

Лекция 9

Диффузионное горение газов (продолжение)

Энтальпия

$$u c_p \frac{\partial T}{\partial x} + v c_p \frac{\partial T}{\partial r} = \frac{a c_p}{r} \frac{\partial}{\partial r} \left(r \frac{\partial T}{\partial r} \right) + Q w_A \quad (3)$$

$$u \frac{\partial c_A Q}{\partial x} + v \frac{\partial c_A Q}{\partial r} = \frac{D}{r} \frac{\partial}{\partial r} \left(r \frac{\partial c_A Q}{\partial r} \right) - w_A Q \quad (4)$$

(3)+(4)*Q:

$$u \frac{\partial (c_p T + Q c_A)}{\partial x} + v \frac{\partial (c_p T + Q c_A)}{\partial r} = \frac{a}{r} \frac{\partial}{\partial r} \left(r \frac{\partial (c_p T + Q c_A)}{\partial r} \right)$$

$$H = c_p T + Q c_A$$

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(9)

$$u \frac{\partial H}{\partial x} + v \frac{\partial H}{\partial r} = \frac{a}{r} \frac{\partial}{\partial r} \left(r \frac{\partial H}{\partial r} \right) \quad (10)$$

$$u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial r} = \frac{v}{r} \frac{\partial}{\partial r} \left(r \frac{\partial u}{\partial r} \right) \quad (2)$$

$$u \frac{\partial H}{\partial x} + v \frac{\partial H}{\partial r} = \frac{a}{r} \frac{\partial}{\partial r} \left(r \frac{\partial H}{\partial r} \right) \quad (10)$$

$$u \frac{\partial \tilde{c}}{\partial x} + v \frac{\partial \tilde{c}}{\partial r} = \frac{D}{r} \frac{\partial}{\partial r} \left(r \frac{\partial \tilde{c}}{\partial r} \right) \quad (7)$$

Если $v = D = a$, то уравнения (2), (10), (7) совпадают

Решения уравнений (2), (10), (7) совпадут, если граничные условия будут одинаковыми.

Граничные условия:

$$H = c_p T + Q c_A$$

$$\tilde{c} = c_B - \sigma c_A$$

$$x=0, \quad 0 < r < r_0: \quad u = u_0; \quad T = T_0; \quad c_A = c_{A0}; \quad c_B = 0;$$

$$H = H_0 = c_p T_0 + Q c_{A0}; \quad \tilde{c} = \tilde{c}_0 = -\sigma c_{A0}$$

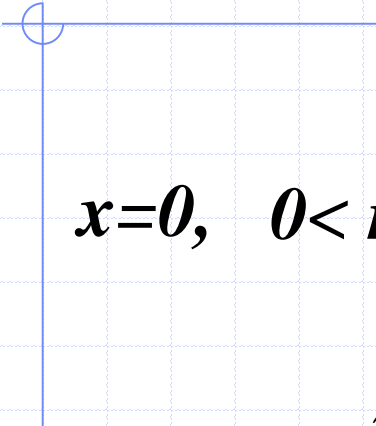
$$x \geq 0, \quad r = 0: \quad \frac{\partial u}{\partial r} = \frac{\partial T}{\partial r} = \frac{\partial c_A}{\partial r} = \frac{\partial c_B}{\partial r} = \frac{\partial H}{\partial r} = \frac{\partial \tilde{c}}{\partial r}$$

$$r \rightarrow \infty: \quad u \rightarrow 0; \quad T \rightarrow T_\infty; \quad c_A \rightarrow 0; \quad c_B \rightarrow c_{B\infty};$$

$$H \rightarrow H_\infty = c_p T_\infty; \quad \tilde{c} \rightarrow \tilde{c}_\infty \rightarrow c_{B\infty}$$

Введем новые переменные:

$$\frac{u}{u_0}, \quad \frac{H - H_\infty}{H_0 - H_\infty}, \quad \frac{\tilde{c} - \tilde{c}_\infty}{\tilde{c}_0 - \tilde{c}_\infty}$$



$x=0, \quad 0 < r < r_0: \quad \frac{u}{u_0} = 1, \quad \frac{H - H_\infty}{H_0 - H_\infty} = 1, \quad \frac{\tilde{c} - \tilde{c}_\infty}{\tilde{c}_0 - \tilde{c}_\infty} = 1$

$x \geq 0, \quad r = 0: \quad \frac{\partial}{\partial r} \left(\frac{u}{u_0} \right) = 0, \quad \frac{\partial}{\partial r} \left(\frac{H - H_\infty}{H_0 - H_\infty} \right) = 0, \quad \frac{\partial}{\partial r} \left(\frac{\tilde{c} - \tilde{c}_\infty}{\tilde{c}_0 - \tilde{c}_\infty} \right) = 0$

$r \rightarrow \infty: \quad \frac{u}{u_0} \rightarrow 0, \quad \frac{H - H_\infty}{H_0 - H_\infty} \rightarrow 0, \quad \frac{\tilde{c} - \tilde{c}_\infty}{\tilde{c}_0 - \tilde{c}_\infty} \rightarrow 0$