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REVIEW ON GREEN CHEMISTRY AND CATALYSIS

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ABSTRACT:

Sustainable chemistry, also referred to as green chemistry refers to the development of chemical products and processes that reduce or eliminate the demand for hazardous materials. Environmentally friendly chemical processes and products are their area of expertise. Its twelve guiding principles can be applied to create or duplicate dust particles, accessories, vaccinations, and procedures that are healthier, cleaner, and safer for human health. Green chemistry lessens the influence of chemical technologies and procedures, as the content demonstrates. The aim of this research is to learn more about the role of catalysts in the herbal mixture in creating the future. Catalysis is an important factor in the combination of new environmentally friendly materials and composites. The energy required for the catalytic process to produce small particles, aggregates, and additional waste points indicates efficiency. Catalysts that will not harm the soil can be created. Catalysts are available in many different shapes and forms, some of which are useful in the pharmaceutical industry.

Keywords: *Biocatalysis, biomass, ionic liquid, critical, Microwave oven irradiation, photocatalysis and green chemistry definition of green chemistry green chemistry: Biocatalysis, biomass, ionic liquid, critical Fluids, Microwave Irradiation, Photocatalytic Chemistry.*

INTRODUCTION

The field of chemistry called "green chemistry" and sometimes “sustainable chemistry" focuses on the development and improvement of Products and procedures designed to cut down on or completely stop the usage and manufacture of dangerous materials medicine. Environmental chemistry and green chemistry are not same thing. The first focuses on how chemical use affects the environment and how environmentally friendly practices (such as reducing the use of non-renewable resources and environmental controls) can be developed. The second focuses on how specific chemicals or chemicals affect the environment.

Principles

The basic principles Here are twelve proposed by American chemists Paul Anantanand John Warner in 1998. List of points following the basics of green chemistry.

Waste Avoidance

It is always preferable to avoid producing waste than to have to clean it up afterward.

Atomic Economy

Synthetic processes and processes based on green chemistry are tools that must use as much as possible in the finished product. This must be strictly adhered to in order to reduce the waste produced by each process.

Preventing the production of toxic chemicals

Toxic chemicals that threaten human health can be prevented with better practices and processes.

Safe drug production process:

Making drugs that are as non-toxic to humans and the environment as possible should be carefully considered when developing pharmaceutical products that work specifically.

Design safety additives and solvents

Process additives should be used as little as possible. degree of ability. They should be used to the maximum even in impossible situations. Minimize risk exposure. Energy efficiency should reduce the intensity of the process as much as possible.

Include renewable resources

Renewable resources and raw materials should be used. It is better than using non-renewable resources.

Reducing the use of derivatives

Reducing unnecessary derivative materials is important because they often require additional chemicals and reagents and create excessive waste.

Use catalysis

It is necessary to promote the use of catalysts and catalytic reagents to lessen the energy needed for reactions in the process.

Design of degradable chemicals

When producing chemical products to perform specific tasks, care must be taken during design to ensure that the chemicals do not contaminate the environment. Ensuring the breakdown of toxic substances into non-toxic substances is one way to achieve this goal.

Add real-time analysis

Technologies and processes should be optimized to provide real-time data. To see. This may allow both parties involved to stop or check. A process that occurs before a problem or poison is created.

Safety chemistry integration reduces the risk of accidents

When developing new processes, it is important to ensure that the materials used in the chemical process are safe. This can help prevent some workplace accidents, such as fire and explosion. This will also help create a safer environment in which to perform the transaction.

