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A Short Overview on the Endurance of Volumetric Reagents and its Implications in Volumetric Analysis

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Abstract: *The purpose of this article is to elucidate the relevance of volumetric analyses and reagents or solutions in pharmaceutical product authentication and quality control. Volumetric analysis, one of the first steps of analysis, is one of the analytical techniques used in quality control. Titration is an analytical technique that dates back thousands of years, but it is still widely employed today due to its excellent accuracy, precision, cost, and ease of use. A quantitative chemical analysis method called titration may be used to estimate unknown quantities of any substance, including compounds, raw materials, and finished commodities. It is a method that is often used and found in most*

Keywords: Volumetric reagents, volumetric analysis titration

I. INTRODUCTION

Various chemical techniques are used in the pharmaceutical sector to analyze unidentified materials. Certain strategies are easy to use, while others need more consideration. Titrimetric analysis, often known as volumetric analysis or titration, is a simple technique for breaking down a solution into its component elements. Nonetheless, there are application distinctions between titration and volumetric analysis. Whereas volumetric analysis examines a solution for several different unknown values, titration is used to determine the concentration of an unknown component in a solution. One kind of volumetric analysis is titration. Titration is used in all volumetric methods. While volumetric analysis is the phrase used to determine many other properties, titrating is the term used when a volumetric analysis is performed to determine the concentration of an unknown component in solution.

History

When combining organic molecules with additional elements, French chemist Jean Beptiste Andre Dumas employed volumetric analysis to measure the amount of nitrogen present. According to Encyclopedia Britannica, Dumas burned a known-weight sample of the chemical in a furnace under conditions that ensured complete conversion of nitrogen to elemental nitrogen gas.

In Duma's experiment, nitrogen that has been taken out of the furnace is combined with carbon dioxide in a strong alkali solution. Depending on the volume it occupied, the solution absorbed carbon dioxide and allowed nitrogen to build up in the tube under certain pressure and temperature parameters. The mass of nitrogen was calculated. This resulted in the nitrogen content of the sample being calculated. The French physicist Jean Beptiste Andre Dumas is credited with introducing volumetric analysis.

Used of volumetric titration

In high school and college chemistry labs, volumetric analysis is done to determine an unknown substance's concentration. When a known quantity of titrant (a known solution) is added to an unknown amount of analyte (an unknown solution), a reaction occurs. Students may determine the concentration of the unknown material by knowing the titrant's volume. Since volumetric analysis and titration are considered essential techniques in analytical chemistry, they are widely used in a wide range of applications. In the biodiesel sector, titration is a helpful method for figuring out

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how acidic a vegetable oil sample is. Scientists can calculate the exact amount of base required to neutralize a sample of vegetable oil by knowing this amount.
Department of Pharmaceutical Quality Assurance, MGVs College of Pharmacy, Panchavati, Nashik, India The food and petrochemical industries utilize titration. To release fatty acids, titrate an acidic solution.

Application and Future Perspectives of Volumetric Analysis

- Glioblastomas are studied via volumetric analysis (malignant tumour affecting brain or spine)
- Metformin hydrochloride in water was analysed by volumetric analysis.
- Volumetric analysis was used to investigate the interaction of L-histidine in an aqueous ionic liquid at various temperatures.
- Application of volumetric analysis to determine the effect of fruit and milk sugar on the medication diphenhydramine hydrochloride in an aqueous solution.
- Volumetric analysis is used to examine for biosurfactant aggregation in galactose and lactose aqueous solutions.
- Volumetric study of naproxen in choline-based deep eutectic solvents in aqueous solution 7.Volumetric analysis in parkinson's patients' substantia innominate

