DIOPHANTINE CONDITIONS ON SUBSTANCE RESPONSES

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ABSTRACT
This paper shows the use of the direct diophantine conditions in adjusting the valency number of the compound conditions. Likewise a few substance conditions and its decent structures are likewise introduced.

KEYWORDS: linear diophantine equations, chemical equations, Applications,

INTRODUCTION

At the point when particles gain or lose electrons to yield particles, or breaker with elective iotas to make atoms, their images are changed or joined to get synthetic equations that fittingly address a few animal varieties. Stretching out this imagery to address each the characters and furthermore the overall amounts of substances going through a synthetic (or physical) change includes composing and compromise of a compound condition. Considering a physicist a least complex and most by and large involved technique for adjusting synthetic conditions is by review or adjusting them utilizing sub-atomic weight. With regards to a mathematician, it is done really by regarding it as conditions and settle utilizing different strategies. Here the synthetic conditions are adjusted utilizing diophantine conditions. Settling Diophantine condition is intently attached to standard math and number hypothesis. A Diophantine equation within the kind $ax+by=c$ is a linear diophantine equations in 2 variables. If 2 comparatively prime integers a and b written during this kind with c = 1, the equation can associate infinite range of olutions. Additionally there'll forever be associated infinite range of solutions if $\gcd(a,b)=1$, and there are not any solutions to the equation if $\gcd(a,b)\nmid c$.

In this paper various chemical reactions are considered and treated as linear diophantine equation and are balanced consequently.

Method of analysis:

Consider the chemical reaction of the form,

$$pu_{p'}v_{q'}w_{r'} + qu_{p''}v_{q''}w_{r''} + ru_{p'''}v_{q'''}w_{r'''} + \ldots = Pu_{P'}v_{Q'}w_{R'} + Qu_{P''}v_{Q''}w_{R''} + Ru_{P'''}v_{Q'''}w_{R'''} + \ldots \quad (1)$$

(1) leads to,

$$\begin{aligned} pp'+qp''+rp''' + \ldots &= PP'+QP''+RP'''+\ldots \\ pq'+qq''+rq''' + \ldots &= PQ'+QQ''+RQ'''+\ldots \quad (2) \\ pr'+qr''+rr''' + \ldots &= PR'+QR''+RR'''+\ldots \end{aligned}$$

where u, v and w, were the elements within the reaction, are positive integers or zero, and $p',q,',r',...P',Q',R',....$ indicates the unknown coefficients of the reactants and product. Equation (2) is an elementary Diophantine equation which gives all integer solutions [u, v, w, … U, V, W, …].

Several chemical equations representing the formation of various chemical products and chemical biproducts are considered and the considered equations are balanced treating them as linear diophantine equations. Consider the chemical reaction of the form,

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where u, v and w, were the elements in the reaction, $p', q, ', r', ... P', Q', R', ...$ are non-negative integers and p, q, r, … , P, Q, R, … are the determinable coefficients of the reactants and products.

Equation (2) is an elementary Diophantine equation which gives all integer solutions [u, v, w, … U, V, W, …].

Several chemical equations representing the formation of various chemical products and chemical biproducts are considered and the considered equations are balanced treating them as linear diophantine equations.

1. The following is the process of preparing Ethyl Alcohol from Molasses, which has been a procedure in the Trichy Distilleries and Chemicals Ltd., Trichy.

$$C_6H_{12}O_6 \xrightarrow{\text{zymase}} C_2H_5OH + CO_2$$

Rewriting the above equation gives,

$$pC_6H_{12}O_6 \xrightarrow{\text{zymase}} P\,C_2H_5OH + QCO_2 \tag{3}$$

Here p, P, and Q are the unknowns to be identified to balance the equation.

From (3), the following is obtained.

$$\left.\begin{aligned} &\text{For 'C'}, p = 2P + Q \\ &\text{For 'H'}, 12p = 6P \\ &\text{For 'O'}, 6p = P + 2Q \end{aligned}\right\} \tag{4}$$

(4) gives, 4p-2Q = 0.

This is a linear diophantine equation in two unknowns which in solving gives, [p, Q] = [1, 2].

Hence,

$$C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2C_2H_5OH + 2CO_2$$

2. Wurtz Reaction:

$$CH_3Br + Na \rightarrow C_2H_6 + NaBr$$

$$pCH_3Br + qNa \rightarrow PC_2H_6 + QNaBr \tag{5}$$

Here p, q, P, and Q are the constants to be identified to balance the equation.

