



E-ISSN: 2709-9423
 P-ISSN: 2709-9415
 JRC 2020; 1(2): 71-77
 © 2020 JRC
 www.chemistryjournal.net
 Received: 13-06-2020
 Accepted: 17-07-2020

DT Sakhare
 U.G, P.G. & Research Centre,
 Department of Chemistry,
 Shivaji, Art's, Comm. &
 Science College Kannad. Dist.
 Aurangabad, Maharashtra,
 India

Correspondence
DT Sakhare
 U.G, P.G. & Research Centre,
 Department of Chemistry,
 Shivaji, Art's, Comm. &
 Science College Kannad. Dist.
 Aurangabad, Maharashtra,
 India

Challenges and their importance of green chemistry in daily life

DT Sakhare

Abstract

Green Chemistry is the plan of synthetic items and cycles that lessen or wipe out the utilization and age of substances risky to people, creatures, plants and the climate. It is an advanced science that arrangements with the use of natural agreeable synthetic mixtures and materials in the different parts of our life like modern uses and numerous others. The start of green science is considered as a reaction to the need to diminish the harm of the climate by man-made materials and the cycles used to deliver them. Green science could incorporate anything from diminishing waste to discarding waste in the right way. Science assumes a crucial part in deciding the personal satisfaction. The synthetic substances industry and other related ventures supply us a gigantic assortment of fundamental items, from plastics to drugs. Be that as it may, these ventures can possibly genuinely harm our current circumstance. Green science in this way serves to advance the plan and productive utilization of naturally harmless synthetics and substance processes. This load of focuses will be examined in this article.

Keywords: Green chemistry, environment, sustainability, safer synthetics, hazardous squanders

Introduction

Green Chemistry is defined as invention, design, development and application of chemical products and processes to reduce or to eliminate the use and generation of substances hazardous to human health and environment ^[1]. The green science insurgency is giving a gigantic number of difficulties to the people who practice science in industry, training and examination. With these difficulties be that as it may, there are an equivalent number of freedoms to find and apply new science, to work on the financial matters of compound assembling and to improve the much-messed up appearance of science. Green science is a way of thinking and investigation of the plan of items or substances that won't include materials unsafe to the climate. The ideal situation is to basically stop contamination before it can even start using non-poisons. Green science is a somewhat new space of science that arose by the need to lessen the risky impact of synthetics and to diminish the measure of ecological contamination that synthetic substances have. Every one of these will be talked about in this article.

The Green Chemistry insurgency gives a gigantic number of freedom to find and apply new manufactured methodologies utilizing elective feed stock; Eco amicable response conditions, energy minimization and the plan of less harmful and intrinsically more secure synthetics. The beginning and premise of Green Chemistry for accomplishing ecological and financial flourishing is inborn in a manageable world. One significant component of feasible science is generally characterized as the compound exploration focusing on the advancement of substance cycles and items as for energy and material utilization, intrinsic security, toxicity, environmental biodegradability, etc. ^[2]

While considering progress has been made in ecological science, Green Chemistry, and the natural appraisal of substance items, in any case, the cultural part of supportable science stays to be completely perceived in all parts of compound examination. One essential for this is the consideration of supportable science into substance training from the earliest starting point. Green Chemistry is the use of set of rules that lessens or kills the utilization or age of dangerous substances in plan, assembling and use of synthetic items. Practically speaking, Green Chemistry is taken to cover a lot more extensive scope of issues than the definition covers ^[3].

Just as utilizing and creating better synthetics with less waste, Green Chemistry additionally includes decreasing other related natural effects ^[3].

Remembering decrease for the measure of energy utilized in substance processes. Therefore, there have been efforts to accomplish earth harmless combination and different demonstrations have been passed to control and treat contamination, in an undertaking to urge enterprises and scholastic to devise novel advancements, processes and educational materials, debilitating the development or utilization of risky substances. Green Chemistry isn't unique in relation to customary science in however much it accepts similar inventiveness and development than has consistently been key to traditional science. In any case, there lies a distinction in that generally engineered scientific experts have not been believed to rank the climate extremely high in their needs. Yet, with the increment in natural cognizance all through the world, there is a test for scientists to foster new items, cycles and administrations that accomplish essential social, monetary and ecological targets [4].

