Autoignition temperature

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The **autoignition temperature** or **kindling point** of a substance is the lowest temperature at which it spontaneously ignites in normal atmosphere without an external source of ignition, such as a flame or spark. This temperature is required to supply the activation energy needed for combustion. The temperature at which a chemical ignites decreases as the pressure or oxygen concentration increases. It is usually applied to a combustible fuel mixture.

Autoignition temperatures of liquid chemicals are typically measured using a 500-millilitre (18 imp fl oz; 17 US fl oz) flask placed in a temperature-controlled oven in accordance with the procedure described in ASTM E659.[1]

When measured for plastics, autoignition temperature can also be measured under elevated pressure and at 100% oxygen concentration. The resulting value is used as a predictor of viability for high-oxygen service. The main testing standard for this is ASTM G72.[2]

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Autoignition equation

The time t_{ig} it takes for a material to reach its autoignition temperature T_{ig} when exposed to a heat flux q'' is given by the following equation:[3]

$$t_{\text{ig}} = \frac{\pi}{4} k\rho c \left[\frac{T_{\text{ig}} - T_0}{q''}\right]^2,$$

where k = thermal conductivity, ρ = density, and c = specific heat capacity of the material of interest, T_0 is the initial temperature of the material (or the temperature of the bulk material).

Autoignition point of selected substances

Temperatures vary widely in the literature and should only be used as estimates. Factors that may cause variation include partial pressure of oxygen, altitude, humidity, and amount of time required for ignition. Generally the autoignition temperature for hydrocarbon/air mixtures decreases with increasing molecular mass and increasing chain length. The autoignition temperature is also higher for branched-chain hydrocarbons than for straight-chain hydrocarbons.[4]

Substance	Autoignition[5]	Note
Triethylborane	−20 °C (−4 °F)	[6]
Silane	21 °C (70 °F)	[6] or below
White phosphorus	34 °C (93 °F)	[6] on contact with an organic substance, melts otherwise
Carbon disulfide	90 °C (194 °F)	[6]
Diethyl ether	160 °C (320 °F)	[7]
Gasoline (Petrol)	247–280 °C (477–536 °F)	[6]
Ethanol	363 °C (685 °F)	[6]
Diesel or Jet A-1	210 °C (410 °F)	[8] or below
Butane	405 °C (761 °F)	[9]
Paper	218–246 °C (424–475 °F)	[8][10]
Leather / parchment	200–212 °C (392–414 °F)	[8][11]
Magnesium	473 °C (883 °F)	[6]
Hydrogen	536 °C (997 °F)	[12]

For paper, there is considerable variation between sources, mainly because there are many physical variables over different kinds of paper, like thickness, density and composition; in addition, it takes longer for the combustion of paper to start at lower temperatures.[13] Ray Bradbury named his novel *Fahrenheit 451* for the autoignition temperature of paper;[14][15] this value chosen lies in the mid-range of reported values.

See also

- Pyrolysis
- Fire point
- Flash point
- Gas burner (For flame temperatures, combustion heat energy values and ignition temperatures)

References

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External links

- Analysis of Effective Thermal Properties of Thermally Thick Materials (http://www.fire.nist.gov/bfrlpubs/fire03/art015.html).

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