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A Linguistic Study Of Chemical Termenology

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ABSTRACT

The application of linguistics to one of the wings of science is something unusual because science or information is fact based and the other is expression based. Linguistics comprises phonology, phonetics, morphology, syntax, semantics, pragmatics and various other branches of the study of a language. The article begins with the admirable quality of adaptability of English language and its acceptance as lingua franca. The etymology and eponyms facilitate nomenclature in chemistry. The paper discusses how the nuances of a language contribute to understanding chemistry. It includes how the universe, names of the inventors, places of the inventors or developers, the places where the resource materials of chemicals are found and their colours and many other factors play a significant role in nomenclature. Even the ancient myths have their own part in naming things. The linguistic study concludes with the inseparable quality of language and information since language is a means of expression and science is an expression of facts.

Keywords: Linguistic, English, Chemical Term, Communication, Chemical element symbols

1. INTRODUCTION

English language, the lingua franca, is a universal medium of communication and it is widely accepted across the globe since it accepts words or terms from many languages. As the adage goes that the sun never sets in British Empire, it is so with their language. Any new inventions or any new epidemic related terms are named in English and immediately the terms are incorporated in the day to day conversation. The recent global pandemic Covid 19 has educated the common mass with many new terms like hydroxycholoroquine, quarantine, isolation, mask, mask N95/KN 95, vapouriser, oxygen deprivation, black fungus, white fungus, asphyxiation and so on... Whether the terms are familiar or unfamiliar, they soon become often used terms in our day to day conversation. In these days of globalisation, inter cultural communication takes place which makes the borders and boundaries disappear gradually. English is used as the universal scientific language. Drub in says, “It has become inevitable for the scientists to express in English for the concepts to be accepted by the scientists all over the world [1]. Sapir affirms that there is necessity for interaction or intercourse which connects the speakers of one

language into direct contact or indirect contact with another language. The neighbouring languages or culturally dominant languages come into contact. with one another. [2] (205). The etymology of words plays a main role in nomenclature. Normally language and science are viewed as distinct subjects. Science is full of information and it needs a language to express. Language borrowing is prevalent around the world whether it is spontaneous or induced. Words are borrowed as it is in any language and only the English alphabets are used. These are called loanwords by the recipient language.[3] Ling says, "while discussing loan words, borrowing terms cannot be neglected"[4]. Yan and Deng (2009) highlighted that borrowing of words from another language becomes natural in due course of time. It is also natural that one language influences the other.[5] Language borrowing is the natural output of language contact when the people of different countries interact with each other. For example, the population of the United States includes many people from many countries and the culture is known as mosaic culture. The central issue is not the loanword but the retention of its pronunciation. Miao, the linguist analyses this linguistic mechanism that governs the pronunciation of loanwords[6].