Since the sorts of synthetic substances and the kinds of changes are quite fluctuated, so are the Green Chemistry arrangements that have been proposed. Created 'The twelve Principles of Green Chemistry' that fill in as rules for rehearsing scientists in creating and surveying how green a union, compound, interaction or innovation is [5].

The term Green Chemistry was begat [6] by Paul T. Anastas in 1991. The reason for existing is to plan synthetic substances and compound cycles that will be less unsafe to human well being and climate. Green science secures the climate, not by tidying up, but rather by designing new compound cycles that don't contaminate. The beginning and premise of Green Chemistry for accomplishing ecological and financial flourishing is innate in an economical world. The green science unrest is giving a huge number of difficulties to the individuals who practice science in industry, schooling and exploration. With these difficulties in any case, there are an equivalent number of freedoms to find and apply new engineered approaches utilizing elective feedstock; Eco well disposed response conditions, energy minimization, plan of less poisonous and intrinsically more secure synthetics and to work on the financial matters of compound assembling and to upgrade the much-sullied appearance of science. Green science is a way of thinking and investigation of the plan of items or substances that won't include materials hurtful to the climate. The ideal situation is to basically stop contamination before it can even start using non-poisons. Green science is a somewhat new space of science that arose by the need to diminish the risky impact of synthetic substances and to decrease the measure of natural contamination that synthetics have.



Fig 1: Green Chemistry

History of Green Chemistry

The term green science was first utilized in 1991 by P.T. Anastas in an extraordinary program dispatched by the US Environmental Protection Agency (EPA) to execute economical improvement in science and substance innovation by industry, the scholarly community and government. In 1995 the yearly US Presidential Green Chemistry Challenge was reported. Comparative honors were before long settled in European nations. In 1996 the Working Party on Green Chemistry was made, acting inside the system of International Union of Applied and Pure Chemistry. After one year, the Green Chemistry Institute (GCI) was framed with sections in 20 nations to work with contact between administrative offices and modern enterprises with colleges and examination organizations to plan and execute new advances. The principal gathering featuring green science was held in Washington in 1997. Since that time other comparable logical gatherings have before long hung consistently. The main books and diaries regarding the matter of green science were presented during the 1990s, including the Journal of Clean Processes and Products (Springer-Verlag) and Green Chemistry, supported by the Royal Society of Chemistry. Different diaries, like Environmental Science and Technology and the Journal of Chemical Education, have given areas to green science.

Green Chemistry and Sustainable Development

"Green science" and "support ability" are short clips, however another worldview that vows to lastingly affect the study of science. Green science and maintainability basically go connected at the hip. Maintainable advancement is addressing the requirements of the current age without compromising the capacity of people in the future to address their own issues. We really wanted greener science that effectively uses inexhaustible unrefined components, kills squander and keeps away from the utilization of harmful as well as perilous solvents and reagents in the two items and cycles to accomplish this respectable objective. Green science encapsulates two fundamental parts. To begin with, it resolves the issue of productive use of natural substances and the attending disposal of waste. Second, it manages the well being, security and ecological issues related with the production, use and removal or re-utilization of synthetic compounds. Green science is one of the most crucial and incredible assets to use on the way to support ability. Indeed, without green science and green designing, there is no way to support ability.

From the start Paul Anastas and John Warner underscored the new standards of Green Chemistry and the new way of thinking that must be followed to accomplish the economical eco-improvement of the compound business later on. Green Chemistry is generally introduced as a bunch of twelve standards proposed by Anastas and Warner [6]. The standards involve instructions for professional chemists to implement new chemical compound, new synthesis and new technological processes. The following list of twelve principles outlines an early conception of what would make a greener chemical, process or product.

- 1. Prevention:** It is better to prevent waste than to treat or clean up waste after it is formed. It goes back to the old saying "prevention is better than cure". It is better to prevent waste than clean it up after the fact [7].
- 2. Atom Economy:** Synthetic methods should be

designed to maximize the incorporation of all materials used in the process into the final product.

