Pool Fire: Burning Rate, Flame Length and Heat Released

Burning rate of a liquid pool fire (Burgess), the mean flame length with wind (TNO), and the heat released, from the fuel's heats and boiling point.

Method: TNO Yellow Book; Methods for the Calculation of Physical Effects; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Pool diameter	10.000	m
Heat of combustion	44,600	kJ/kg
Heat of vaporisation at the boiling point	336.00	kJ/kg
Liquid heat capacity	2.2400	kJ/(kg·K)
Boiling point	68.750	°C
Ambient temperature	20.000	°C
Wind speed at 10 m	5.0000	m/s
Air density	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Burning rate per area	0.10018	kg/(m²·s)
Characteristic wind velocity	2.0157	m/s
Scaled wind velocity (at least 1)	2.4805	
Mean flame length	18.525	m
Flame length to diameter	1.8525	
Heat released	350.92	MW

Notes for this case

- Burgess' correlation is for single-component liquids at ambient conditions and not for alcohols; tabulated large-pool burning rates are better where they exist (e.g. gasoline 0.055, hexane 0.074 kg/(m²·s) in TNO Table 6.5). Only part of the heat released is radiated (typically 15–35 %).
- A screening estimate for training and early design, not a hazard or risk study.

Formula and method

$$m'' = \frac{0.001\,\Delta H_c}{\Delta H_v + C_p(T_b - T_a)}, \quad u_c = \left(\frac{g\,m''\,D}{\rho_{air}}\right)^{1/3}, \quad u^* = \max\left(\frac{u_w}{u_c}, 1\right)$$

$$\frac{L}{D} = 55\left(\frac{m''}{\rho_{air}\sqrt{gD}}\right)^{0.67}(u^*)^{-0.21}, \quad \dot{Q} = m''\frac{\pi D^2}{4}\Delta H_c$$

Variables

D	Pool diameter	m
ΔH_c	Heat of combustion	J/kg
ΔH_v	Heat of vaporisation at the boiling point	J/kg
C_p	Liquid heat capacity	J/(kg·K)
T_b	Boiling point	K

T_a	Ambient temperature	K
u_w	Wind speed at 10 m	m/s
ρ_{air}	Air density	kg/m³
m''	Burning rate per area	kg/(m²·s)
u_c	Characteristic wind velocity	m/s
u^*	Scaled wind velocity (at least 1)	-
L	Mean flame length	m
L/D	Flame length to diameter	-
$\dot{Q}$	Heat released	W

Method and standards

TNO Yellow Book pool fire model: Burgess burning rate and the Thomas-type flame length with wind.

Assumptions and limits

- Circular pool; single-component liquid.

References

- TNO Yellow Book
- Methods for the Calculation of Physical Effects
- CPR 14E
- 3rd ed. (2005)
- ch. 6
- §6.5.4
- eqs. 6.12–6.14 and 6.67 (Burgess; Thomas)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/process-safety/pool-fire-burning-rate-flame

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.