INVESTIGATIONS ON DIFFUSION OF NANO-ADDITIVE VOLATILE LIQUIDS: PETROL AND METHANOL

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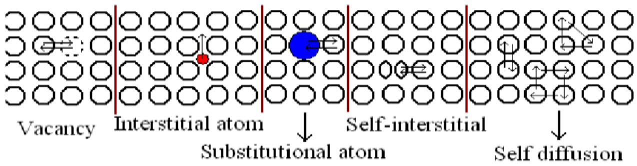
Abstract – Now a days we use conventional source of energy. These source of energy are limited. Depletion of conventional energy resources due to increasing demand of energy sources require environmental concern. It is the driving force to search the ways for saving the fuel and development of the alternative fuels. It may be done by increased the efficiency of the engine or by reducing the consumption and wasting of fuel by fuel saving. With the objective of minimizing the fuel loss due to its volatile nature for fuels like petrol, methanol etc. present review has been undertaken. In the present work diffusion coefficient of the different volatile liquids have been calculated initially. After calculating the diffusion coefficient we choose a alternative method to reduce its diffusivity.

***Key Words*: Diffusion coefficient, diffusivity, petrol, methanol, aluminum nitrate, urea, calorific value.**

1 . INTRODUCTION

World population are increasing day by day and due to increasing population and changing lifestyle energy demand is propagating and increasing continuously. Most of the energy resources used today is oil, coal, and natural gas ,and wood to full fill the world energy demand. In the present works on diffusion coefficient of the different volatile liquids has been reviewed. Diffusion is the process of mass flow in which atoms change their positions relative to neighbors in a given phase under the influence of thermal and a gradient. The gradient can be a compositional gradient, an electric or magnetic gradient, or stress gradient. Diffusion is the process of movement of an individual component through a mixture due to some physical driving force. It occurs all mass transfer operation in at least one phase or often both the phases. Diffusion mechanism can be defined as From an atomic perceptive, diffusion is a step wise migration of atoms from one lattice position to another. Migration of atoms in metals/alloys can occur in many ways, and thus corresponding diffusion mechanism is defined.



1.1 Types of diffusion

Diffusion can be two types, molecular and eddy depending on the phase conditions. The transfer through stagnant layers is known as "molecular diffusion" this type of diffusion in slow in process.

Diffusion is a mass transfer phenomenon its causes the distribution of a chemical species to become more uniform in space as time goes passes. The mass transfer of a species depends upon the evolution of its concentration in space and time. If the concentration of a species is initially is ununiformed then, over time, diffusion causes a mass transfer process in favor of a more uniform concentration. The driving force for the diffusion is the thermal motion of molecules and the density of the molecules and medium . At temperature above absolute zero that is above the 0 kelvin, molecules never at rest. Their kinetic energy means that why they are continually in motion, and when molecules collides with each other frequently and randomly, the direction of the motion becomes randomized. In most cases, these collisions are common process ; even in air at atmosphere at atmospheric pressure the molecule of air are collides with each other, which hardly seems a "dense" fluid, each molecule collides with a neighbor every few microseconds or nanoseconds. When molecules are moving and also constantly changing direction, diffusion can occurs because of the statistics of this movement,

1.1 .1 Molecular diffusion

Molecular diffusion, often simply called a diffusion, in the thermal motion of all (liquid or gas) particles at temperature above absolute zero. The rate of molecular diffusion movement is a function of temperature, size of the particles and viscosity of the fluid . This diffusion explains the net flux of molecules from a region of higher concentration to one of lower concentration. The phenomenon of the molecular diffusion in gases is encountered under two situations,

(1) separation process
(2) chemical reaction (diffusion controlled).

Depends upon the situation Transport of material in stagnant fluid or across streamlines of a fluid in a laminar flow and turbulent flow occurs by molecular diffusion. Two adjacent layer are separated by a partition, containing pure gases A or B may be considered . Random movement of all type of molecules occurs so that after a period molecules are found remote from their original positions.. Before this point in time ,a gradual variation in the concentration of A occurs along an axis, expressed x, which joins the original compartments. This variation, expressed mathematically as

$$-dC_A/dx,$$

where CA is the concentration of A. The negative sign arises because the concentration of A decreases as the distance x increases. Similarly, the variation in the concentration of gas B is

$$-dC_B/dx.$$

The rate of diffusion of A, NA, depends on the average velocity and concentration gradient with which the molecules of A moves in the direction of X. This relationship is expressed by Fick's Law of diffusion

$$NA = - dCA/dx$$

Where, D is the Diffusivity of A through B, proportional to the average (squared?) molecular velocity and, therefore its dependent on the pressure and temperature of gases. The rate of Diffusion NA, is usually expressed as the number of moles diffused across the unit area in unit time. It is similar to the basic equation of heat transfer .This indicates that the rate of force is directly proportional to the concentration gradient.

1.2 Eddy diffusion

Eddy diffusion, eddy dispersion, multipath, or turbulent diffusion is any diffusion process by which the substances are mixed in the atmosphere or in any fluid and other medium due to its nature of eddy motion. In another definition it is mixing that is caused by eddies that can vary in size from the small Kolmogorov micro scales to subtropical gyres.