3. **Less Hazardous Chemical Synthesis:** Synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and environment ^[8]. Some toxic chemicals are replaced by safer ones for a green technology.
4. **Designing Safer Chemicals:** This principle is aimed at designing products with desired function while minimizing their toxicity ^[9].
5. **Safer Solvents:** This principle focuses on creating Safer Solvents and auxiliaries substances (e.g., solvents, separation agents, etc.) for workers and the environment ^[10]. It is obvious that water is the most inexpensive and environmentally benign solvent.
6. **Design for Energy Efficiency:** This principle focuses on creating products and materials in a highly efficient manner and reducing associated pollution and cost ^[11].
7. **Use of Renewable Feed Stocks:** Raw materials or feedstock should be renewable rather than depleting. Biodiesel is an example of this where researchers are trying to find alternative fuels that can be used for transportation ^[12].
8. **Reduce Derivatives:** Unnecessary derivatization (blocking group, protection/ deprotection) should be avoided whenever possible, because such steps require additional reagents and can generate more waste ^[13].
9. **Catalysis:** Catalysis and new catalytic reagents (enzymes, as selective as possible) are superior to stoichiometric reagents ^[14].
10. **Design for Degradation:** Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment ^[15].
11. **Pollution Prevention:** Everyone knows that prevention is better than cure from this pollution is better than pollution control. Pollution prevention is using materials, process or practices that reduce or eliminate pollution or wastes at the source.

Safer Chemistry for Accident Prevention: This principle focuses on safety for the worker and the surrounding community where an industry resides. It is better to use materials and chemicals that will not explode, light on fire, ignite in air, etc. when making a product ^[16]

