2 Ciclo Diesel Dual. $P_3/P_1 = 70$

$C_{10}H_{21}$ $\phi = 0,7$

$r_{12} = 18$ $T_1 = 290K$

$P_1 = 85.000\ Pa$

(A) Compresión isentrópica.

$T_2 = T_1 \, r_{12}^{\gamma_{12}-1}$ γ_{12}: es del aire (sólo comprime aire).

$\frac{\bar{C}p_{12}}{\bar{C}v_{12}} = \gamma_{12}$ $\bar{C}p_{12} = Cp_{aire}\Big|_{\frac{T_1+T_2}{2}}$

$\bar{C}p_{12} - 8,314472 = \bar{C}v_{12}$

γ_{12}	T_2 (K)	T_m (K)	$\bar{C}p_{12}$ (J/molK)	$\bar{C}v_{12}$ (J/molK)	γ_{12}^*
1,4	921,52	605,8	30,482	22,168	1,375
1,375	857,5	573,7	30,265	21,951	1,379
1,379	866,7	578,4	30,296	21,982	1,378

$\Rightarrow$ $T_2 = 866,7\ K$; $\gamma_{12} = 1,378$

(B) $C_{10}H_{21} + \alpha(O_2 + 3,772\,N_2) \rightarrow \beta CO_2 + \gamma H_2O + \mu N_2 + \nu O_2$

$10 = \beta$

$21 = 2\gamma \Rightarrow \gamma = 10,5$

$2\alpha = 2\beta + \gamma + 2\nu \Rightarrow \nu = 6,54$

$\alpha \cdot 3,772 \cdot \not{2} = \not{2}\mu \Rightarrow \mu = 82,18$

$2\alpha_q = 2\beta + \gamma \Rightarrow \alpha_q = 15,25$

$\alpha = \frac{\alpha_q}{\phi} \Rightarrow \alpha = 21,79$

$$y_{CO_2} = \frac{\beta}{\beta + \gamma + \mu + \nu} \rightarrow \boxed{y_{CO_2} = 0,0916}$$

$$y_{H_2O} = \frac{\gamma}{\beta + \gamma + \mu + \nu} \rightarrow \boxed{y_{H_2O} = 0,0961}$$

$$y_{N_2} = \frac{\mu}{\beta + \gamma + \mu + \nu} \rightarrow \boxed{y_{N_2} = 0,7524}$$

$$y_{O_2} = \frac{\nu}{\beta + \gamma + \mu + \nu} \rightarrow \boxed{y_{O_2} = 0,0599}$$

$$PM_F = 10 \times 12 + 21 \cdot 1 = 141 \ \frac{g\ Fuel}{mol\ Fuel}$$

Gasto de aire: $4,722 \ \frac{mol\ aire}{mol\ O_2} \times \alpha \ mol\ O_2 \ PM_a$

$$PM_a = \frac{2 \times 16 + 2 \times 3,772 \times 14}{4,772} = 28,84 \ \frac{g\ aire}{mol\ aire}$$

$$\frac{m_F}{m_a} = \frac{141 \ g\ Fuel / mol\ Fuel}{\left(4,772 \cdot \alpha \ \frac{mol\ aire}{mol\ Fuel}\right)\left(28,84 \ \frac{g\ aire}{mol\ aire}\right)} = \boxed{0,047 \ \frac{kg\ Fuel}{kg\ aire}}$$

$$\phi = \frac{(m_F/m_a)}{r_q} \rightarrow \boxed{r_q = 0,0672}$$

(c) Combustión adiabática.

$$(m_F + m_a)\,u_4 - m_a u_2 = -P_3 (V_4 - V_3) + m_F h_F$$

$$\rightarrow h_4(T) \approx \frac{1}{1+\phi r_q} \left(u_2 + P_1 \cdot r_p \cdot v_2\right) + \frac{\phi r_q}{1+\phi r_q} Q_p^i$$

$r_p = P_3/P_1$

$Q_p^i = 6.420.897{,}36$ KJ/Kmol$_F$ → Tabla.