Types of Volumetric Analysis

- Simple titration
- Back titration
- Double titrations

Simple Titration - A simple titration is used to determine the concentration of an unknown solution from the concentration of a known solution. There are four forms of simple titration.
Acid and base Titration: Acid and base are titrated to determine the acid content in a solution (or vice versa). By adding a standard base solution, the expected amount of acid in solution may be determined. A appropriate indicator is gradually added drop by drop to the solution whose concentration has to be determined in order to assist in determining the equivalence point. A substance's different hues may be shown using an acid-base indicator. Based on the indicator's pH range and the pH change at the equivalence point, an indicator is chosen for a particular titration.
Redox titration - By monitoring the gain or loss of electrons inside the sample, this kind of titration—also known as an oxidation-reduction titration—measures the quantity of material present in the sample. Water pollution and metal concentrations in a solution may both be examined using redox titration. Many names for this kind of titration exist, depending on the drug that is used to produce the noticeable change throughout the titration process. For example, in permanganate titrations, potassium permanganate, a kind of salt, may produce a reaction that reveals the concentration of hydrogen peroxide in a sample.
Precipitation titration - A sample is treated with a reagent until a reaction takes place and a solid "falls out" of the sample. Precipitation titration may be used to measure the concentration of certain metals in a sample, the amount of salts in a solution, and the amount of chloride in drinking water. This is a distinct kind of titration that goes by multiple names according on the reagent used. In argentometric titrations, for example, silver nitrate is used (the Latin word for silver is "argentum"). White silver chloride particles precipitate because of a reaction that happens when silver nitrate is added to a solution containing sodium chloride.

What is volumetric solutions?

Volumetric solutions contain a defined amount of solvent per unit of volume. a mix of components inside a certain volume. These are readymade, usable solutions. Through the use of a burette, an analytical volumetric solution, or titrant, is added to a sample or analyte until the reaction between the two liquids is complete. In a manual titration, the existence of a physically observable change usually signifies the completion of the reaction (end point) when titrant is added to the analyte.

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Why we do the stability study of volumetric solution ?

Since standing standard solutions might change their strength, it is necessary to assess the stability of volumetric solutions. The results of an analysis might be affected by using the incorrect strength or concentration of a buffer solution or solution reagent. The solution used for chemical analysis is unstable over an extended length of time. It is crucial to verify the stability duration of each solution independently as a consequence. Shelf life valuation is required for GLP regulatory compliance.

The Instruments Pipette is a tool for measuring accurate and precise amounts of solution. Burette: a device for measuring and pouring solution. To mix two solutions, use a conical flask. Wash bottles: they contain distilled water and are used to clean equipment. Liquids are transported using a funnel to prevent spills. A volumetric flask is a kind of flask used to measure out exact amounts of liquids with specified concentrations.

Preparation and Standardization

Volumetric solutions must be standardized by titrating against a primary standard or by titrating with a standard solution that has recently been standardized against a primary standard. After preparing the volumetric solution, give it some time to settle. After 24 hours, calculate the mean of the data, estimate the molarity of the solution in triplicate, and repeat the process every 7 days for 30 days to get the RSD.

Precautions

Solutions with limited stability or instability should be developed on the day of use, unless specified and standardized differently. At room temperature, prepare and standardize the volumetric solution.

To avoid contamination, you should keep the solution container well covered. Distribute the necessary amount of solution into a dry, sterile container.

To avoid contamination, never dip a pipette into a stock solution. Wear goggles, gloves, and a lab coat at all times. Add a little amount of acid to a large amount of water while diluting it to ensure that heat is distributed evenly during mixing. A certain process must be followed in order to develop and standardize volumetric solutions. A certain process must be followed in order to develop and standardize volumetric solutions. The volumetric solution must be made by precisely measuring an adequate quantity and dissolving it in a specified solvent in order to produce the proper volume, as per the general test procedure and pharmacopoeia. For a more powerful solution, restandardize volumetric solutions prepared by dilution in accordance with the directions. Before using any volumetric solution, the analyst must confirm the expiration and restandardization dates. For unstable solutions like sodium thiosulphate, the analyst should use freshly cooked and cooled pure water. For storage, volumetric solutions must be prepared in plastic bottles containing sodium hydroxide; all volumetric solutions must be stored in glass bottles with a clear or amber tint.