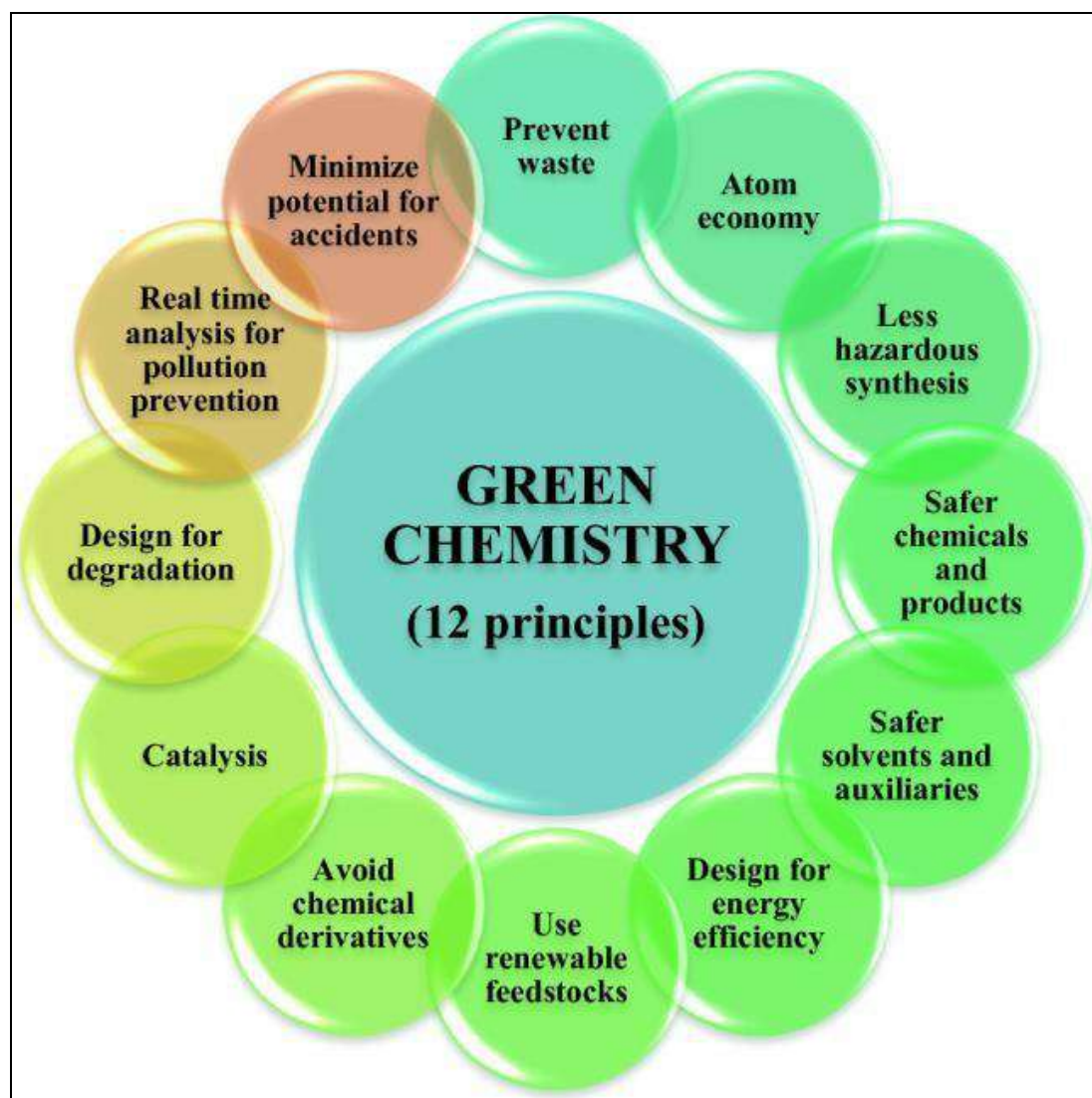


Fig 2: Principles of Green Chemistry

The challenges to chemists

Maintainable advancement is presently acknowledged by

state run administrations, industry and general society as a vital objective for accomplishing social, financial and

natural destinations. Inside this, science plays a vital part to play in keeping up with and working on our personal satisfaction, the seriousness of the compound business and the regular habitat. This job for science isn't for the most part perceived by government or the public. Truth be told synthetic substances, science and physicists are really seen by numerous individuals as reasons for the issues.

The test for scientists and others is to foster new items, cycles and administrations that accomplish the social, financial and ecological advantages that are currently required. This requires another methodology which decides to decrease the materials and energy force of synthetic cycles and items, limit or dispense with the scattering of destructive synthetic compounds in the climate, augment the utilization of inexhaustible assets and broaden the strength and recycle ability of items in a manner which increments modern seriousness. A portion of the difficulties for scientific experts incorporate the revelation and advancement of new engineered pathways utilizing elective feed stocks or more particular science, distinguishing elective response conditions and solvents for further developed selectivity and energy minimization and planning less harmful and innately more secure synthetic compounds. In synthetic amalgamation, the ideal will be a blend of various ecological, wellbeing and security and monetary targets. Albeit numerous scientists, and some huge and more modest organizations, are effectively seeking after 'green science' there are as yet numerous boundaries to advance. These remember an overall absence of mindfulness and preparing for schools, colleges and industry and an administration discernment that green science is an expense without benefits. The drive towards clean innovation in the synthetic business with an expanding accentuation on the decrease of waste at source will require a degree of advancement and new innovation that the compound business has not seen in numerous years. Mature compound cycles that are regularly founded on innovation created in the principal half of the twentieth century may presently don't be satisfactory in these ecologically cognizant days. 'Enviro-financial matters' will turn into the main thrust for new items and cycles. This can be seen by considering the always raising and different 'expenses of waste'. The expenses of waste can genuinely be tremendous.

The term green chemistry was first utilized in 1991 by Poul T. Anastas in an exceptional program dispatched by the US Environmental Protection Agency (EPA) to carry out economical advancement in science and substance innovation by industry, the scholarly world and government. In 1995 the yearly US Presidential green science challenge was reported. Comparative honors were before long settled in European nations. In 1996 the functioning party on green science was made, acting inside the system of International Union of Pure and Applied Chemistry (IUPAC). After one year the Green Chemistry Institute (GCI) was framed with sections in 20 nations to work with contact between legislative organizations and modern companies with colleges and exploration foundations to plan and carry out new advances. The primary meeting featuring green science was held in Washington in 1997. Since that time other logical gatherings have been before long hung consistently. The main book and diaries regarding the matter of green science were presented in 1990, including the Journal of Clean Processes and Green Chemistry, supported by the Royal Society of Chemistry. The idea of green science fuses

another way to deal with the combination, handling and utilization of synthetic substances in such way as to decrease dangers to well being and climate.