$T_2 = 866{,}7$ K → $u_2 = 19.337{,}3$ KJ/KmolAire

$$R_u = \frac{R}{PM_a} = \frac{8{,}314472\ \frac{J}{g \cdot K}}{28{,}84} = 288{,}297\ \frac{J}{Kg \cdot K}$$

$$v_1 = \frac{R_u T_1}{P_1} = 0{,}9836\ \frac{m^3}{Kg\,aire}; \quad v_2 = v_1 \rightarrow v_2 = 0{,}0546\ \frac{m^3}{Kg\,aire}$$

$r_p = P_3/P_1$

$$\rightarrow h_4(T) \approx \frac{1}{1+\phi r_q} \left[19.337{,}3\ \frac{KJ}{KmolAire} \times 4\ \frac{KmolAire}{KmolF} + 85\,kPa \cdot \frac{P_3}{P_1} \cdot 0{,}0546\ m^3 \cdot \frac{1\ Kg\,aire}{Kg\,aire} \cdot \frac{1}{0{,}04\ Kg\,Fuel} \right] \rightarrow KJ/KmolF$$

$$+ \left[14{,}1\ \frac{Kg\,Fuel}{KmolF} \right] \rightarrow PM_F + \frac{\phi r_q}{1+\phi r_q} Q_p^i \quad \frac{1}{\phi r_q}$$

$$\rightarrow h_4(T) \approx 3.139.687\ \frac{KJ}{KmolF} = 3139{,}687\ \frac{KJ}{molF}$$

$$\rightarrow \boxed{T_4 \approx 5340\ K} \rightarrow \text{Tabla } C_{10}H_{21}$$

(D) $\beta = V_4 / V_3$

$\bar{\gamma}_{4,5} = \dfrac{\bar{C}_{p_{4,5}}\big|_{\frac{T_4+T_5}{2}}}{\bar{C}_{v_{4,5}}\big|_{\frac{T_4+T_5}{2}}}$??

$R_b = \dfrac{R}{PM_b} \Rightarrow R_b = 289,257 \ \dfrac{J}{kg\,K}$

$PM_b = PM_{O_2} y_{O_2} + \ldots + PM_{N_2} y_{N_2} = 28,7442 \ g/mol$

$P_4 = P_3 = P_1 \cdot 70$

$v_4 = \dfrac{R_b \cdot T_4}{P_4} \rightarrow v_4 =$

$v_3 = v_2 =$ $m^3/kg\ Fuel$

$\beta =$??

$T_5 = T_4 \cdot \left(\dfrac{\beta}{r_{12}}\right)^{\bar{\gamma}_b - 1}$ (i)

$\bar{C}_{v_{4,5}} = \bar{C}_{p_{4,5}} - 8,314472$ (ii)

$\bar{C}_{p_{4,5}} = y_{CO_2} C_{p_{CO_2}}\big|_{\frac{T_4+T_5}{2}} + \ldots y_{N_2} C_{p_{N_2}}\big|_{\frac{T_4+T_5}{2}}$ (iii)

$\bar{\gamma}_b$	T_5 (K)	T_m (K)	$C_{p_{CO_2}}$	$C_{p_{H_2O}}$	$C_{p_{O_2}}$	$C_{p_{N_2}}$	$\bar{C}_{p_{4,5}}$	$\bar{C}_{v_{4,5}}$	γ_b^*

Proceso 4-5

Análogo al ciclo Otto pero cambia la relación de expansión:

$\varphi(\bar{T})$

$$\bar{\gamma}_b = \frac{R_b}{c_v(\bar{T})} \quad ? \qquad \bar{\gamma}_b = \frac{R_b + c_v(\bar{T})}{c_v(\bar{T})}$$

$$T_4 = T_5 r_e^{\bar{\gamma}_b - 1} = T_5 \left(\frac{V_5}{V_4}\right)^{\bar{\gamma}_b - 1}$$

$$T_5 = T_4 \left(\frac{V_4}{V_5}\right)^{\bar{\gamma}_b - 1} = T_4 \left(\frac{V_3}{V_5}\frac{V_4}{V_3}\right)^{\bar{\gamma}_b - 1}$$

$$\boxed{T_5 = T_4 \left(\frac{\beta}{r}\right)^{\bar{\gamma}_b - 1}}$$

(E) Ecuación:

$$\eta_{AF} = \frac{r_p T_1}{Q_p \phi_{lq}} \left[R_a \left(\frac{\beta}{r} - \frac{1}{r} \right) + \frac{R_a}{1-\gamma_b} \left(\frac{\beta}{r} \right) \left[\left(\frac{\beta}{r} \right)^{\gamma_b - 1} - 1 \right] + \frac{C_{va}}{r_p} \left(1 - r^{\gamma_a - 1} \right) \right]$$