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Chemical equation as a string using color periodic table

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ABSTRACT

A chemical reaction is best represented as a chemical equation. Any element and its properties are easy identified using periodic table. A wide variety of products we use everyday are developed with the application of chemical reaction. Products like toothpaste, soap, shampoo, cleaning agents etc., are all the results of chemical reactions. Almost all the things around us are made of some kind of substances. New products are always launched in market, and most of them involve chemical equations. Transfer of data regarding them is a must, and safety of the data send is important for all the industries, due to the heavy competition in today market. In this paper we propose a method of converting a chemical equation as a string using HTML codes and periodic table.

Key words: chemical equation, molecular formula, colors, HTML code, periodic table.

INTRODUCTION

Today chemistry is doing wonders to mankind and evolving into a branch of science which helps survival at luxury with its never ending inventions and researches. In the process of growth of new inventions, derivation of new formulas and chemical equations for synthesis of various materials brings in the need of saving and securing the research and hard work from being stolen, copied or being misused while being transferred. In this paper we propose an idea of encrypting the chemical equation using HTML codes.

Various fields of science have contributed to the development of chemistry. In [1] an analysis on the relativity of water resources utilization in Minqin and economic sustainable development is provided. In [2] a comparison of a series of different DFT methods and higher basis sets than the other ones is done in order to find a more suitable method and basis set in predicting geometry and vibration spectra of Pyrimidine adopting optimal multiple regressions. In [3] a simple method of finding the Wiener index of a tree is developed. In [4] a new genetic code is proposed, which can be used for transfer details about DNA sequences. New methods and techniques are developed, which provides scope for development of chemical sciences.

In this paper we propose a method of representing any chemical equation using periodic table and HTML colors as tool for the same.

Preliminary Note

In this section we provide few discussions used in the encryption of the equation

Periodic Table

The periodic table is a tabular arrangement of the chemical elements, organized on the basis of their atomic number, electron configurations, and recurring chemical properties. Elements are presented in order of increasing atomic number, which is typically listed with the chemical symbol in each box. The standard form of the table consists of a grid of elements laid out in 18 columns and 7 rows, with a double row of elements below that. We use this regular periodic table for our encryption, since elements are best represented using this [5].

Chemical Equation

A chemical equation consists of the chemical formulas of the reactants and the chemical formula of the products . The two are separated by an arrow symbol and each individual substance's chemical formula is separated from others by a plus sign. The stoichiometric coefficients (the numbers in front of the chemical formulas) result from the law of conservation of mass and the law of conservation of charge [6]. We encrypt the regular chemical equation in this paper.

HTML Color Code

Web colors are colors used in designing web pages, and the methods for describing and specifying those colors. Colors may be specified as an RGB triplet or in hexadecimal format. A color is specified according to the intensity of its red, green and blue components, each represented by eight bits. Thus, there are 24 bits used to specify a web color, and 16, 777, 216 colors that may be so specified. A number of the color swatches below are taken from domain-specific naming schemes such as X11 or HTML4 This html code for colors is used for recognition of a particular shade by the computer, this six bit code is used for the proposed method for encryption [7]. We use this six digit color code for the proposed method.

Proposed String for Chemical Equations

Construction of Color Periodic Table

The first step is to create a new periodic table using HTML colors. In the usual periodic table colors are assigned to represent and classify the elements into different groups. We modify this table and assign different colors to distinct cells of the periodic table randomly. Each cell is represented by a color and each color has a specific color code. So each element in the periodic table is now represented by a color code. A sample periodic table with distinct colors assigned to different cells is provided in Table – 1. Table – 2 provides the color codes assigned to the elements in the periodic table based on the colors used in Table – 1. We have used the base table [8] for preparing the same.

