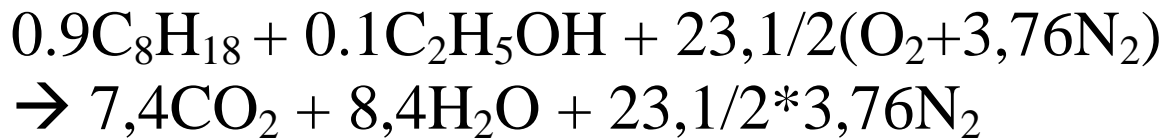


REAKSI CAMPURAN BAHAN BAKAR



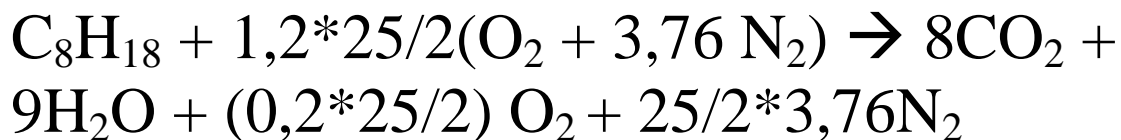
$$A/F =$$

$$23,1/2(32 + 3,76 \times 28) / \{0,9 * (12 * 8 + 1 * 18) + 0,1 \\ (12 * 2 + 1 * 6 + 16)\}$$

$$A/F = 14,79 \text{ Kg udara/Kg bahan bakar}$$

Iso Octan dibakar dengan udara teoritis

120%



$$A/F = 15(32 + 3,76 \times 28) / (12 * 8 + 18) = 18,06$$

Kg udara/Kg bahan bakar

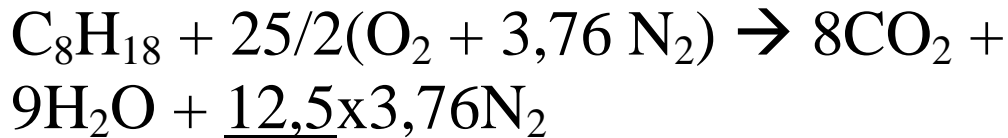
$$\Phi = (F/A \text{ act}) / (F/A \text{ stoic}) =$$

$$(1/18,06) / (1/15,05) = 15,05 / 18,06 = 0,833$$

$$\text{udara teoritis} = 100 / 0,833 = 120\%$$

$$\text{udara lebih} = 120 - 100 = 20\%$$

MENGHITUNG KALOR PEMBAKARAN
(HHV, LHV)



HV = ENTHALPI REAKTAN – ENTHALPI PRODUK

HHV TERBENTUK KALAU H₂O BERBENTUK CAIR

LHV TERBENTUK KALAU H₂O BERBENTUK UAP

KALOR PEMBENTUKAN:

C ₈ H ₁₈	: -208,45 KJ/Kg mole
O ₂	: 0
N ₂	: 0
CO ₂	: -393,52 KJ/Kg mole
H ₂ O (UAP)	: -241,83 KJ/Kg mole

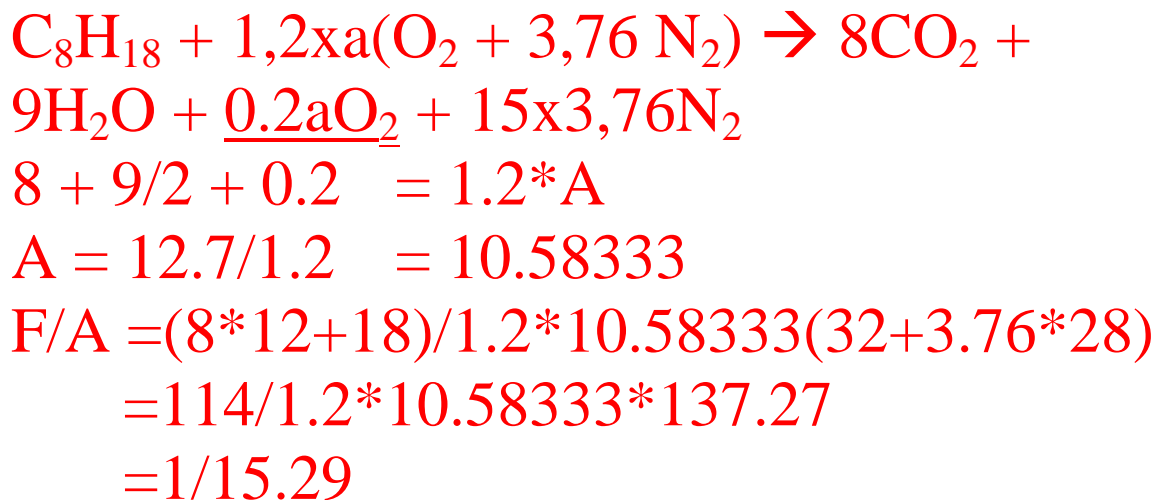
Panas penguapan air : 43,98 KJ/Kg mole
 H₂O (Cair) : -241,83 - 43,98 KJ/Kg mole
 : -285,81 KJ/Kg mole