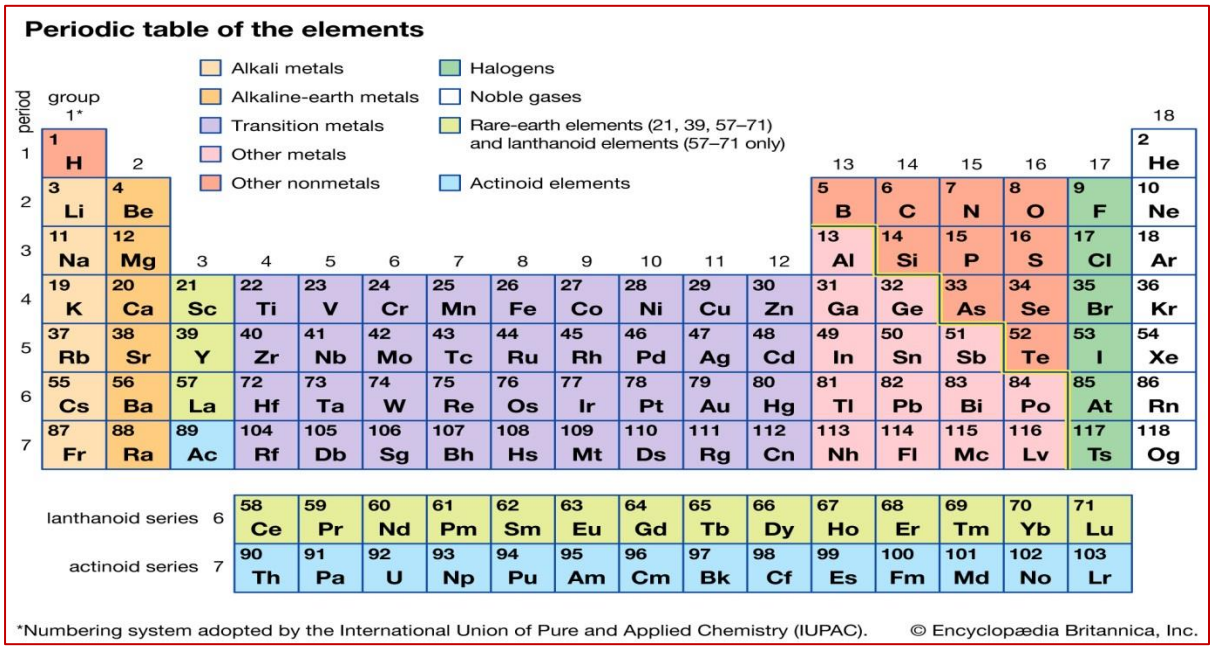

Fig 1: Chemical elements and their symbol representation in Periodic table

Normally, native speakers prefer native language but the language lovers accept the pronunciation and meaning of the borrowed word from any language. Nelson (2013) conducted a survey which displayed astonishing result that many participants preferred borrowed words and their phonological adaptations.[7] Leila Valipouri and Hossein Nassaji analysed thousands of research articles in chemistry with millions of words and explored the frequency of General Service List or Academic Word List in research articles in chemistry and the results indicated a necessity for developing or introducing word list belonging to specific domain.[8] Simon Rees, Vanessa Kind and Douglas Newton investigated the developments in chemical language usage. The results indicated that students struggled incorporating sub-microscopic language while describing and so they used potential chemical inter-language combining common scientific language and its uncommon version interchanging terms.[9] Rudi Firmayanto, Leny Heliyawati

and Bipin Rubini analysed the relationship of English language skills and the students' learning outcomes in chemistry. The students need good language skills to understand the concepts in chemistry[10]. Mammino declared that learning depends on communication effectiveness. Language analysis proves a potential tool to facilitate full identification of the concepts in the text. It also stimulates further reflection on the various features of an information or concept. This paper considered some illustrative examples from teaching and learning community[11]. The above reports analysed the relationship of language proficiency and understanding concepts in chemistry and the need for developing domain specific list. But the present paper explores the relationship of language and nomenclature in chemistry.

2. METHODOLOGY AND DISCUSSION

2.1. NUANCES AND CHEMICAL TERMS:

Nuances in the language should be learnt to understand the chemical processes better. For example, absorption differs from adsorption. Absorption is the physical process in which a substance in one state becomes incorporated into another state. For example, soil or cotton absorbs water. It is also a chemical process. Absorption differs from adsorption in the sense that the first substance penetrates the whole bulk of the second substance, rather than just sticking on to the surface. Adsorption is a surface phenomenon whereas absorption is not a surface phenomenon since it invites the involvement of entire volume of materials. The term, 'adhesion' can be contrasted with 'cohesion'[12]. Cohesion is the clinging of similar particles or surfaces to one another because of intermolecular forces whereas adhesion is the clinging of dissimilar particles or surfaces to one another due to inter molecular forces. Both adhesion and cohesion mean a union. Similarly precision and accuracy seem to be synonymous but there is a minute distinction. Precision and accuracy can be compared to know the difference accurately. Accuracy is perfection. It is actually studying the relationship between the measured value and the actual value and how close they are to each other. Precision is the nearness of the results of umpteen experimental trials or observations. It is actually studying how close they are to each other. There is a difference between reaction and response. Response is somewhat positive and reaction is mostly negative in linguistic sense.