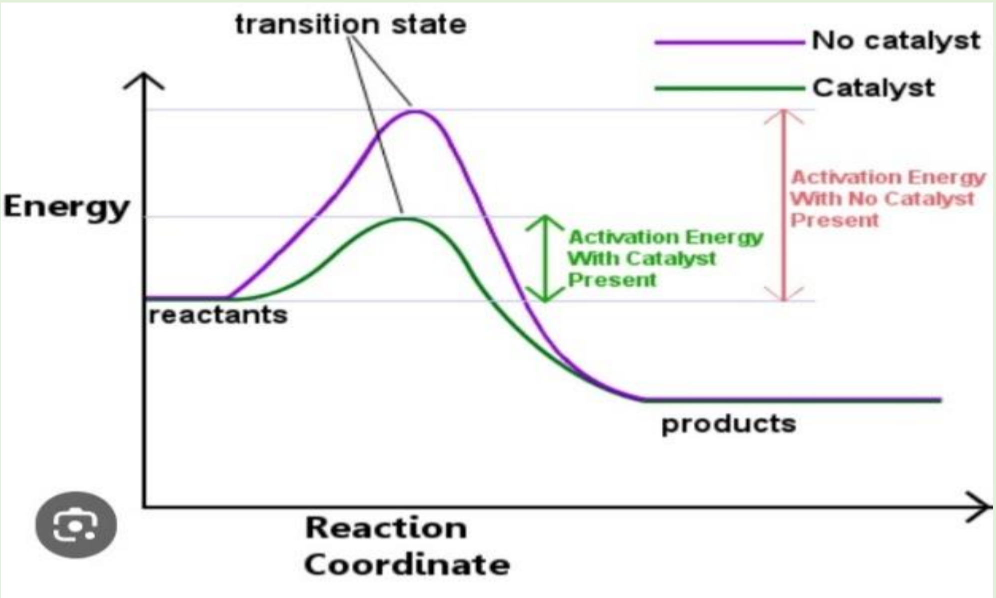

Fig.1: Role of Catalysis

Catalysis

Chemical reactions occur at different rates, but they do not change when the reaction is completed. In general, catalysis changes the rate of the reaction by increasing or decreasing the temperature in ways that would be unthinkable without the catalyst. Outside of chemistry, the word "catalyst" refers to anything that causes a change or action in a reaction.

Catalysis Role

Something that speeds up a chemical process is called a catalyst. or lowers the necessary temperature or pressure to start one. Catalysis is defined as the addition of a catalyst to a reaction catalyst is a material that alters, encourages, or quickens a reaction. Between two or more elements in order to yield a different outcome.
Catalysts are widely used in industrial processes, such as food production, to maximise production volumes and rates. For instance, if Pt metal is used as a catalyst to combine hydrogen and ethene gases, Pt is a catalyst that is heterogeneous. But an enzyme presents in a solution that catalyses a solution phase

Solid Acids and Bases as Catalysis

An acid or base can be added to a chemical reaction to speed it up without consuming the acid or base itself. This process is known as acid-base catalysis. Acid specific catalysis (as described below) is another cause of catalytic reactions. Sulfuric acid induces the breakdown of sucrose into glucose and fructose; or base-specific (base-catalysed), such as the addition of hydrogen cyanide to ketones and aldehydes in the presence of sodium hydroxide. Bases and acids can act as catalysts in many reactions. From an economic and environmental perspective, acidic and catalysed processes are important for the chemical and petrochemical industry, oil refining technology, oil refining and production of various products. Specialty chemicals including flavourings, fragrances, agricultural chemicals and pharmaceuticals. Some examples include hydrocracking, hydration/dehydration, esterification, hydrolysis, isomerization, oligomerization, alkylation, catalytic cleavage, and several condensation reactions. In most of these methods, Lewis's acids ($AlCl_3$, $ZnCl_2$, BF_3) or classical Bronsted acids (H_2SO_4, HF, HCl, p-toluene sulfonic acid) are used in gas-phase systems or liquid-phase homogeneous systems of an inorganic carrier.
Similarly, many bases are KOH, NaOH, NaOMe and KO But. Use only in the petrochemical and oil refining industries these acids' or bases' catalytic concentrations, though not always, and the total amounts of waste produced are significant because of the massive production volumes that are involved. After they are neutralised, inorganic salts are produced, which eventually find their way into aqueous waste streams. However, even though production is Much smaller, volumes aldol and related condensations, Friedel-Crafts acylation, and other fine and specialised chemical processes often involve the use of acids and bases in stoichiometric proportions. Stricter laws and growing environmental concerns have resulted in the widespread replacement of conventional Lewis and Brønsted acids with reusable solid bases and acids.

Catalysis by Solid Acids Of all heterogeneous catalysts:

Solid acids have been the focus of the most thorough research. Solid acid can be defined as a solid that causes a basic indicator's colour to change or as a solid on which a solid acid or a base is chemically adsorbed demonstrates a propensity to accept or give up a pair of electrons. The total surface area is determined by the number of these sites. acidity, whereas the acid strength is determined by their structure (coordination, partial charge). Numerous materials can be classified as solid acids, including hybrid organic–inorganic materials like mesoporous oxides with pendant organic sulfonic acid moieties and Nafion, supported heteropoly acids, acidic clays, zeolites, and mixed oxides like silica–alumina and sulphated zirconia.