From (5) , the following is obtained.

$$\text{For 'C'}, p = 2P$$

$$\text{For 'H'}, 3u = 6P$$

$$\text{For 'Br'}, p = P$$

$$\text{For 'Na'}\ q = Q$$

which reduces to $p = q$.

This is a linear diophantine equation in two unknowns which in solving gives, [p, q] = [2, 2].

Hence,

$$2CH_3Br + 2Na \rightarrow C_2H_6 + 2NaBr$$

3. Kolbe's Reaction:

Sodium acetate added to water and when electrolyzed gives ethane and bi-products.

$$CH_3COONa + H_2O \xrightarrow{\textit{Electrolysis}} C_2H_6 + CO_2 + H_2 + NaOH$$

This equation is rewritten as,

$$pCH_3COONa + qH_2O \xrightarrow{\textit{Electrolysis}} PC_2H_6 + QCO_2 + RH_2 + SNaOH \tag{6}$$

Here p, q, P, Q, R and S are the constants to be identified to balance the equation.

From (6), the following are obtained.

$$\left.\begin{aligned} &\text{For 'C'}, p = 2P + Q \\ &\text{For 'H'}, 3p + 2q = 6P + 2R + S \\ &\text{For 'O'}, 2p + q = 2Q + S \\ &\text{For 'Na'}, p = S \end{aligned}\right\} \quad (7)$$

(7) reduces to, $5p - 5q + 4R = 0$.

This is a linear diophantine equation in three unknowns which in solving gives, [p, q, R] = [2, 6, 5].
Thus [p, q, P, Q, R, S] = [2, 6, 1, 2, 5, 2].
Hence, $2CH_3COONa + 2H_2O \xrightarrow{Electrolysis} C_2H_6 + 2CO_2 + H_2 + 2NaOH$

4. Preparation of water from Methane:

$CH_4 + O_2 \rightarrow CO + H_2 0$

Now this equation is balanced treating this as a linear diophantine equation in three variables.
The considered equation is rewritten as,

$$pCH_4 + qO_2 \rightarrow PCO + QH_2 0 \quad (8)$$

where p, q, P, Q are the constants to be identified to balance the equation.
From (8), the following are obtained.

$$\left.\begin{aligned} &\text{For 'C'}, p = P \\ &\text{For 'H'}, 4p = Q \\ &\text{For 'O'}, 2q = P + Q \end{aligned}\right\} \quad (9)$$

(9) reduces to $3p - 2q = 0$.

This is a linear diophantine equation in two unknowns which in solving gives,
[p, q] = [2, 3].
Thus [p, q, P, Q] = [2, 3, 2, 4].
Hence $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

5. Preparation of Manganese:

$Mno_2 + Al \rightarrow Mn + Al_2O_3$

Rewriting the above equation leads to,

$$pMno_2 + qAl \rightarrow PMn + QAl_2O_3 \quad (10)$$

This on proceeding as in the previous cases reduces to,
2p -3q = 0.
From the above equation the basic solution is obtained as, [p, q] = [3, 2].
Thus [p, q, P, Q] = [3, 2, 3, 2].
Hence, $3Mno_2 + 2Al \rightarrow 3Mn + 2Al_2O_3$

In the same manner as discussed above, the following equations are balanced and are listed in the table given below.

S.No	Unbalanced equation	Balanced equation
1	$Zn + HCl \rightarrow ZnCl_2 + H_2$	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$
2	$CaO + C \rightarrow CaC_2 + CO$	$CaO + 3C \rightarrow CaC_2 + CO$
3	$N_2 + H_2 \rightleftharpoons NH_3$	$N_2 + 3H_2 \rightleftharpoons 2NH_3$

4	$H_2 + I_2 \rightleftharpoons HI$	$H_2 + I_2 \rightleftharpoons 2HI$
5	$Al + Cl_2 \rightarrow AlCl_3$	$2Al + 3Cl_2 \rightarrow 2AlCl_3$
6	$Si + F_2 \rightarrow SiF_4$	$Si + 2F_2 \rightarrow SiF_4$
7	$CaCO_3 + HCl \rightarrow CaCl_2 + H_2O + CO_2$	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
8	$BaCl_2 + Na_2SO_4 \rightarrow BaSO4 + NaCl$	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$
9	$CuO + NH_3 \rightarrow Cu + N_2 + H_2O$	$3CuO + 2NH_3 \rightarrow 3Cu + N_2 + 3H_2O$
10	$HCl + O_2 \rightarrow H_2O + Cl_2$	$4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$

CONCLUSION

There are several applications for diophantine equations. In this paper the linear diophantine equations are used to balance the valency number of chemical equations. One may also try to attempt some other procedures to do the same.

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