2.2. ODDITIES AND LOGIC

There are certain matters of curiosity which need reference and analysis. Once when analysis is made, facts are arrived at. The expansion of pH is potential of Hydrogen. Why sometimes p is written in small and H is written in capital letter is a matter of curiosity. Then comes the clarification which is as follows. In 1909, "pH" was first explained by the biochemist, Lauritz Sorensen from Denmark. The 'power of Hydrogen' is shortened as pH. The small letter "p" stands for potenz which is a German word meaning 'power'. 'H' is a chemical symbol for Hydrogen. The word, acyclic has only linear structures of atoms and hence it is not cyclic or round. The words are sensible and sensitive and they cannot be taken for granted even in science.

2.3. ROLE OF EPONYMS IN CHEMISTRY

The study of eponyms is relevant in the linguistic study of chemistry. Many chemical elements and processes are named after their inventors. It is good to refer the tabular display of chemical elements formulated by Mandeleeve.[13] Aristotle proposed that everything is made up of four 'roots' such as air, water, earth and fire. Plato named it elements.[14] How the elements are named is an interesting research.

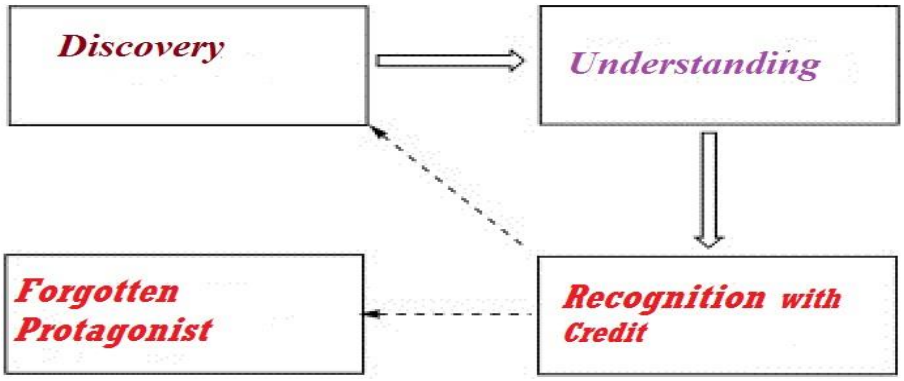

Fig 2: Eponyms in chemical names

An eponym is actually naming things after names of persons. There are about 97 chemical eponyms which are in common use within the scientific literature. Avagadro constant and Avogadro's law are named after Ameodeo Avogadro. Borodin reaction is named after Russian chemist, Alexander Borodin. Boyle's law is called so after its formulator, Robert Boyle, an Irish scientist. In the process of Capitalization, sugar is added to unfermented grapes. The addition of sugar increases the alcohol content after they are fermented. This process is named after its inventor and scientist, Chaptal who is from France. Pateurisation was invented by a French scientist called Louis Pasteur in 19th century. He discovered that heating milk to a high temperature and then quickly cooling it before packaging keeps milk fresh and unspoilt for a longer time. The process makes the milk safer to drink by killing the bacteria in it.

Some chemical reactions are named after their developers. The world of science has witnessed thousands of scientific reactions. Hundreds of such reactions are named after their discoverers or developers. The reaction out of the experiments conducted by Grignard, Sabatier, Wittig and Diels-Alder are named after their names. There are other processes named after their developers such as Claisen condensation and the Friedel Crafts acylation. They can be taken as examples. An Indian scientist and professor from the University of Hyderabad, DB Ramachary, have joined a list of important scientists who have done research work in developing new and novel reactions. Many books contain or explain the name reactions. There is also a chemical encyclopedia with the list of name reactions.

