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APPLICABILITY OF GASS CHROMATOGRAPHY /MASS SPECTROMETRY IN SUPPORT OF PHARMACEUTICAL RESEARCH AND DEVELOPMENT

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Abstract

Gas chromatography -Mass spectrometry is analytical techniques that combine the advantages of gas chromatography and mass spectrometry. It is used to measure individual components of complex mixture in both quantitative and qualitative ways. GC-MS is the most suitable for the analysis unknown compound and volatile component. Application of GC-MS includes drug detection, explosive academy of investigation researches, and identification of unknown sample using iatochemistry. It can be used to find trace elements in material that had previously been assumed to have decomposed beyond recognition. Many field research involving organic chemical detection and determination use GC-MS as an integral and complementary tool.

Keywords: Gas- chromatography-Mass spectrometry, Quantitative Analysis, Qualitative Analysis, Identification, and detection of compounds.

- **INTRODUCTION**

GC is the process of separating components from a given crude medication using a gaseous mobile phase. A sample is vaporized and inserted into the chromatographic column's head. The specimen is transporting .The mobile phase is created by the passage of inert gases. A liquid stationary phase is adsorbed onto the surface of an inert solid in the column itself. Different distributions of the molecules of the components being separated between the mobile gas phase and the stationary gas phase are used to separate them in GC. The most straightforward way to acquire a quantitative description of the elution process in GC is to use. The kinetic treatment of the basic mechanisms of the motion of the molecules of the test chemicals in a column can be done quickly. The phrase "gas chromatography" refers to a series of analytical separation techniques for analyzing volatile compounds in gas. The components of a sample are dissolved in a solvent and vaporized in gas chromatography. The analytes must be separated by dividing the sample into two phases, a stationary phase and a mobile phase, the analytes can be separated. The analyte molecules are carried through the heated column by the mobile phase, which is a chemically inert gas. One of the few types of chromatography that does not use the mobile phase is gas chromatography. The analyte is reacting with it gas chromatography, often known as gas liquid chromatography, is a technique used to analyze gases. Separation, identification, and quantification of components of an organic compound mixture using selective chromatography within a column, partitioning between the stationary and mobile phases occurs, followed by sequential elution of the stationary and mobile phases. One of the most often used chromatography techniques for separating volatile molecules or molecules is gas chromatography. Gas, such as helium, serves as the mobile phase, while a high-boiling liquid adsorbed on a surface serves as the stationary phase. Components differ in the column, thus moving out of the analyte is moved through the column through the stationary phase by the pressure applied and the mobile phase. It is simple to use, has a high sensitivity, and can successfully separate mixture. The components of the mixture are dispersed between two phases: a stationary phase and a mobile phase or carrier gas that transport the mixture through it, as compound pass through stat in the mobile phase. As compounds in the mobile phase pass through the stationary phase, they interact with it via means of Because of the changes in structure and properties, of each component, as well as its size and affinity. (1)

- **Introduction to Mass spectrometry and it's principle**

Mass spectrometry is a strong analytical technique that may be used to quantify known chemicals, as well as to identify unknown chemicals. To find new substances in a sample and to figure out their structure and chemical characteristics of various molecules .The entire procedure entails converting the material to a gaseous state. Ions fragmented or not, are then classified according to their mass to charge ratios (m/z). The low of motion in Newtown is the basis for mass spectrometry. A mass spectrum, on the other hand, uses this feature of matter to plot ions with varied masses on a mass spectral diagram. The instrument is made up of three main parts.

I. Sample inlet

A sample kept in a huge reservoir from which molecules enter the ionization chamber in a steady stream at low pressure through a pinhole Molecular leak".

II. Ionization

Ionization occurs when an atom is bombarded with a stream of electron knocking one or more electrons knocking one or more electrons off to produce positive ions. The majority of the produced positive ions will have a +1 charge. The ions are resolved into their distinct Mass components after Ionization according to their mass charge ratio. Mass spectrometry instrumentation is a type of mass spectrometry that is used to identify different species. Components of Mass Spectrometry A mass spectrometer should always execute the following steps with all of the above components.