Acceptance Criterion

The volumetric solution must, overall, deviate from standard strength by more than 10%. For every volumetric solution, three sets of titrations with an RSD of no more than 0.2 percent are needed. When all volumetric solutions are titrated in triplicate sets, the RSD has to be more than 0.2 percent and the variation cannot be more than 1.0 percent. The molarity should be approximated to the fifth decimal place for volumetric solutions less than 0.1M/N and computed to the fourth decimal place for volumetric solutions 0.1 to 1.0M/N. If a volumetric solution is not freshly created and standardized within a month, it will not be used; moreover, if it shows signs of degradation, such sedimentation, discolouration, or crystallization, it will be rejected. If a solution has expired, discard it.

Record

It is necessary to record all drying and weighing-related information in the relevant log books. and upholding the standards set during the course of the solution's shelf life This documentation has to be retained for a minimum of two years beyond the expiration of the solution. The format must be followed in the development and authorization of any volumetric solutions as well as the details of any standardized volumetric solutions.

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Primary Standards

The primary standards for volumetric calculations When measuring, a standard solution serves as a point of reference. The precision and quality of the standards used determine how accurate the findings are. A standard is a reference material whose purity and composition have been carefully determined. Primary standards may be used to other substances as a standard or as titrants.

Primary Standard Requirements

It ought to be completely pure, or at least recognized to be completely pure. While drying, the temperature should remain constant. usually solid to facilitate easy weighing. It is easy to gather, clean, and dry. It is also easy to store. It is inert in the atmosphere. It should neither react with oxygen or carbon dioxide, nor should it absorb moisture. Major standards are indicated by the suffix RV. One may either buy a suitable main standard commercially or make one by following the steps listed below.

Arsenic trioxide-As2O3

Sublime arsenious trioxide R in suitable apparatus. storage-over anhydrous silica gel R.

Benzoic acid- C7H6O2

Sublime benzoic acid R in a suitable apparatus.

Potassium bromated-KBrO3

Crystallise potassium bromated R from boiling water R. collect the crystals and dry to constant mass at 180 degree celsius.

Potassiun hydrogen phthalate-C8H5KO4

Recrystallise potassium hydrogen phthalate R from boiling water R , collect the crystals at a temperature above 35 degree Celsius and dry to constant mass at 110 degree Celsius.

Sodium carbonateNa2CO3

Filter the saturated sodium carbonate solution R at room temperature. Slowly add a stream of carbon dioxide R to the filtrate while stirring and continuously chilling it. After two hours, gather the particulate matter on a sintered glass filter. Wash the filter with cold water and let it dry at 100–105 degrees. Then, heat it to a consistent mass at 270–300 degrees, stirring occasionally.

Sodium chloride –NaCl

Add two volumes of hydrochloric acid to one volume of sodium chloride saturated solution. Gather the crystals that have formed and use hydrochloric acid to cleanse them. After heating the crystals in a water bath to eliminate the hydrochloric acid, dry them to a consistent mass at 300 degrees Celsius.

Sulfanilic acid –C6H7NO3S

Recrystallisesaulfanilic acid from boiling water. Filter and dry to constant mass at 100-105 degree Celsius.
Zinc-Zn

Standardization of Volumetric Solutions

0.1 M Cerric ammonium sulfate

Preparation-dissolve 65 g of cerric ammonium sulfatewihb aid of gentle heat in a mixture of 30 ml sulfuric acid and 500 ml of water .cool filter the solution if turbid and dilute to 1000 with water.

Standardization- Take 25 ml of csrric ammonium sulfate solution in a volumetric flask and add2 gm KI and add 150 mlof water and mix well add starch and titrate immediately with freshly prepared 0.1 N sodium thiosulfate until blue color disappear.

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0.1 MDisodiumEDTA

Preparation – 37.2 gm disodium edetate in1000ml water. Standardization-Weigh about 0.8gm of granulated zinc dissolved by gentle warming in 12 ml dilute HCL and 0.1 ml of bromine water boil to remove excess bromine and add sufficient water to produce 200 ml pipette 20 ml of resulting solution into flask and nearly neutralized with 2M sodium hydroxide dilute to about 150 ml with water and sufficient ammonia buffer PH 10 to dissolve ppt and add 5 ml in excess add 50 mg of mordant Black 2 in mixture and titrate with disodium edetate solution until solution turns green.