Several procedures using solid acids include the following: paraffin isomerization (chlorinated Pt-Ag), catalytic cracking (X and Y zeolites), reforming (silica-alumina, noble metal framework D. Solid Base

Catalysis Recyclable solid base catalysts have fewer applications than acid catalysis. The main reason for this is that acid-catalysed reactions are frequently used in the synthesis of many chemical compounds. Compared with acids, the main features of base-catalysed materials are high selectivity and high efficiency; They may create adverse effects when used as accessories or carriers.

Solid Base Catalysis

Recyclable solid base catalysts have fewer applications than acid catalysis. The main reason for this is that acid-catalysed reactions are frequently used in the synthesis of many chemical compounds. Compared with acids, the main features of base-catalysed reactions are high selectivity and high efficiency; It can cause negative effects when used as an additive or carrier that can replace molecules in fresh foods. A substance that can gain a proton or release an electron, chemically adsorbing an acid or base. Definition A substance that can gain a proton or release an electron, chemically adsorbing an acid or base.

Catalytic Reduction

The process of employing oxygen and certain inorganic or organic reducing agents to reduce nitrogen oxides (NO, NO2, and N2O). is called Selective Catalytic Reduction or SCR. Nitrogen oxides (NOx) are produced as exhaust gas during industrial synthesis. Nitric acid or lean combustion or gasoline engine exhaust.

Enzyme biocatalytic reduction technology

Using living (biological) systems or their components to accelerate (catalyse) the reaction is called biocatalysis. Enzymes and other naturally occurring catalysts cause chemical changes in organic compounds during biocatalytic reactions. Biocatalysts or catalysts of life are enzymes.

The definition of A catalyst is an agent that speeds up a chemical process without changing its composition. changing the reaction process in any way. One way to describe enzymes is as biocatalysts produced by living cells. They are proteinaceous in nature, colloids, their action is specific and they are heat resistant in nature. In the laboratory, it will take at least a few days for the proteins to hydrolyse in strong acid at 100^{o}C. Within a few hours, the same proteins are completely broken down by intestinal enzymes at body temperature (37°C). Enzymes alone are responsible for the amazing changes in chemical reactions that occur in living organisms. Without enzymes, life as we know it would not exist.

Catalytic oxidation

Using a catalyst to accelerate the oxidation reaction is called catalytic oxidation. For example, formaldehyde can be produced through the catalytic oxidation of methanol. An important substance used in many applications, including resins and adhesives. Catalytic reactions are important in many fields, including the pharmaceutical industry, because they can help produce chemicals, reduce pollution and increase efficiency. One type of catalytic reaction is catalytic oxidation; In other types there are many additional processes such as catalytic dehydrogenation and hydrogenation [3]

Catalysing the Creation of Bonds Between Carbons:

The main reaction that forms the skeleton of organic molecules in organic synthesis is the formation of carbon-carbon bonds. This review includes many studies on biocatalytic C-C bond forming reactions. Over the last five years, they have demonstrated their suitability for use in organic syntheses. In general, the reaction shows that the functional product of the C-C bond is amino alcohols, α-hydroxyketones, diols, 1,4-diones, etc. or allows substituent exchange between heteroaromatic and aromatic molecules. Moreover, in addition to stereoselective cyclization of native (non)precursors to form saturated carbocycles, alkenes also undergo cyclopropanetrione to form cyclopropanes. Although many services already exist, new research also shows that nature provides many enzymes to carry out C-C bond reactions. Although the options are endless, to have a specific enzyme (stereoselectivity) it is necessary to have a large library of mutations for different reactions.[4]

Hydrolysis Process:

A type of enzyme called hydrolysis Type of reaction: Water usually breaks down organic compounds, all the hydrolysis reactions are: [5]