III. Detector

Process the singles from the detector that are sent to the computer and utilize feedback to manage the instrument to detect ion and record the relative's quantity of each resolved ionic species. (2)

- **Applications of Gas chromatography and Mass spectrometry**

Gas chromatography-Mass spectrometry is an analytical method that combines the techniques of gas chromatography and mass spectrometry. To detect distinct chemicals within a test, features of gas chromatography and mass spectrometry are used. As example Drug detection, fire investigation, and environmental monitoring are all examples of GC-MS applications. Analysis, explosives investigation, and sample identification, including material samples collected from the planet Mars as early as the 1970s during probe operations GC-MS can be used in a variety of ways. It can also find trace elements in

materials that had previously been assumed to have decomposed beyond identification. It facilitates analysis and detection even in the absence of liquid chromatography mass spectrometry Comprises extremely small amounts of a substance GC-MS has been dubbed the "Gold Standard" for forensic substance analysis. GC-MS is an analytical technique that combines separation and mass spectrometer, GC capabilities combined with MS detection qualities to improve sample efficiency. Examination MS assists in fragmenting components and identifying them based on their mass a lot of people spectrometry can characterize biological products, specifically proteins and protein complexes. The technique of mass spectrometry is used to identify unknown substances. Comparing molecular weight and molecular mass values to known compound measurements as well as determine a molecule's structure and chemical properties to determine the isotopes of a substance.

1) Medicine and Pharmaceutical Analysis

GC has experienced a renaissance in the recent decade, particularly in its hyphenated variant, GCMS. Increasingly widely used for detecting very low quantities of volatile mutagenic contaminants (MIs) like alkyl halides, as well as determining volatile Leachable. This article looks at how GC and GC-MS are used in these critical areas. Regions The volatile and thermally stable replacements in a sample are separated using GC, whereas fragments are separated using GC. The mass of the ANALYTE will be used to identify it. The inclusion of a mass spectrometer transforms it into GC-MS/MS. Single and triple QUADRUPOLE modes provide superior performance. There are dozens of metabolic illnesses that are present at birth. Inborn metabolic errors, often known as metabolic inconsistencies, are now identifiable in new born employing gas chromatgphy Mass spectrometry is a technique for determining the composition of a sample even in low concentrations, GC-MS can identify chemicals in urine. The GC-MS technique is commonly utilized. In the pharmaceutical industry, for analytical research and development quality control, quality assurance, and distribution, as well as active pharmaceutical ingredients API bulk medicines and formulation in pilot plants. It's employed for Carry out and method development, as well as API impurity detection. The technique of gas chromatography-mass spectrometry is widely employed, Impurity, stability testing, and impurity profiling characterization, synthesis of medicinal chemicals impurity, stability testing, and impurity profiling.

2) **Environmental monitoring**

For many types of organic studies, GC-MS can provide the most trustworthy analytical information. As GC-MS analytical systems have evolved, so have the application scenarios. With the advancement of technology, these instruments have been proved to be usable in the demanding environment of the military. Demilitarization of the rainforest and chemical DEMILITARISATIONOR conditions requiring military reconnaissance. GC-MS used in study of known persistent pollutants and some new chemicals in an environmental sample. The utilization of Linear QUADRUPOLE on-trap, double-focusing sectors, and time-of-flight mass ANALYZER are some of the mass ANALYZER available. ANALYZER is investigated. DIBENZOFURANS, herbicides, CHLOROPHENOL, and other chemicals are commonly detected by GC-MS. This is highly useful for screening soil and air, water phenol, halogenated insecticides, and sulphur in the air. It can be used to screen lignin breakdown products in bio-mass studies, as well as insecticides in spinach.

3) GC-MS Application for toxicology

Gas chromatography -Mass spectrometer is a toxicological analysis method for drugs and other substances and in drug overdoses. The GC-MS ionization of drug molecules resulted in a wide distribution of poisonous in the drug as potential toxin must be identified and represented by chromatographic peaks. GC-MS can be beneficial for the stimulation, detection, and screening of hazardous substances. Even though the chemical are unrelated, MS application is important for toxicological investigations of medication and toxin. Drug evaluation for specific purpose application for TDM and pain control screening, e .g. usage of drugs is a death sentence. GC-MS has strong peaks and sensitivity, resolving pharmacokinetic and Pharmacodynamics studies. Application power for toxicological compound identification and screening GC-MS is a type of gas chromatography-mass spectrometry that normal iron screening and blood screening of the toxic chemical prescription. The gas chromatography-mass spectrometry technique is commonly used in the drug substance convent screening of a wide range of substances and for in substances, as well as any impurity present PHENAL, chloramphenicol, water.

