Analytical chemistry

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Introduction

Analytical chemistry is the study of the separation, identification, and quantification of the chemical components of natural and artificial materials.

Divided into TWO

1. qualitative analysis gives an indication of the identity of the chemical species in the sample,
2. quantitative analysis determines the amount of certain components in the substance.

The separation of components is often performed prior to analysis.

Analytical methods

Analytical methods can be separated into classical and instrumental.

- Classical methods (also known as wet chemistry methods) use **separations** such as precipitation, extraction, and distillation

  qualitative analysis by color, odor, or melting point.

  Classical quantitative analysis is achieved by measurement of weight or volume.

  Gravimetrical analysis-measured by weight

  Volumetric analysis-measured by volume

- Instrumental methods use an apparatus to measure physical quantities of the analyze such as *light absorption, fluorescence, or conductivity.*
- The separation of materials is accomplished using chromatography, electrophoresis or field flow method methods.

- Analytical chemistry is also focused on improvements in experimental, design, chemometrics, and the creation of new measurement tools to provide better chemical information.

Analytical chemist

- a person who actually involve in the theory, instrumentation, and practise of these method as the tools for their research work.
- They always think about the new areas for its applications and also aware about it limitations.

He always concerned with the *accuracy*, *precision*, *reproducibility and reliability* of the method as well as the source of any error that may be introduced.

-also think how to improve the techniques so as to get best result i.e., result close to true value as possible.

Accuracy and Precision

- Accuracy- of the determination is defined as the concordance between the result (i.e. the observed values) and the true or most probable values(ie the accepted correct value).
- Precision of a determination is defined as the concordance of a series of measurement of the same quantity.

Accuracy	Precision
It expresses the correctness of the measurement	It is a set of result express the reproducibility of a measurement.
It relates to close the observed result is to the true value.	Relates to how close the measurement are to each other
Accuracy is followed by precision.(an accurate result definitely be precise)	High degree of precision doesn't imply accuracy.(But a given set of experiment showing precision may not be accurate)

True value and error

No of student in a class room-accurate result get in first attempt.

But,

no. of atoms in 10g of carbon –not get the correct answer in the first attempt. By repeating the experiment, in each step it show some error from the true value.

Thus true value of physical measurement can never be known with absolute accuracy.

Normally the accepted one is the average of the best results obtains by efficient and experienced workers in many laboratories using different techniques.

Expressions of Errors

a. Absolute error b. Relative error

Absolute error(E)-is the different between the observed value(X_{obs})and the true value(X_t).

$$E = X_{obs} - X_t$$

It express the in the units of measurement.

It is a measure of the accuracy of the experiment.

Relative error(E_R)

- It is the ratio of the error to the true value(most probable value).
- *It* is more useful than the absolute error.
- It is also expressed as percentage error or as parts per thousand(ppt).

$$\text{Relative Error } (E_R) = \frac{(X_{obs} - X_t)}{X_t} 100 \quad (\%).$$

$$\text{Relative Error } (E_R) = \frac{(X_{obs} - X_t)}{X_t} 1000 \quad (\text{ppt}).$$

Classification of errors

Divided into two

(a)Determinate error (b) Indeterminate error

(a)Determinate error or systematic error

-these error can be avoided or eliminated by improving repetition.

-it is divided into four

1.Operational error

- Due to the careless of the observer
- Eg. misreading of the burette, loss of drop from the pipette.

2. Instrumental and reagent error.

-errors occurred from the instrument.

Eg. use of balance, weight etc

Reagent error: error is due to use of defective reagent if the reagent containing impurity or one which attack the glass etc.

3. Method error- Which are inherent in the method itself. It arising from the incorrect sampling and incompletion of a reaction.

Eg. volumetric reactions due to side reactions.

4. Additive and proportional errors

Additive error -are *independent* of the amount of constituent present in the determination.

Eg. due to the loss in wt. of a crucible or due to errors in weights.

Proportional error: *depending* the amount of the constituent present in the determination.

-due to the presence of an impurity in the standard substance weighed.

(b) Indeterminate error(random or accidental error)

--which does not be discovered, corrected or eliminated in a repetition of the measurement.

Such errors are beyond the control of the analyst.

divided in to 3

1. Personal error -due to the inability of the analyst to distinguish between slightly different readings, colours etc

   Eg. analyst cant able to decide the position of the meniscus in the burette.

2. Instrumental errors-due to the random variation in the response of instrument, variation in voltages etc.
3. Conditional errors-external conditions

Eg: temp, pressure, humidity