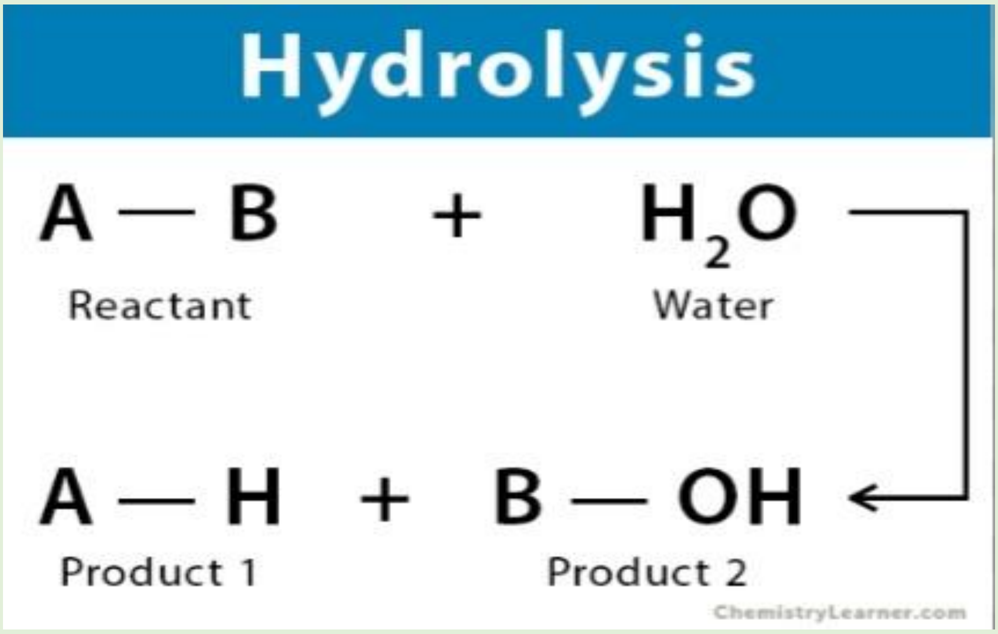

Fig.2: Hydrolysis Process

Reaction Environment

Catalysis New types of Lewis acids have been developed as water-compatible catalysts. Many salts have been found to function as Lewis's acid catalysts in aqueous media, and catalytic asymmetric aldol reactions have been carried out under these conditions. In addition, Lewis's acid-surfactant hybrid catalysts can be used in aqueous solution without organic-solvent. These studies will help reduce the use of hazardous substances and improve the quality of catalytic processes that cannot be carried out with organic solvents.

Microwave Assisted Synthesis

Microwave Assisted Synthesis is done using the excitation of microwave electromagnetic radiation to form external dipoles of the material. It is usually done in combination with known synthetic methods.

Aspects of Microwave Dielectric Heating Theory

The radio frequency (RF) and microwave (MW) frequency bands of the electromagnetic spectrum are referred to herein as "dielectric heating". The frequency range for RF heating is 1-200 MHz, and for MW heating is 300 MHz300 GHz. For commercial use, international agreements reserve certain frequencies to prevent interference in communications. These include frequency bands between MW 2450, RF 13.56 and 27.12 MHz, and 896 and 915 MHz the half-energy depth for water is approximately 12 mm at 2450 MHz and 75 mm at 100 MHz Osmosis in food is less than in water.

Microwave-Accelerated Metal Catalysis

Due to its better performance and selectivity, microwave-assisted catalytic pyrolysis is considered a promising coal stage conversion technology. The aim of this study is to analyse the pyrolysis behaviour and quality of low coal pyrolysis products supported by microwave-assisted dielectric catalysis with metal catalysts (K, Ca and Fe), and using a microwave. tube. a type of furnace for the reaction. Catalytic Cracking Mechanism of Metal Catalysts The effect of microwave radiation on tar was also studied. Vector network, Raman, XRD, FTIR, SEM and EDS analyses were used to describe the physicochemical structure and dielectric properties of coal. Chemical properties of the products were determined using FT-IR and GC-MS. Studies have shown that microwaves tend to interact with metal catalysts and can cause adverse effects and polarization.

The catalytic pyrolysis process produces high yields of syngas (CO + H2). In particular, the poor dielectric quality of carbon is greatly reduced by the use of metal catalysts, especially Ca and Fe. The presence of metal catalysts has also been found. Significantly enhanced the amorphous carbon structure in the produced chars and the observation of a reversal in the carbon graphitization process. Furthermore, under the combined action of microwave and metal catalysts, the conversion of larger polycyclic aromatic compounds into lighter tar species was catalytically accelerated, leading to the significant amount of single ring aromatics in tar.[6]

Heterocyclic chemistry with the aid of microwaves

The fundamental idea underlying microwave oven heating is the result of charged particles interacting with the substance used in the reaction that has a specific electromagnetic wavelength. The process of generating heat by Electromagnetic radiation is produced either by conduction or collision, or occasionally by both. There are two fundamental principal mechanisms.

Heat is produced in polar molecules through the process of dipolar polarisation. Polar molecules try to follow the electromagnetic field oscillating at the appropriate frequency and adjust themselves in phase when exposed to the field in this area.