4) Criminal and forensic cases

Because it is used to identify forensic substances, the gold standard is GC-MS, which performs a 100 % accurate test that positively identifies the chemical. A nonspecific test only reveals the presence of the chemical. There are many number of different types of substance is present as MDGC can help for component separation, possibly increasing the sensitivity of substances that don't match the criteria. In GC–MS, there is a detection limit. There is some ambiguity in this case; according to the DIRUCTURATE forensic science laboratory. The FSL conducted preliminary testing and found no intoxicants in the man's system. In circumstances when there is a suspicion of due of the volatile nature of inflammable liquid samples, GC/MS is frequently used in arson investigations. Mass spectrometry may be quite useful in the analysis distinct samples of paint or color that appear to be identical. The compounds that are used in a if two samples are likely to have come from the same source, a specific brand may be enough to determine if they came from the same source.

5) Application of petrochemical and hydrocarbon Analysis

The major application of GC-MS is to identify hydrocarbon mixtures. The employment of different ionization techniques is often utilized to detect crude oil in GC-MS. The matching of low abundant molecule ions to structurally significant fragment ions is aided by energies. A wide range of chemicals, from polar to medium polar, were effectively detected, as well as additional information about the compounds. The ability of GC-MS to offer analytical data aids petrochemical companies in maintaining quality. To detect contamination and assess the refining procedure, GCMS was performed. GC-MS is a valuable tool for molecules are identified and analyzed using this technique.

6) Food safety and pesticides Analysis

A powerful method for pesticide detection is the combination of gas chromatography and mass spectrometry. Due to its toughness and good selectivity, it is an ideal choice for residues. This method enables for the quantification and identification of non-polar and volatile insecticides have low pesticide concentrations. Areas of food safety and analyzing food contamination from any unknown substance MS may also be keeping an eye on things. Food contamination has become a global concern, demanding varied levels of regulation and enforcement. Pesticide residues remain a top priority on the list of food safety issues. As a result, pesticide residue detectors have been developed.

7) Application of food and fragrance

Food safety against possibly dangerous residues has become a hot topic among the general public. Because food analysts play such an essential role in modern society, it's commonly employed in food-related applications. GC-MS can also be utilized in food as a fragrance and aroma. The products contamination of flavor and aroma components of products, as well as adulteration of any food, can occur. The qualitative results of identified substances are obtained using gas chromatography-mass spectrometry. It can also be used to add flavor to perfumes as well as scent in beverages and culinary goods also used to make formulas with volatile substances.

8) Detecting agent for security and Chemical warfare

Chemical warfare agents are unquestionably one of the most dangerous poisonous compounds ever created. GC-MS and GC-MS-MS were recognized as important players in belligerent conflicts until world war ways for identifying chemical warfare agent remnants in the environment at low quantities unequivocally from low ppb to ppm. They also provide the first unambiguous identification of nerves in the scientific literature. After a chemical assault, environmental samples were taken to look for agent residues. Manufacture has emerged, and it has done so fiercely .Influenced the way current combat and diplomacy are conducted Because of their capability for mass destruction, Countermeasures to lessen their impact came almost as quickly as they were developed.

9) Application of GC- MS in Astro-chemistry and Geochemistry

Several GC-MS have been launched into space for Astro-chemistry research. The programme Scientists used GC-MS to examine Venus's atmosphere. One of the Cassini -Huygen probes landed on Saturn's largest moon Titan. The molecular ion mass spectral has been significantly increased, indicating a low range of volatility hydrocarbons useful for geochemical applications since it can analyze unique isotope ratio information. (3-5)

Conclusion

Thus, it can be concluded that at present, GC-MS is most widely used analytical technique available for separation and identification of compound or complex. The factors that make most widely used technique are its good resolving power sensitivity with few mg of sample, good precision & accuracy. Gas chromatography/Mass chromatography is a widely used analytical method for qualitative and quantitative

research in a variety of fields. It's an effective analytical technique for separating ionisable chemical elements in the gas phase. In clinical forensic and environmental toxicological assessment, it has been an effective method in analytical determination, detection of poison and their metabolites. Based on the ability to classify a majority of chemical compounds using interlaboratory comparison GC-MS is widely used for general unknown screening of any compound, poison drug, metabolites, and for pesticide purpose.

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