

## Chapter 7

# Combustion Processes in Engines

- 7.1) Compare the laminar flame speed  $s_f$  of isooctane, propane, and methanol for  $P = 20$  atm,  $T_u = 600$  K,  $f = 0.05$ , and  $\phi = 0.9, 1.0, 1.1$ , and  $1.2$ . At what equivalence ratios are the laminar flame speeds maximum for these fuels ?

The laminar flame speed correlation (Equation 7.1) is

$$s_f = s_{f,0} \left( \frac{T_u}{T_{u,0}} \right)^a \left( \frac{P}{P_0} \right)^b (1 - 2.1f)$$

The reference flame speed is

$$s_{f,0} = c_1 + c_2 (\phi - \phi_0)^2$$

Where  $c_1, c_2$ , and  $\phi_0$  are from Table 7.1

```
% this program computes laminar flame speed sl(cm/s)
phi = 1.2;
Tu=600;
P=20;
f=0.05;
a= 2.18-0.8*(phi-1);
b=-.016+0.22*(phi-1);
c1=36.92;
c2=-140.51;
phi0=1.11;
sl0=c1+c2*(phi-phi0)^2;
sl=sl0*(Tu/298)^a*(P)^b*(1-2.1*f)
```

For  $T_u = 600$  K,  $f = 0.05$ ,  $P = 20$  atm, the following flame speed table is formed:

$\phi$	isooctane [cm/s]	propane [cm/s]	methanol [cm/s]
0.9	84.8	115.5	119.3
1.0	97.6	130.7	138.1
1.1	104.0	135.3	146.2
1.2	103.6	128.9	143.2

By differentiating Equation 7.1 with respect to  $\phi$  and setting it equal to zero, we find the laminar flame speed is maximized at slightly rich conditions at an equivalence ratio of  $\phi = \phi_0$ .

# Manual On Combustion Engines

**E Durkheim**



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