1.3 Laws of diffusion

Fick's First Law (Steady state of Diffusion):

Its relates the diffusive flux to the concentration under the assumption of steady state . It postulates that the flux goes from regions of high concentration to regions of low concentration, with a magnitude that is proportional to the concentration gradient (spatial derivative), or in simplistic terms the concept that a solute will move from a region of high concentration to a region of low concentration across a concentration gradient. In one (spatial) dimension, the law is

$$J = -D\frac{dc}{dx}$$

Where, J is the differential flux or the mass transported per unit time per unit area and dc/dx is the concentration gradient D is known as the diffusion coefficient.
The mechanism involves migration and transfer of atoms from one interstitial site to a neighboring empty interstitial site.or one layer to the other adjacent layer And this mechanism is more prevalent for impurity atoms such as hydrogen, carbon, nitrogen, oxygen which are small enough to fit in to an interstitial position for substitution diffusion atoms exchange their places directly or along a ring. And it is called as ring diffusion mechanism. 1.7 Diffusivity: In case of molecular diffusion, since the mass transfer occurs from a region of high concentration to one of lower concentration, the flux is proportional to the concentration gradient.

$$J_a \propto \frac{\partial c_a}{\partial z} \text{ or } J_a = -Dab\frac{\partial c_a}{\partial z}$$

Where J_a is the molar flux of component a. And Dab is the proportionality constant, called the molecular diffusivity or diffusion coefficient of molecule a in b. Diffusivity is defined as the ratio of flux to its concentration gradient and its unit is $m2/s$.

Ficks second law

Fick's second law predicts how diffusion causes the concentration to change with time. It is a partial differential equation which in one dimension reads:

$$\frac{\partial \varphi}{\partial t} = D\frac{\partial^2 \varphi}{\partial x^2}$$

whereφ is the concentration in dimensions of [(amount of substance) length^{-3}], example mol/m^3; $\varphi = \varphi(x,t)$ is a function that depends on location x and time tt is time [s],D is the diffusion coefficient in dimensions of [length^2 time^{-1}], example m^2/s

1.4 Diffusivity

The diffusivity is generally prescribed for a given pair of species and parawise for a multi-species system. The higher the diffusivity (of one substance with respect to another), the faster they diffuse into each other.

1.5 Methods of measurement of diffusion coeffient

(1) Twin bulb method
(2) Stefan tube method

Table 1-Properties of different fuel

Fuel	Chemical formula	Molecular weight	Density Kg/m^3
Petrol	C_8H_{18}	114	755
diesel	$C_{12}H_{23}$	167	820-950
methanol		32.04	792

1.6 Nano particle

Nanoparticles are particles between 1 and 100 Nano-meters (nm) in size. with a surrounding interfacial layer. The interfacial layer is an integral part of Nano scale matter, fundamentally affecting all of its properties. The interfacial layer typically consists of ions, inorganic and organic molecules. Organic molecules coating inorganic nanoparticles are known as stabilizers, capping and surface ligands, or passivation agents. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Particles are further classified according to diameter.

Table 2-Properties of some chemical utilised in blending

Property	Aluminum nitrate	Urea
Formula	$Al(NO_3)_3$	CH_4N_2O
Molar mass	212.996 gm/mole	60.06 gm/mole
Melting point	72.8^{0}C	133^{0}C
Density	1.72gm/cm^3	1.32gm/cm^3

2. Literature survey

T. Graham [1], Discussed about the liquid diffusion applied to analysis. The property of volatility of volatile liuqids, possessed in various degrees and nature by so many substances, affords invaluable modes of separation, as is seen in the ever-recurring processes of evaporation , diffusion and distillation.

J Chromatogr A [2], Discussed about that the determination and different methods of calculating diffusion coefficients by gas chromatography. Gas chromatography, apart from the quantitative and qualitative analysis of gaseous and liquidious mixtures, offer many possibilities for physiochemical measurements method, he was discussed about the most important factor is the determination of diffusion coefficient of gas in liquid ,liqyid in gas ,gas in gas and liquid and solid using the various gas chromatographic techniques and predicting and find out the diffusion coefficients.
Jamnongwong, Marupatch, Loubiere, Karine, Dietrich, Nicolas, Gilles[3], Those are discussed about the study of :

(i) studying the effect on oxygen diffusion coefficients of the parasite in clean water of some other compounds usually encountered in biologicaland chemical media.

Brahm D. Prasher, Yi Hua Ma [4], those are study about the Liquid diffusion effect in micro porous alumina pellets. The effect of the ratio of the molecular solute diameter to the pore diameter and adsorption equilibrium on the liquid phase effective diffusivity for different hydrocarbon solutes was studied in two alumina pellets. Shows that the correlation of the effective diffusivity is strongly influenced by both the adsorption coefficient as well as the ratio of the solute molecular size to the average pore size.

3. CONCLUSIONS

After checking a diffusion coefficient of volatile liquid like petrol, methanol etc we think about some Nano additive mixed in liquid for future work and its effect on diffusivity.

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