Heat can be produced by dipole polarization by either or both of the following:

1. Interaction between molecules of polar solvents such as ethanol, methanol and water
2. Interaction of polar solute molecules with formic acid (such as ammonia)[7]

Conduction mechanism

When current meets resistance, heat is generated. When electrons or ions in a conductor vibrate under the influence of an oscillating electromagnetic field, an electric current is created. The conductor heats up due to internal current resistance. Conventional heating is different from microwave heating. Stay warm in many ways. Below is presented the development of a fast, selective, economical, efficient and environmentally friendly microwave reduction (MWAR) method for combining organic and inorganic materials. Mixed medicine. Additionally, several applications of these recovered materials have been explored in various fields.

Multicomponent reaction using microwaves

Microwave-assisted multicomponent reaction (MCR) (MWA-MCR) has proven to be an effective tool for producing biologically relevant heterocycles.

These reactions are intentionally used to generate heterocyclic diversity in addition to poly diversification. Over the past few decades, Ugi, Biginelli, and others have shown that traditional MCRs, such as microwave ovens, improve productivity and efficiency. MWA highlights that the hallmarks of MCR are high yield, reduced reaction time, selectivity, atom economy, and simple purification procedure. . This method can speed up the discovery of new drugs. This review focuses on recent developments in MWA-MCR. It covers the technological discoveries of the past decade better than traditional ideas. [8]

Multi-component reaction assisted by microwave

Multicomponent reactions (MCRs) aided by microwaves (MWA-MCRs) have proven to be effective instruments in the production of heterocycles with biological significance. These responses are deliberately utilised to create a heterocycle diversity in addition to multiple point diversifications. In the past few decades, traditional MCRs like Microwave assistance has been shown to increase yield and efficiency in Ugi, Biginelli, etc. The MWA highlights High yields, shortened reaction times, selectivity, atom economy, and easier purification methods are characteristics of MCRs. method can quicken the process of finding new drugs. The current review centres on the most recent developments in MWA-MCRs. and their mechanistic discoveries over the previous ten years, illuminating its benefit over the traditional strategy.

Solid-phase synthesis with microwave assistance

One of the methods that peptide chemists use the most frequently to synthesise both simple and complex peptide sequences is microwave-assisted peptide synthesis. The use of microwave technology greatly decreases the synthesis time while simultaneously raising the calibre of the peptides generated. The majority of amino acid couplings are able to take only five minutes to finish. Additionally, the Fmoc removal can be expedited in the microwave, which will shorten the reaction time. from a minimum of 15 minutes to typically just 3 minutes. Typical adverse effects include aspartimide and racialization formation are simple to manage and can be regularly applied with efficient techniques. This protocol describes in detail how to perform high purity and yield manual and automated microwave-assisted peptide synthesis of two challenging peptide sequences: β-amyloid and ACP (65-74). [9]

Sonochemistry

The chemical study of the use and effect of ultrasound on matter is called sonochemistry. In other words, it is noise that is difficult for the human ear to process and eventually passes into hearing; for adults it is usually between 18 and 20 kHz. Although industry and academia have long recognized the "green" value of using ultrasound, only recently have synthetic and environmental scientists realized that acoustic radiation is not a problem. Ultrasound contains chemicals and objects through cavitation collapse, creating local pain clouds and causing the formation of chemical types that are difficult to obtain under normal conditions. Special reactivity to free radicals. This explanation, which can be understood without mathematics, shows the benefits of using this technology for many processes such as simpler processes, better chemical reactions with better results and options, creating catalysts and active substances, or other methods. dangerous reagent. Ultrasonic processing enables rapid dispersion and decomposition of organic materials (including biological components) and the formation of porous products and nanostructures.

This review summarises the ways in which ultrasound can be used to create a different kind of mild chemistry, similar to the way that acoustic waves can cause homolytic bond cleavage

PROTOCOL FOR SOLVENT-FREE SONOCHEMISTRY

A sequence of ambient-temperature ionic liquids known as 1-alkyl-3methylimidazolium (AMIM) halides are prepared with the help of ultrasounds. This process is carried out by the effective reaction of 1-methyl imidazole with alkyl halides or terminal dihalides. is described in terms of solvent-free conditions. Because of cavitational collapse, ultrasound irradiation (USI) can carry out a variety of organic reactions with exceptional results with regard to selectivities, yields, and reaction rates. Conversely, solvent-free synthesis has been garnered a lot of attention because environmental concerns about solvents' effects are growing. USI in tandem leads to environmentally friendly synthetic conditions and significantly increased selectivity when there are no solvent conditions. shorter reaction times, better yields and purities, and cleaner reactions.