2.4 LANGUAGE BORROWING AND LANGUAGE DEVELOPMENT

There is logic behind giving symbols for chemicals. Language borrowing has been existing since language accepts loan words either because of necessity or because of spontaneity. "Borrowing is actually taking a word or phrase from one language and using it in another

language. If a word is borrowed, it is called loan word"[5] (qtd. in Yan 34). Sometimes single word is not borrowed but a single letter is used to indicate chemical terms. Sodium is marked Na and Potassium is marked K though the spellings do not carry that particular letter. The Greek and Latin root words play a major role in chemicals being symbolised. The chemical symbol Na is derived from the Latin term, natrium which stands for "natron" . "natron" means 'soda' in English. Sodium is the output of electrolysis of caustic soda, NaOH. It was discovered by the English chemist Humphry Davy in 1807. "Language borrowing is inevitable in language development. It is a linguistic occurrence rising out of necessity almost everywhere and all the time. More and more borrowed words are perpetuated in the native languages and some even take the place of the indigenous language" (Ling 180)[4]. Potassium is a soft metal which is silvery white in colour. It is a member of the alkali group of the periodic table which is marked K. "Potassium" is derived from the English word 'potash'. But the chemical symbol used for potassium is "K" since kalium is the Medieval Latin term for Potash. Kalium may have been derived from qali, an Arabic term meaning alkali. Iron is marked with the symbol 'Fe' since the symbols originate in Latin word Ferrum. Copper has no 'u' in it but it is marked with the symbol 'Cu' because of its origin in Latin or Greek. Since the symbol for silver is derived from Latin argentums, it is marked with Ag. Similarly the symbol for tin is also derived from Latin. The Swedish term, tungsten means a heavy stone. The symbol for tungsten is W. The symbol is derived from the old name of tungsten mineral wolframite. Lithium (Li), a chemical element is named after a stone. The Greek word, lithos means stone. Since language and science are sensible and sensitive matters, there is logic behind nomenclature. The origin of antimony, a lustrous gray metalloid is an interesting study. It has many origins one from Latin, the others from Greek, Arabic and French. The uncertain origin has many folk etymologies behind it. The Greek prefix, anti-meaning 'against' is well known. monos is single or only one. The symbol for antimony, Sb is derived from the Latin term stibium.

Many chemical elements have a great association with the universe. The sun is the centre of the universe. The Greek word for sun is Helios. Helium (He), the chemical element is named after the sun. It is the found in the periodic table in the noble gas group[10]. It was first detected in sunlight and hence it is named so. Palladium (Pd) is derived from the asteroid, Pallas which was considered planet at the time of its discovery. Similarly Cerium (Ce) is derived from the dwarf planet named Ceres which was considered a planet at the time of its discovery. The chemical symbol of Mercury (Hg) is a clipped form of Latin name hydrargyrum.

The origination of the names of chemical elements or metals is associated with a place either where they were found first or where they are found in large quantities or the hometown of their inventors. For example, beryllium, scandium, strontium, yttrium or holmium. Terbium (Tb) is a village in Sweden called ytterby. The atomic number of the chemical element named Terbium is 65. The colour of this element is silvery-white. It belongs to the metal of the lanthanide series which is used in low energy light bulbs and mercury lamps. Holmium (Hb), an earth element is a rarely found one and the word, 'holmium' is derived from the Latin language. The word, Stockholm is the name of a city and the latter half of the word is taken for

naming this earth element. The Stockholm area contains minerals rich in yttria which is an air stable white solid substance. It was also the hometown of Cleve who discovered Holmium and thulium. Erbium (Eb), the chemical element originates in a village in Sweden. It was originally found in the mine in Ytterby which is a village in Sweden from which it gained its name. Copper (Cu) was mined mainly on Cyprus, the large reserves of copper in the Roman era. The word copper is derived from aes cyprium, the metal of Cyprus. The word, copper is deemed to have been derived from old English term coper and the current spelling was first used around 1530. The term, Thulium (Tm) is derived from 'thuli', the ancient name for an unclear northern location. It should not be confused with thallium or thorium and is an element in the lanthanide series. The word for the chemical element, Ytterbium (Yb) derives from the name of a place in Sweden, Ytterby where the element was found. Strontium (Sr) is named after a hamlet in Scotland. Both strontium and strontianite are named after the place, Strontian. It is a village where this mineral was discovered first in 1709. The mineral was first seen by by Adair Crawford and Cuickshank.