0.1 MHCL

Preparation-8.5 ml HCL dilute with water to produce 1000ml. Standardization-weigh 0.15 gm of anhydrous sodium carbonate previously heated 270 degree Celsius 1 hour cool and dissolve it in 100 ml distilled water and add 0.1 ml methyl red solution add acid slowly from burette with constant stirring until solution become faintly pink heat the solution to boiling cool and continue titration heat again to boiling and titrate further as necessary as faint pink color is no longer affected by continual boiling.

Manual Titration vs. Automated Titration

At the moment, only 40% of labs use automated titration. Though automation has been demonstrated to be the superior technique time and time again, it may be difficult to persuade others in your company to understand the benefits.

Manual Titration - Manual titration has remained popular in the business due to its low cost and simplicity. A class A glass burette, standardized titrant, sample, colour indicator, and an operator to do the work were necessary for the manual titration. When conducted by a qualified expert, this technique can produce accurate and repeatable results. To attain these talents, significant academic training and/or on-the-job training are
required. This methodology is used by 60% of labs because of its main advantage of being largely driven by low initial cost. Manual titration is the best option if your application is simple and accuracy/reliability aren't a major concern. To maintain accuracy and consistency, manual titration relies on a number of human elements. The quality of your analysis is directly influenced by transcription, maintenance/cleaning, and sample preparation.

Automated titration - Even if the initial cost of an automated solution is greater, there are many important reasons why a buyer would choose it. Due to its numerous important advantages, automated titration is becoming more and more popular. A fully automated system improves accuracy, repeatability, safety, and traceability while meeting regulatory requirements and saving labor. Improved accuracy and reliability Tiny amounts of titrant are administered by an extremely precise motor-driven piston burette in automated titration. End equivalent point detection based on data: Rather than relying on a professional to see a color change from a color indicator, the results of this titration are based on electrochemical measurements from your chosen electrodes. traceability of each titration result using built-in memory or a PC program. Transferable by USB or software. Increased safety: the enclosed burette requires relatively little interaction with caustic and potentially deadly titrants, and it almost eliminates broken glassware. Get critical time. Employees can do more work in a day thanks to automated titration, which replaces labor-intensive manual titration. While manual titration could take years to learn, automated titration can be quickly taught to people of any ability level.

The accuracy and efficiency of automated instruments are increasing, making manual titration less and less practical. Furthermore, as regulatory requirements and audits rise, the cost of maintaining human titrations will surpass the cost of converting to an automated method.

II. CONCLUSION

A technique for determining a substance's mass by measuring the volume it occupies is called titration analysis, which is another term for volumetric analysis. Numerous forms of volumetric titrations are covered on this page, such as complexometric, acid-base, redox, and precipitation titrations. The basic principle of volumetric analysis is to use an indicator to determine the concentration of an unknown item in a solution. Titration is an analytical technique that dates back thousands of years, but it is still widely employed today due to its excellent accuracy, precision, cost, and ease of use. Examples include modifications to brain perfusion, uses in space exploration, and the evaluation of vegetable oil acidity using volumetric titration. One frequent laboratory method in chemistry is titration. The test may also be used to assess a student's interest in chemistry in general. The simplicity and low cost of volumetric titration is one of its

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advantages. Titration is a commonly used method in research, academia, and the automobile sector. Among its many uses are the testing of aquarium water, medicines, medical laboratories, wine, cheese, the manufacturing of cosmetics and cleaning products, and the determination of the amount of unsaturated and saturated fatty acids in food. Since volumetric reagents are such an important part of analysis, they may be verified as stable using volumetric analysis and titrations. Since no equipment is supplied, further research is required to get more trustworthy, accurate, and timely results.

REFERENCES

[1]. Anastas Dimitrov Dakashev, VeselinaTodorovaDimitrova, Titrimetric analysis with adding the titrant by means of electrodialy sis, Talanta, Volume 58, Issue 2, 2002, Pages 247-254.

[2]. S.A.M. Abdulrahman, F.K. Algethami, N.A.S. Qarah, K. Basavaiah, E. El-Maaiden, Development of non-aqueous titrimetric and spectrophotometric methods for the determination of valganciclovir hydrochloride in bulk drug and tablets, AnnalesPharmaceutiquesFrançaises, Volume 79, Issue 5, 2021, Pages 489-499, ISSN 0003-4509.