The content in this chapter provides an overview of recent advancements in solvent-free heterocyclic compound synthesis with US assistance. The chapter is divided into two sections, to be more specific.

Organic Heterogeneous Catalysis

Solid phase catalysts and gas phase reactants are commonly used in heterogeneous catalysis. At the catalyst surface in this instance, a cycle of molecular adsorption, reaction, and desorption is taking place. Mass transmission, thermodynamics, and the rate (kinetics) of a reaction is influenced by heat transfer.

Water-Based Heterocyclic Synthesis

The chemical community has been compelled by economic and environmental pressures to look for more effective ways to carry out chemical transformations. In this context, organic reactions have received a great deal of attention. in the last ten years, and the field of water research and development is still growing at an exponential rate. Using water as a in addition to being affordable and safe for the environment, solvent produces entirely new reactivity. Numerous organic Reactions in aqueous media proceed quickly and produce excellent yields. Responses previously believed to be presently achievable that were previously unattainable in water.

Quinazolin-4(3H)-ones are an important class of fused heterocyclic compounds with diverse biological activities, including treatment of diabetes and obesity, inhibition of human erythrocyte purine nucleoside phosphorylase and poly (ADP-ribose) polymerase; antagonistic, antitumor, anti-inflammatory, insecticidal and antimicrobial properties. They are also important components in the production of natural products and are found in some isolated alkaloids found in nature. Previously, quinazolin-4(3H)-one derivatives were synthesized from 3-alkyl, heteroaryl and aryleneamine-1,2,3-benzotriazin-4-one in paraffin oil. It was prepared by pyrolysis and condensation in aldehyde at 300°C. 8 C. CuC is also available in refluxing ethanol, but the temperature in this process is problematic. Low efficiency, long reaction time and not environmentally friendly. Deep eutectic solvents (DES) were developed to solve eighteen problems of ionic liquid (IL) solvents. However, some authors consider them to belong to the IL category. However, other writers19 have said that these are important aspects of freedom. Different product categories. 20 This raises the question: Which solvent should be DES? Perhaps the current curriculum needs to be added to the 21st grade. This activity is about identifying ionic liquids and solvents. Solvent-Free [14]

Reactions

Since we are interested in the production of quinazolinones and now understand the use of environmentally friendly techniques in organic synthesis, this paper describes anthranilamide> Quinazolin-4(3H)-one is prepared via oxidative ring condensation mediated by different aldehydes. from I2/KI in boiling water (Method B) or ethanol-water (Method A). I2/KI solutions are prepared by dissociating specific molecular iodine in a saturated solution of potassium iodide. We were happy to see that the mixed anthranilamide came into contact with an aromatic aldehyde.

SOLVENTLESS REACTIONS

When there is a mixture of a solid and a liquid, the reaction in question is whether the solid will dissolve in the liquid phase or the liquid will adsorb to the upper edges of the material as an interfacial reaction. [10]

Organic Solvent Reaction

Everyone uses organic solvents through application in most of their daily activities br>Disinfectants can remove stubborn oils. The cologne and perfumes we use, the laundry detergents we use to keep our clothes clean, all these products are clean, fresh and extremely organic. [11]

Solvents and Ionic Liquids

To solve the problem of ionic liquid (IL) solvents, deep eutectic solvents (DES) have been introduced as an alternative. However, some authors consider them to belong to the IL category. Other authors, however, say that these are actually different, self-regulating devices. The question therefore arises: Where should the solvent DES be? Maybe a new group should be added to the existing group. [12]

CONCLUSION

Older methods that harm the environment, involve hazardous solvents, and are not atom-specific in the sense that they defy the principles of green chemistry must be updated or modified. In addition to improving student safety, this might also be sustainable in terms of the environment. This is the first time a novel strategy has been developed. Non-traditional methods are employed in organic synthesis. The synthesis of chemicals in an ecologically responsible manner depends heavily on catalysis. Numerous byproducts, co-products, potential wastes, and pollutants can be avoided by switching from a typical synthetic method to an ecologically friendly synthetic one. The feasibility of using catalysts for environmentally friendly synthesis is demonstrated by the elimination of many stages that are typically included in the process. In chemical synthesis, catalysts can be used to great advantage. Creating using eco-friendly technologies and creating eco-friendly chemicals.

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