Consider the chemical equation of methyl acetate with water

$CH_3COOCH_3 + H_2O \rightarrow CH_3COOH + CH_3OH$

In chemical equations we notice that an element is prefixed with its stoichiometric index and suffixed with values based on the chemical equation. We convert these values into three digit numbers (This can be converted into numbers of any size depending on the values in the equation). In the above equation the stoichiometric index of C in CH_3COOCH_3 is 1 and it is not suffixed. So we suffix and prefix C by 001. In H_2O, H has a stoichiometric index 1 and is suffixed by 2. So we suffix H by 001 and prefix it by 002. We replace the elements by the six digit code from table .This is done for each element in the equation. Now + and → are replaced with P and E respectively in all places they occur. A chemical equation is now converted into sequence that can be represented as a string of size 3 6 3 3 6 3 …….. with P and E whenever required. This can be summarized in the following algorithm.

Chemical Equation Representation Algorithm

Let S: $\mathbf{2H_2 + O_2 \rightarrow 2 H_2O}$ be the chemical equation to be encrypted

Step 1: Convert S into a string of numbers, elements, +, → in the order in which they appear in the equation (If an element is not suffixed or prefixed by a number replace it by 1, so that each element is prefixed and suffixed by numbers) to obtain S1.

S1: 2H2+1O2→2H21O1

Step 2: Replace each number in S1 by three digit code (this can vary as per need) to generate S2
S2: **002**H**002**+**001**O**002**→**002**H**002001**O**001**

Step 3: Replace each element by its six digit string from Table to generate S3
S3: **002 ffa091 002+001919192002→002 ffa091002001919192001**

Step 4: Replace + by P and → by E to get S4.
S4: **002 ffa091 002P001919192002E002 ffa091002001919192001**

Step 5: Send S4 to the receiver.
The procedure is reversed for decryption.

For example suppose the received message is

0067faca8001001919192002 P006ffa09100200191919200 1E0017faca8006001ffa091012001 919192006P006919192002.