2.5. MYTHOLOGY AND CHEMISTRY

The name magnesium is derived from the Greek word which stands for locations related to the tribe of the Magnets. The tribe lived either in a place in Thessaly or Magnesia which is now in Turkey. The invention of magnesium dates back to 1618 when a farmer accidently found out that the water in his village, Epsom, England contained bitterness. Even the animals refused to drink that water due to it different taste. The farmer found out that the water cured rashes and other skin ailments. Its fame spread to other areas and the substance came to be known as Epsom salt. It was finally recognized to be hydrated magnesium sulphate, MgSO4 7H. The ancient Greek mythology plays its role behind nomenclature in chemistry. Titans or titanium comes to our mind quickly the moment Greek mythology is mentioned. Titanium (Ti) was discovered in England at a place called Cornwall. In 1791, it was first found out by William Gregor and the chemical element was named after Titans who appear in the myths of Greece. It was named by Martin Heinrich Klaproth. Titans, the sons of the Earth Goddess of Greek mythology are known for their incredible powers, strength and valour and the chemical element titanium resists corrosion due to salinity and chlorine in sea water. Reasoning takes place behind any nomenclature. Nickel is a white metal silvery in colour. Its glowing lustre is its special feature. It is hard but it has great ductility. This metal has a golden tinge. There are many German miner mythologies available and Nick is one such mischievous spirit of German mythology. Nickel is similar to Old Nick who is the personification of the fact that copper-nickel ores resisted any kind of refinement into copper. Niobion (Nb) also called as Columbium is in light grey colour. It derives its name from Niobe, the daughter of the king Tantalus in Greek mythology. The story of Prometheus is well known among Greek myths. The origin of the chemical element, Promethium (Pm) is the Greek mythology of Prometheus.

2.6 ROLE OF COLOURS IN NAMING TERMS

Even the colours are associated with naming chemical elements. Rubidum (Rb) the chemical element is named after red colour. The Latin rubidus means deep red. In 1861, Two German chemists named Robert Bunsen and Kirchhoff discovered rubidium. They developed a new

technique called flame spectroscopy. The name, 'rubidium' is derived from the colour of its emission spectrum. Since German chemists, Robert Bunsen and Kirchhoff discovered rubidium in 1861 by the newly developed technique called flame spectroscopy and the name comes from the colour of its emission spectrum. Vanadium (V) is a hard silvery metal and is named because of its colourful compounds. Nils Gabriel Sefstrom, the inventor named the metal Vanadium. It is derived from the name of the Scandinavian Goddess of beauty. This Goddess of fertility, Vanadis is an old Norse name. Vanadis is also called Freyja. The term was based on the variety of colours found in Vanadium compounds. Indium (In) is derived from Latin, indicum and it is named after indico colour found in its spectrum. Iodine (I) is derived from the Greek word for violet, ioeides. There are many chemical elements named after colours like Caesium (Cs)-skyblue.

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The subject Chemistry is not like a language as English or Spanish but it is the language of science or it is the language of Chemistry, chemical terms and chemical processes. Both language and science have a system. "Some languages do not have writing systems and all writing systems cannot be termed as language. Chemistry is one of the latter cases" [15] (Gordin web). Like language, a countless or limitless number of chemical formulas and chemical reactions can be constructed from finite components. Avram Noam Chomsky, an American theoretical linguist has made many observations about human language and science. Both are designed in the interests of the human beings and to solve their problems. " It is very difficult to form or achieve a complete theory but in this respect, linguistics is no worse off than any other subject of science like Physics or Chemistry. [16] (McGilvray web). The chemical equation, "$2H_2O \rightarrow 2H_2 + O_2$" can be written in English as two molecules of water change into two diatomic hydrogen molecules added with one diatomic oxygen molecule. Chemical equation simplifies a language and letters of the language simplify the chemical elements. Both should go hand in hand for further development. The less widely used vocabulary and grammatical features can be emphasised to the writer of under-graduation for widening their options of expression both in science and language (Table 1 & Figure 3). A table of specific chemical elements is given below for easy reference:

Table 1: List of some chemical elements and its Language Origin

S. No	Chemical elements	Symbol	language of origin
1	Potassium	K	Kalium, a Medieval Latin term
2	Sodium	Na	Natrium, a Latin term.
3	Copper	Cu	Latin or Greek (Or) old English term, Cyprus metal
4	Silver	Ag	Latin word, Argentums
5	Tungsten	W	Swedish term and old name, Wolframite
6	Mercury	Hg	Latin name, Hydrargyrum
7	Iron	Fe	Latin root, Ferrum

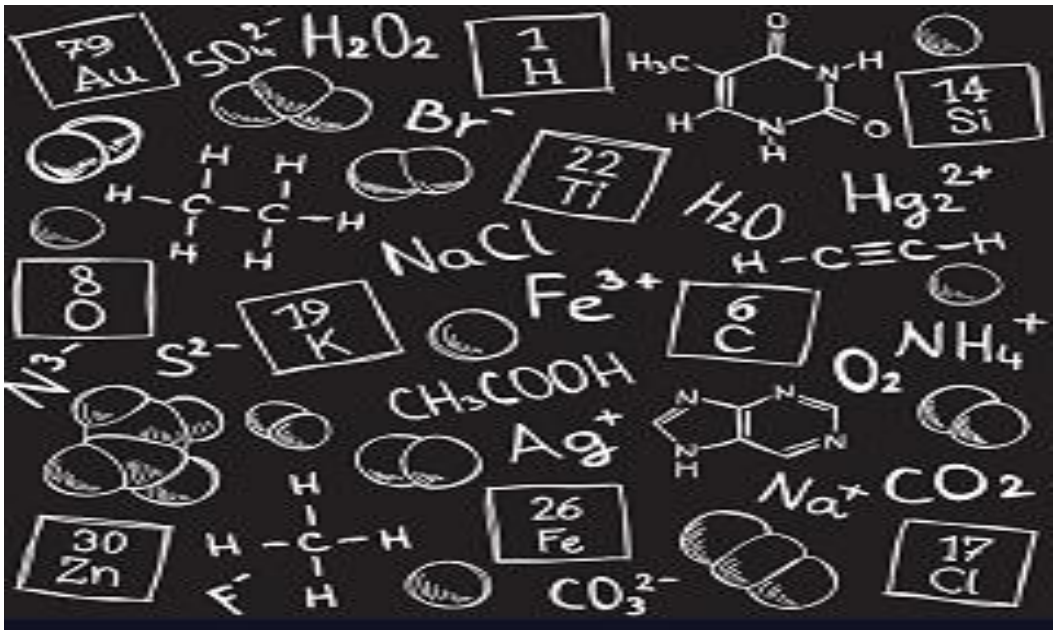

Fig 3: Some chemical elements formula expression

3. CONCLUSION

Nomenclature follows a system or certain logic. Language and information are inseparable. Language is a means of expression and science is an expression of information. Just a change of a single letter in the spelling changes the meaning of a scientific process. Necessity is the mother of invention and curiosity is the foster mother of science. The created thing lives longer the creators. "Art is long and life is short"(20) (Burns web) [3]. Life is short to acquire the skill but the skill is improvised from time to time. People remember the invention, discovery, process and reaction but tend to forget the developers and inventors. And this facilitated the rise of eponyms. Chemical terms or symbols are named after their Greek or Latin roots, the names of the developers or inventors, place where the elements are found in large quantities, their colours and cosmos. Greek mythology has its own role in nomenclature. One should understand the logic behind nomenclature to name a new process or an element. The linguistic study of chemical terms is interesting, incredible and unforgettable.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests.

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