$$\text{LHV} = \{ -208,45 + 25/2(0 + 3,76*0) \} - \{ 8*-393,52 + 9*-241,83 + 25/2*3,76*0 \}$$

$$\text{LHV} = \dots \text{ KJ/mol}$$

$$\text{HHV} = \{ -208,45 + 25/2(0 + 3,76*0) \} - \{ 8*-393,52 + 9*-285,81 + 25/2*3,76*0 \}$$

$$\text{HHV} = \dots \text{ KJ/mol}$$

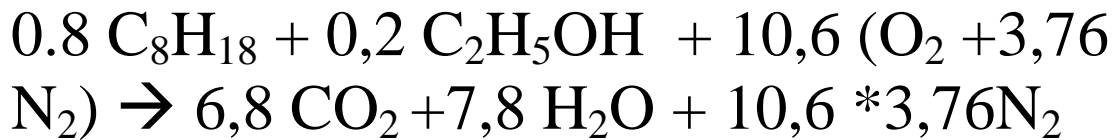


$$\Phi = 15,05/15,29 = 0,98$$

$$\text{Udara teoritis} = 100/0,98 = 102\%$$

$$\text{Excess air koef.} = 102-100 = 2\%$$

HV Gasohol



KALOR PEMBENTUKAN:

C_8H_{18}	: -208,45 KJ/mole
$\text{C}_2\text{H}_5\text{OH}$: -234,81 KJ/mol
O_2	: 0
N_2	: 0
CO_2	: -393,52 KJ/mole
H_2O (UAP)	: -241,83 KJ/mole

Panas penguapan air : 43,98 KJ/mole

H_2O (Cair) : -241,83 - 43,98 KJ/mole
: -285,81 KJ/mole

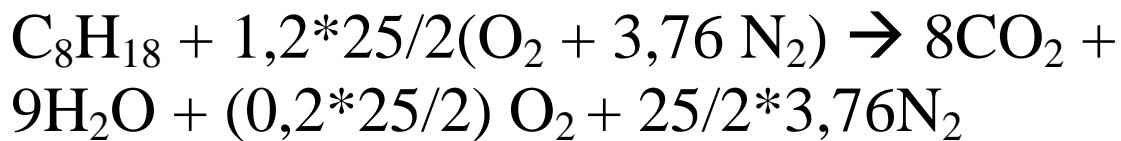
$$\text{LHV} = \{0,8 * (-208,45) + 0,2 * (-234,81) + 10,6 * 0\} - \{6,8 * (-393,52) + 7,8 * (-241,83) + 10,6 * 3,76 * 0\}$$

$$\text{LHV} = \dots \text{ KJ/mol}$$

$$\text{HHV} = \{0,8*(-208,45) + 0,2*(-234,81) + 10,6*0\} - \{6,8*(-393,52) + 7,8*(-285,81) + 10,6*3,76*0\}$$

HHV=... Kj/mol

NILAI KALOR PEMBAKARAN DENGAN UDARA LEBIH/KURANG



$$\text{LHV} = \{ -208,45 + 1,2*25/2(0 + 3,76*0) \} - \{ 8*(-393,52) + (9*-241,83) + 0,2*25/2*0 + 25/2*3,76*0 \}$$

LHV= ... KJ/mol

$$\text{HHV} = \{ -208,45 + 1,2*25/2(0 + 3,76*0) \} - \{ 8*(-393,52) + (9*-285,81) + 0,2*25/2*0 + 25/2*3,76*0 \}$$

HHV =... Kj/mol

TEMPERATUR NYALA ADIABATIK

Adiabatik : sistem terisolasi dari kalor, artinya kalor yang ada di dalam sistem tidak bisa keluar, sedangkan kalor yang ada di luar sistem tidak bisa masuk ke dalam sistem, sehingga tidak terjadi perubahan kalor di dalam sistem.

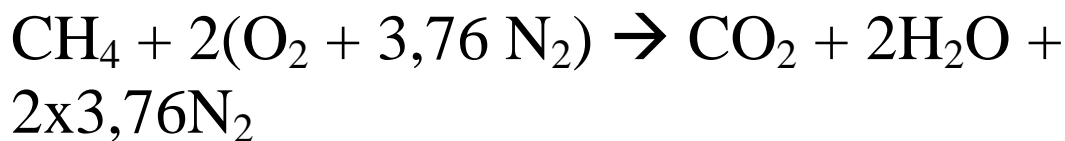
Panas reaktan = panas produk + panas sensibel

Panas sensibel = panas reaktan – panas produk

Panas sensibel = HV

$$\sum n_{pi} \int_{289}^{Tad} Cp_i dT = \sum [n_{Ri} H_{Ri} - n_{pi} H_{pi}]$$

Contoh:



Spesies (i)	C _{pi} [j/mol K]
CH ₄	35,71 – 95
O ₂	29.18 – 37,28
N ₂	29.12 – 35,97
H ₂ O	33,58 – 51.1
CO ₂	37,22 – 60,35