Splitting this into a sequence 3, 3, 6, 3, 3... we generate

Table – 1

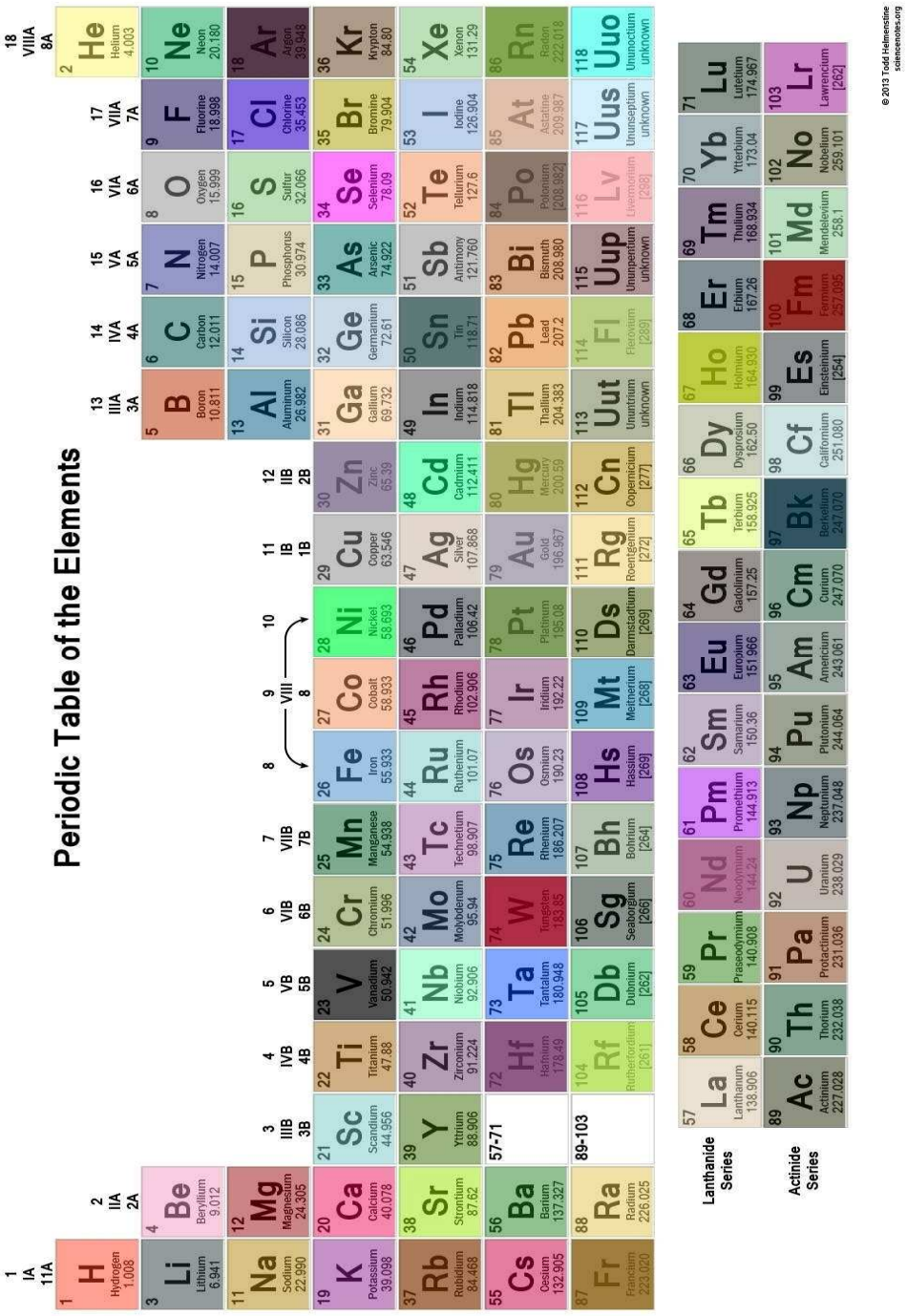
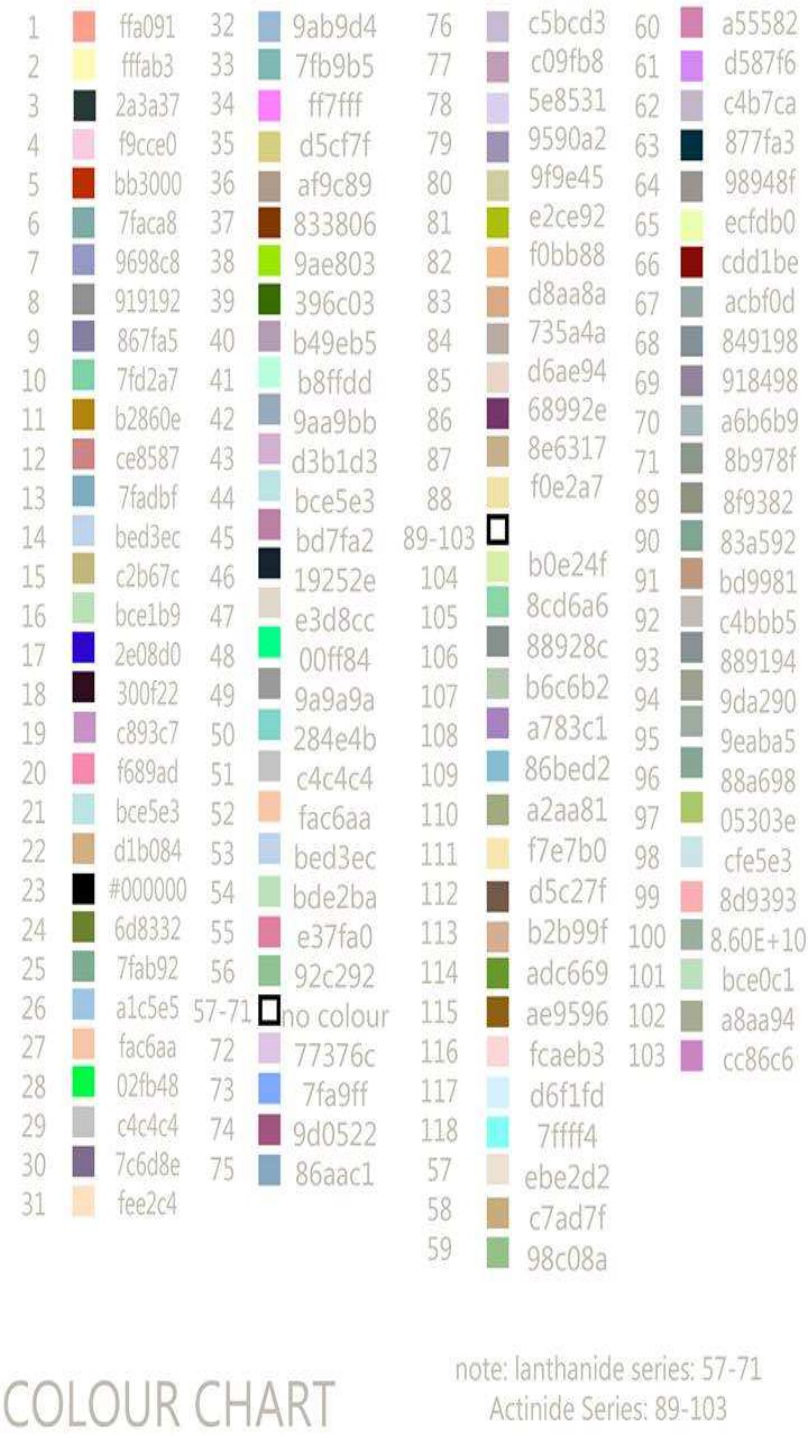