[3]. Henry J. Niemczyk, Susan D. Van Arnum, Analytical method development for a specific assay method for monomethoxypoly(ethyleneglycol)succinimido carbonate (mPEG-SC): A comparison of spectrophotometric, titrimetric and chromatographic methods, Analytica ChimicaActa, Volume 615, Issue 1, 2008, Pages 88-95, ISSN 0003-2670.

[4]. Na Zhang, Yonglin Li, Shasha Wen, Yiwen Sun, Jia Chen, Yuan Gao, AltayulySagymbek, Xiuzhu Yu, Analytical methods for determining the peroxide value of edible oils: A mini-review, Food Chemistry, Volume 358, 2021, 129834, ISSN 0308-8146.

[5]. Partha S. Das, BasudamAdhikari, Mrinal M. Maiti, SukumarMaiti, A titrimetric method for estimation of fluorine in organic compounds, Talanta, Volume 35, Issue 11, 1988, Pages 909-910, ISSN 0039-9140, M. G. Macdonald, in Advances m Analytical Chem-istry and Instrumentation, C. N. Reilley (Ed.), Vol. 4, pp. 75-116. Wiley-Interscience, New York, 1965.

[6]. L. Šafařík, Z. Stránský, G. Svehla, D.Thorburn Burns, Titrimetric analysis in organic solvents (Comprehensive analytical chemistry, vol. XXII): Elsevier, Amsterdam, 1986 (ISBN 0-444-98984-6). 532 pp. Price US$ 186.75.

[7]. G. Svehla, Chapter 7 - Automatic Titrimeters, Editor(s): G. SVEHLA, In International Series of Monographs on Analytical Chemistry, Automatic Potentiometric Titrations, Pergamon, Volume 60, 1978, Pages 172-186.

[8]. G.Siva Reddy, S.C.SoundarRajan, Y.Krishna Reddy, Titrimetric determination of dissolved oxygen in waste water, Talanta, Volume 25, Issue 8, 1978, Pages 480-482,ISSN 0039-9140.

[9]. Jaroslav Zýka, Prospects Of Titrimetric Methods In Modern Analytical Chemistry, Editor(s): a. Hulanicki, Analytical Chemistry, Butterworth-Heinemann, 1975, Pages 685-690,ISBN 9780408707305.

[10]. W.T. Elwell, D.F. Wood, Chapter 7 - Titrimetric Methods, Editor(s): W.T. Elwell, D.F. Wood, In International Series of Monographs on Analytical Chemistry, Analytical Chemistry of Molybdenum and Tungsten, Pergamon, Volume 47, 1971, Pages 61-77.

[11]. Mika Sillanpää, Marja-LiisaSihvonen, Analysis of EDTA and DTPA, Talanta, Volume 44, Issue 8, 1997, Pages 1487- 1497, ISSN 0039-9140• Kambojj P.C., Pharmaceutical Analysis, Volume – I, Third edition, 2014, VallabhPublications, Pages: 53–133.• Mendham J. et.al. Vogel's Textbook of Quantitative Chemical Analysis, Sixth edition,2006, Dorling Kindersley (India) Pvt. Ltd, Pages: 33 - 36.

[12]. ASTM (American Society for Testing and Materials). 2001.Standard Practice for Preparation, Standardization, and Storage of Standard and Reagent Solutions for Chemical Analysis, E200-97(2001)e1; ASTM: West Conshohocken, PA.

[13]. Dux, J.P. 1990. Handbook of Quality Assurance for the Analytical Chemistry Laboratory, 2nd ed.; Van Nostrand Reinhold: New York.

[14]. Siddiqui MR, AlOthman ZA and Rahman N. Analytical techniques in pharmaceutical analysis: A review. Arabian J Chem. 2013: 1-13.

[15]. Skoog DA, West DM, Holler FJ and Crouch SR. Fundamentals of Analytical chemistry. 8thEd. Thomson Brooks/Cole. 2004: 160-167.