H_f (entalpi) CH₄ = -74,85 Kj/Kmol

$$HV = \{ 1*(12+4)* (-74,85)Kj + 0 \} - \{ 1*(12+32)* (-393,52) + 2*(2+16)*(-241,83) + 0 \} Kj$$

$$HV = \{-16*74,85 + 44*393,52 + 36*241,83\} Kj$$

$$HV = 25075,16 KJ$$

$$[1*(12 + 32)*60,35 + 2*(2 + 16)*51.1 + 2*3,76* 28* 36] Tad = 25075,16$$

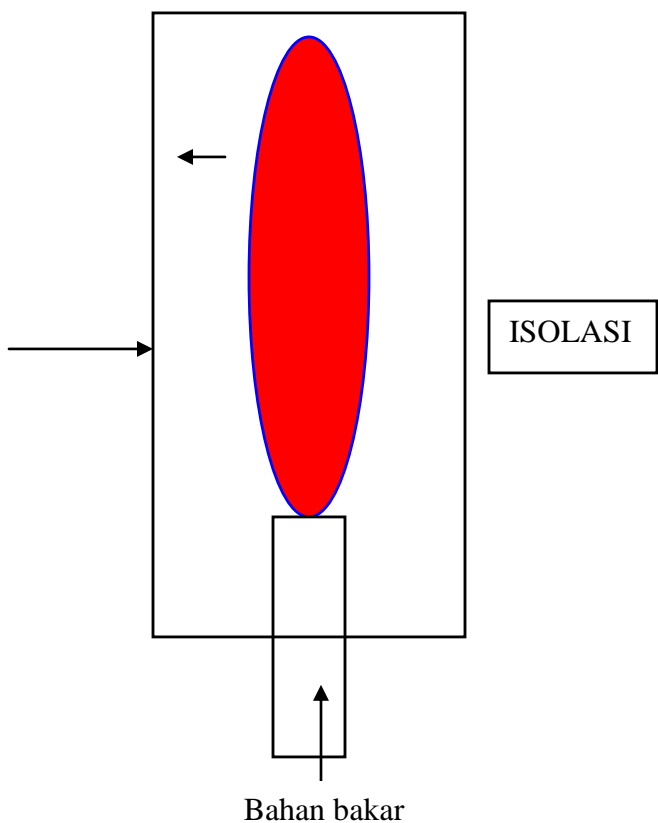
$$Tad = 25075,16 / \{ [44*60,35 + 36*51,1 + 7,56*28*36] / 1000 \} = 2.0697* 1000 K$$

$$Tad = 2070 K$$

Secara matematik temperatur nyala adiabatik dirumuskan:

$$dQ = 0 \rightarrow Q = \text{Constan}$$

Dalam pembakaran?



Dalam pembakaran, semua kalor yang terkandung didalam bahan bakar menjadi kalor produk + kalor sensibel

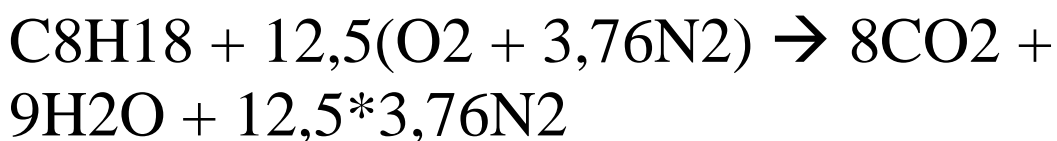
Kalor sensibel = kalor reaktan – kalor produk

Kalor sensibel = HV

$$\sum n_{pi} \int_{300}^{Tad} C_{p_{pi}} dT = \sum [n_{ri} H_{f_{ri}} - n_{pi} H_{f_{pi}}]$$

Contoh: hitung temperatur api adiabatik dari pembakaran gasolin (C₈H₁₈) dengan udara: 300K – 2000K

Spesies (i)	C _{pi} [J/mol K]
O ₂	29.18 – 37,28
N ₂	29.12 – 35,97
H ₂ O	33,58 – 51.1
CO ₂	37,22 – 60,35



$$\text{LHV} = \{1*(12*8 + 18)*(-208,45) + 0\} \text{KJ} -$$

$$\{8*(12 + 32)*(-393,52) + 9*(2 + 16)*$$

$$(-241,83) + 12,5*3,76*0\} \text{KJ}$$

$$\text{LHV} = -114*208,45 + 352*393,52 +$$

$$162*241,83$$

$$\text{LHV} = 153932,2 \text{ KJ}$$

$$\{8*(12 + 32)*60,35 + 9*(2 + 16)*51,1 +$$

$$12,5*3,76*(28)*35,97\} \text{Tad} * 1/1000 [\text{KJ}] =$$

$$153932,2 [\text{KJ}]$$

$$\text{Tad} = 153932,2*1000/\{352*60,35 +$$

$$162*51,1 + 12,5*3,76*28*36\}$$

$$\text{Tad} = 153932,2*1000/(21243,2 + 8278,2 +$$

$$47376)$$

$$\text{Tad} = 153932200/76897,4$$

$$\text{Tad} = 2001,78 \text{ K}$$