Table – 2



006 7faca8 001 001 919192 002 P 006 ffa091 002 001 919192 001 E 001 7faca8 006 001 ffa091 012 001 919192 006 P 006 919192 002.

From Table – 2 the strings of size 6 represent the following

7faca8: Code for C

ffa091 : Code for H

919192: Code for O

Replacing the three bit strings by their corresponding decimal values we generate the following

6C1O2P6H21O1EP1C61H121O2P6O2

The decrypted message represents photosynthesis [9]

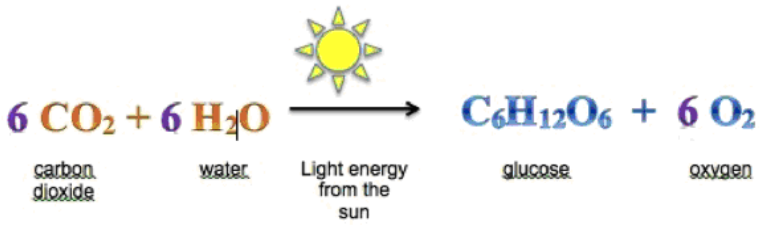


Table – 3 represents few chemical reactions and their encryption codes [10] [11].

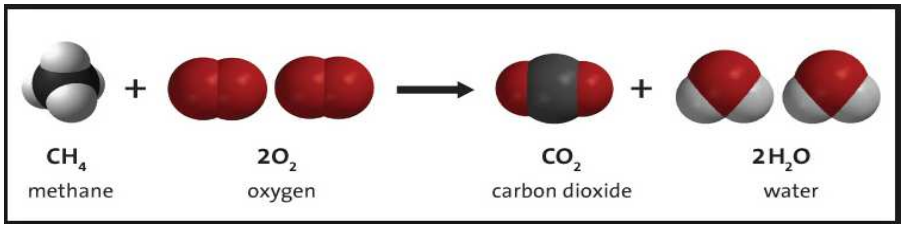
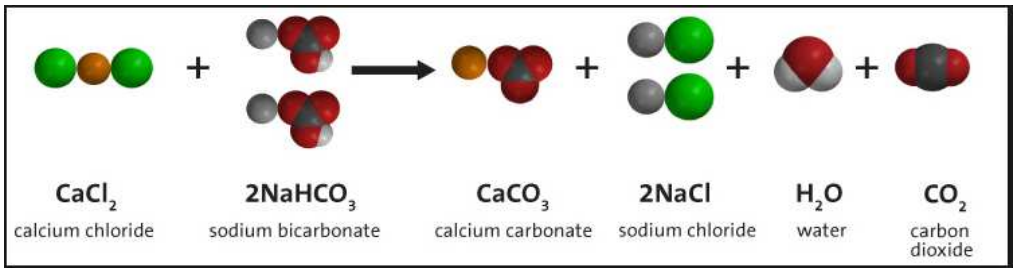
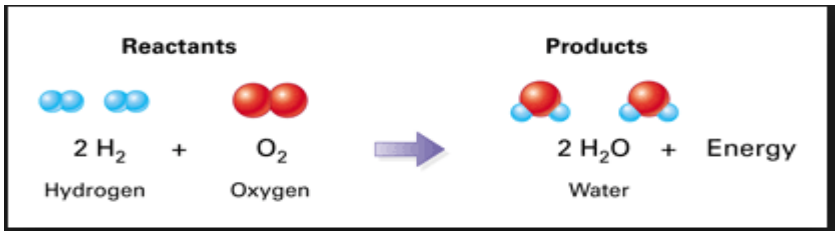
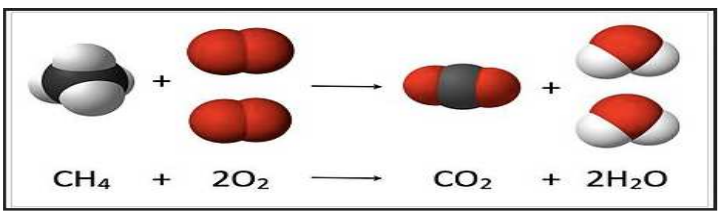
S. No	Chemical Equations and their Encryptions
1	 0017faca8001001ffa091004P002919192002E0017faca8001001919192002P002ffa091002001919192001.
2	 001f698ad0010012e08d0002P002b2860e001001ffa0910010017faca8001001919192003E001f698ad7faca8001001919192003P002b2860e0010012e08d0001P001ffa091002001919192P0017faca8001001919192002.
3	 002ffa091002P001919192002E002ffa091002001919192001.
4	 0017faca8001001ffa091004P002919192002E0017faca8001001919192002P002ffa091002001919192001.

Table – 3

CONCLUSION

In the present scenario chemistry is ever evolving and developing. This proposed method helps in a double encryption which is almost impossible to decode without the key because of the following reasons which helps in safe and secure information transmission.

- The array is complicated and in itself without decoding has no meaning.
- The array fragmentation needs to be done in a specific order. If fragmentation pattern is not followed then the generated array becomes tougher to decode.
- In case of wrong selection the array can be arranged in thousand of possible / desired combinations, which leads the search in a wrong direction, creating time wastage in computation of wrong code, causing misleading by their own trusted systems for example

002ffa091002P001 919192002E002ffa091002001919192001 can be de fragmented in the following wrong combination

- 002f fa091002 P001 9191920 02E002ffa 09100200 1919192001.
- 002f fa0 91002P00 1 919192002E00 2ffa0910 0200191919200 1.
- 002f fa09 1002P 0019 19192 002E0 02ffa09 100200 1919 1920 01…

- The fragmented array in itself is encrypted. As the 6 sized array is a code of the color.
- The guessing of the color becomes difficult because of 16,777,216 color possibilities. With the probability of guess

P (correct_guess) = 1 / 16,777,16

= 5. 9960 X 10^{-9}

- Even at correct guessing the color code with a probability of order -9, the chosen color should again be chosen, as it represents an element out of 118. Once the code is found, for the code as it could be of any of 118 elements. The next code would belong to an element of 117 rest of elements, hence

Permutations of the finding HTML=118 $_{\text{first element}}$ x $117_{\text{second element}}$ x $116_{\text{third element}}$ Codes of elements …$2_{\text{117th element}}$ x $1_{\text{118th element}}$

= 118! = 4.684526e+194

So, with this new way of representation of chemical research can help us in protecting the data using the key, keeps the data secure and safe between the sender and the receiver preventing misuse and piracy of the data.

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