ENHANCING THE DEVELOPMENT OF ANALYTICAL SKILLS IN CHEMISTRY USING THE RUDIMENTS OF STOICHIOMETRY

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ABSTRACT

Everything that exists in the physical world is made up of one or more chemicals. While some occur naturally some are synthetic. Chemistry deals with the characteristics and compositions of material and with the changes they undergo. Science educators are wonted about the limited scientific skills acquired by students upon completion of science courses whether at the primary, secondary or tertiary levels of education. Analytical chemistry involves qualitative and quantitative determinations of substances, which employ a number of measurements. 71Iis paper provides a framework for enhancing the development of analytical skills in chemistry using the rudiments of stoichiometry.

INTRODUCTION

Chemistry is a branch of science that deals with the study of the composition and structure of substances and of the changes, which they undergo when combined, or in contact with one another, or under different conditions, (Ezekwe, 1995). Chemistry as a physical science is the study of the material substances that occur on earth and elsewhere in the universe. It is concerned with the utilization of natural substances and the creation of artificial ones, (Asiriuwa, 2009)

Chemistry teaching in our schools is far from tapping the potentials of chemistry largely due to poor teacher preparation programmes and the lack of adequate science teaching infrastructural facilities. According to AIi (1998) the enthusiasm to study science has not been followed up with realistic or concrete efforts that are necessary for producing scientists and technologists which are prerequisites for industrial, social and economic growth.

Despite the fairly long exposure of our society to science, AIi, (1998) opined that it has not played an important role in our lives because of the type of education that was introduced and perpetuated in African countries prior to and just before self-rule. Examining the type of education that was handed down by the British colonialists, one

can see that Education was introduced for the dual purposes of inculcating the western European ethics (civilization) and. also to develop.

Africans the needed arithmetical and language skills necessary for buying, selling and exporting cash crops to western European countries.

Science is meant to play an important role in the society. For years, students who enrolled in science courses found that they did not acquire more than facts in science. What was learned constituted only a single aspect of science, acquisition of knowledge? The technical skills and competencies that are needed for becoming a scientist and performing as one were lacking. It becomes necessary to point out that the role science has to play in improving the lives of the people in Africa do not depend on greater scientific knowledge only. Rather, some aspects of this role will depend on the ability of the scientists there in applying the science they have learnt in solving local problems.

In the face of global economic meltdown, science has a lot of catching up to do for its role to be felt in achieving the Millennium Development Goals. The challenge is urgent because the available health facilities, food reserves, good road and rail network, means of communication, production of goods and services are grossly inadequate and starkly demands of science to play a positive role in addressing them.

Chemistry is a practical science: Chemical analysis is a most important method of investigation and is widely used in all branches of science, which are related to chemistry.

DEVELOPMENT OF SKILLS IN ANALYTICAL CHEMISTRY

Analytical chemistry is the chemistry used in connection with the separation and analysis of chemical substances, (Ezekwe, 1995). In analytical chemistry we have two branches; qualitative and quantitative analysis. While the qualitative analysis deals with finding 'Out what is present (or absent), quantitative analysis deals with how much is present. Analytical chemistry is a very important aspect of chemistry because of the extensive application it finds in the analysis of compounds, pharmaceuticals, raw materials, foods and chemicals etc

Analytical chemistry is of enormous importance in science and industry. For instance, an unknown substance can have its formula derived from the percentage composition of its constituents found by analysis. In industries for instance, the technologist must know at

every stage of the production process both the qualitative and quantitative compositions of the material undergoing conversion. Also, no material is taken into production or released without analytical data, which characterize its quality and suitability for various purposes. These results not only form the basis of all the processing calculations but they also determine the costs of the materials, which form the basis of financial estimates, (Alexeyev, 2004). The great importance for' proper chemical control of production is obvious. Therefore, in nearly every factory one of the most important sections is the analytical laboratory for chemical control of production.

Students engaged in experiments, projects, practical works etc need to be skilled in analysis. Calculations often follow the results obtained in analysis or determination of quantities of chemicals used in reactions. How much of a particular chemical must be used to react completely with a certain quantity of another chemical? Questions of this type can be answered once the knowledge of stoichiometry is grounded.

TEACHING STOICHIOMETRY FOR ENHANCING ANALYTICAL SKILLS

The term stoichiometry is used to designate the calculation of quantities involved in chemical reactions. Stoichiometry is derived from the Greek stoicheion "element or part" and metron "measure". It is usually employed in the study of the quantitative aspects of chemical formulas and reactions. Chemical analysis involving the determination of masses of elements or prediction of amount of substances consumed and produced in a reaction is very useful. For instance, if the polymer chemist is interested in preparing a new plastic, he determines how much of the new material a given polymerization reaction will yield. In a similar vein, the chemical Engineer who is studying rocket engine thrust will be interested in finding out the amount of exhaust gases a test of the fuel mixture will produce etc. In all these, stoichiometry is the fundamental knowledge required. The essential skills of chemical analysis involve relating the mass of a substance to the number of chemical entities (atoms, molecules or formula units), converting the results of mass analysis into a chemical formula, (Silberberg, 2003).

The numerical quantities with which an analyst deals may be exact or approximate. Exact quantities include:

i. Quantities taken as constant
ii. Relationship between units e.g. 1kg contains 1,000g

iii. The results of counting number of objects or operations; for example, the number of known elements and their atomic numbers, the number of determinations carried out etc.

Approximate quantities include all results of measurements, covering the results of weighing. The final result of an analysis is found by calculation from weight or volume data obtained during the analysis. This is where stoichiometry is very necessary. This is because the calculation of the results is as much an integral part of analysis as any other operation. Calculation errors lead to the same consequences as errors in any other analytical operation. A general approach presented for solving stoichiometry problem that involves a chemical reaction therefore is;

1. Write a balanced equation for the reaction
2. Convert the given mass (or number of entities) of the first substance to amount (mole).
3. Use the appropriate mole ratio from the balanced equation to calculate amount (mole) of the second substance.
4. Convert the amount of the second substance to the desired mass number of entities).

SUMMARY AND CONCLUSION

Chemistry is a very useful and practical science. An understanding of chemistry and its role in our society is beneficial to understanding our world. In chemical analysis involving both qualitative and quantitative determinations, calculations often follow the results obtained in the analysis. The chemist makes use of stoichiometry in the weight and volume measurements to get the final result of an analysis.

Analytical chemistry finds extensive use in science and industries. Questions that arise during analysis can be tackled with knowledge of stoichiometry. Students encounter the "process of science" through experiments. From experiments and chemical analysis, data are gathered requiring stoichiometric conversions. Analytical skills in chemistry can be enhanced when students are taught how to arrive at final results using the road map to stoichiometric conversions.

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