac{10\ kg}{20\ s} = 0{,}5\ kg/s$

e) Radio de cámara (R)

$t = 0$

$$\dot r = a P_c^n = 0{,}00362\ m/s$$

$$R = 2 \dot r \cdot t_b = \boxed{0{,}145\ m}$$

Se modifica diseño, ahora
$\left\{ \begin{array}{l} \frac{A_{g2}}{A_{g1}} = 0{,}75 \quad (A_{g2} \to 3\,cm^2) \\ A_s, L, R = \text{iniciales} \\ \text{Mismo propulsante} \end{array} \right.$

f) Nuevo $E_{vac,2}$

1) Nueva $\varepsilon = \frac{A_s}{A_{g2}} = 26{,}66$

2) Nueva $\frac{P_s}{P_c} \longrightarrow \left\{ \begin{array}{l} \Gamma(\gamma) = 0{,}6524 \\ \varepsilon = f\left(\frac{P_s}{P_c}, \gamma\right) \end{array} \right. \Longrightarrow \frac{P_s}{P_c} = 3{,}26 \times 10^{-3}$

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F 3) Nuevo $C_{E,vac}$:

$$C_{E,vac_2} = \Gamma(\gamma)\sqrt{\frac{2\gamma}{\gamma-1}\left[1-\left(\frac{p_s}{p_c}\right)^{\frac{\gamma-1}{\gamma}}\right]} + \varepsilon\frac{p_s}{p_c} = \boxed{1,8304}$$

c 4) HIPÓTESIS : c^* constante

5) $P_c = \left(\rho_P\, a\, c^*\, \frac{A_b}{A_{g_2}}\right)^{\frac{1}{1-n}}$

- $\rho_P = \dfrac{M_P}{\pi R^2 L}$
- $A_b = 2\pi R L$
- $c^* = \dfrac{I_{SP_1}}{C_{E_1}} = 2007,2$ m/s

$$P_c = \left(\frac{2 M_P \cdot a \cdot c^*}{R\, A_{g_2}}\right)^{\frac{1}{1-n}} = \boxed{6521,9 \text{ kPa}}$$

6) $E_{vac_2} = C_{E\,vac,2} \cdot P_{c_2} \cdot A_{g_2} = \boxed{3581,3 \text{ N}}$

9) $t_{b,2}$

$\dot{r} = a P_c^n = 0,00707$ m/s

$$t_b = \frac{R}{2\dot{r}} = \boxed{10,26 \text{ s}}$$