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rate of formation, $v_{n,\mathrm{y}}$ or $v_{c,\mathrm{y}}$

Like the rate of consumption, the rate of formation of a specified product may be defined in two ways:

1. As the time derivative of the amount of a product. Thus for a product Y, present at any time in amount n_{Y}. the rate of its formation may be given by:

$$v(n_{\mathrm{Y}}) = \frac{\mathrm{d}n_{\mathrm{Y}}}{\mathrm{d}t}$$

   This definition is particularly appropriate for open systems.

2. For kinetics in closed systems it is more usual to define a rate of formation per unit volume, denoted $v(c_{\mathrm{Y}})$:

$$v(c_{\mathrm{Y}}) = \frac{1}{V}\frac{\mathrm{d}n_{\mathrm{Y}}}{\mathrm{d}t}$$

   When the volume is constant this reduces to:

$$v(c_{\mathrm{Y}}) = \frac{1}{V}\frac{\mathrm{d}n_{\mathrm{Y}}}{\mathrm{d}t} = \frac{\mathrm{d}[\,\mathrm{Y}\,]}{\mathrm{d}t}$$

   When the volume is not constant the relationship $n_{\mathrm{Y}} = [\,\mathrm{Y}\,]\,V$ may be differentiated to give:

$$\mathrm{d}n_{\mathrm{Y}} = V\,\mathrm{d}[\,\mathrm{Y}\,] + [\,\mathrm{Y}\,]\,\mathrm{d}V$$

   and the rate of formation becomes:

$$v(c_{\mathrm{Y}}) = \frac{\mathrm{d}[\,\mathrm{Y}\,]}{\mathrm{d}t} + \frac{[\,\mathrm{Y}\,]}{V}\frac{\mathrm{d}V}{\mathrm{d}t}$$

   A rate of formation may be specified even for a reaction of time dependent stoichiometry or of unknown stoichiometry.

Source:

PAC, 1996, *68*, 149 *(A glossary of terms used in chemical kinetics, including reaction dynamics (IUPAC Recommendations 1996))* on page 181

