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2. Two or More Combustibles

The calculation of the limits of flammability of combustible mixtures from a knowledge of the limits of each combustible and the percentage of each combustible present in the mixture can be done rather accurately for a number of mixtures by applying the so-called "mixture law."

Le Chatelier[25] first applied the law to the limits of flammability of gases. The law states that if we separate limit combustible-air mixtures and mix them, then this mixture will also be a limit mixture. The equation for expressing this law in its simplest useful form is written as follows:

$$L = \frac{100}{\frac{P_1}{N_1} + \frac{P_2}{N_2} + \frac{P_3}{N_3} + \frac{P_4}{N_4}}$$

When P_1, P_2, P_3, and P_4 are the proportions of the various combustible gases present in the mixture, free of air and inerts (so that $P_1 + P_2 + P_3 + P_4 = 100$), and N_1, N_2, N_3, and N_4 are the respective lower, or upper, limits of flammability of the combustibles in air, then L is the lower, or upper, limit of flammability of the mixture.

As an example of the application of the method we may take a natural gas of the following composition:

Hydrocarbon	Per cent by volume	Limits of flammability (per cent by volume)	
		Lower	Upper
Methane	80.0	5.00	15.00
Ethane	15.0	3.10	12.45
Propane	4.0	2.10	9.50
Butane	1.0	1.86	8.41

$$\text{Lower limit} = \frac{100}{\frac{80.0}{5.00} + \frac{15.0}{3.10} + \frac{4.0}{2.10} + \frac{1.0}{1.86}} = 4.30$$

$$\text{Upper limit} = \frac{100}{\frac{80.0}{15.00} + \frac{15.0}{12.45} + \frac{4.0}{9.50} + \frac{1.0}{8.41}} = 14.13$$

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