This new approach is also known as:

- Environmentally benign chemistry
- Clean chemistry
- Atom economy
- Benign-by-design chemistry

Green chemistry in day-to-day life

Scientific experts from everywhere the world are utilizing their inventive and imaginative abilities to foster new cycles, engineered techniques, response conditions, impetuses and so on, under the new Green science ideas. Business uses of green science have prompted novel scholarly exploration to look at options in contrast to the current engineered techniques. A portion of these are:

1. The utilization of phosgene and methylene chloride in the blend of polycarbonates has been supplanted by diphenylcarbonate.
2. The most dirtying response in industry is oxidation. Execution of green science has prompted the utilization of option less dirtying reagents viz., metal particle pollution is limited by utilizing sub-atomic O₂ as the essential oxidant and utilization of very high oxidation state progress metal edifices.
3. A helpful green blend of acetaldehyde is by Wacker oxidation of ethylene with O₂ in presence of acatalyst, instead of its amalgamation by oxidation of ethanol or hydration of acetylene with H₂SO₄.
4. Conventional methylation responses utilizing harmful alkyl halides or methyl sulfate prompting ecological peril are supplanted by dimethyl carbonate without really any store of inorganic salts.
5. In 1996, Dow Chemical won 1996 Greener Reaction grant for their 100% carbon dioxide blowing specialist for polystyrene froth creation. Polystyrene froth is a typical material utilized in pressing and food transportation. Generally, CFC and other ozone draining synthetics were utilized in the creation cycle of the froth sheets, introducing a genuine natural peril. Dow Chemical found that very basic CO₂ works similarly just as a blowing specialist, without the requirement for dangerous substances, permitting the polystyrene to be all the more effectively reused. The CO₂ utilized in the process is reused from different businesses, so the net carbon set free from the interaction is zero.
6. Propylene oxide (PO) is a substance building block for an assortment of items including cleansers, polyurethanes and food added substances. Conventional PO creation utilizes chlorohydrin which prompts co items, for example, t-butyl liquor, styrene monomer or cumene. Its assembling makes side-effects, including a lot of waste. Dow and BASF have mutually fostered another course to make propylene oxide with hydrogen peroxide and propylene that kills the majority of waste. Dow and BASF have together fostered another course to make propylene oxide with hydrogen peroxide and propylene that takes out the majority of waste.
7. Historically, chlorofluorocarbons (CFCs) have been utilized as refrigerants in climate control systems and fridges. CFCs enjoy the benefits of safe

- incombustibility, high security, and low harmfulness, yet tragically they obliterate the ozone layer. In the previous decade, different hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) have supplanted CFCs. HCFC and HFCs are, to be sure, more secure for the ozone layer.
8. Chelates are intricate that connect with metal particles, frequently expanding the dissolvability of the metal particle. They are utilized in many sorts of cleaners and modern cycles. Regular chelates depend on amino carboxylic acids (e.g., ethylenediaminetetraacetic corrosive, EDTA) and phosphates (e.g., sodium tripolyphosphate). Tragically, on the grounds that EDTA isn't promptly biodegradable and in light of the fact that phosphates can cause contamination by means of eutrophication, these traditional materials are regularly seen as earth hostile. Akzo Nobel has fostered a promptly biodegradable chelating specialist that is made basically from a sustainable feed stock. This new chelate, called tetrasodium L-glutamic acid, N, N-diacetic corrosive (GLDA), will supplant phosphates in programmed dish washing cleansers. GLDA is made from the character enhancer monosodium glutamate (MSG) in a basically squander free combination. MSG is made by aging promptly accessible corn sugars and is viewed as a sustainable material. The amalgamation of GLDA remembers exemplary cyanomethylation of the essential amino nitrogen for the MSG followed by in situ soluble saponification. Conversely, with EDTA whose carbon is fossil-based, however in GLDA is biobased. Since GLDA is profoundly solvent, it will be presented at an altogether higher focus (roughly 30% higher molar fluid fixation) than EDTA, decreasing vehicle and bundling costs just as bundling waste. Most altogether, GLDA is promptly biodegradable and will lessen contamination by supplanting phosphates in dish washing cleansers.
 9. Spinosad is an okay pesticide in wide spread use on crops. Spinosad adsorbs unequivocally to soils and natural matter, corrupts photochemically at the site of utilization, and is intrinsically unsteady in water. These qualities make it incredible for use ashore, however had forestalled its utilization in watery conditions. Spinosad is a naturally protected pesticide yet isn't steady in water thus accordingly can not be utilized to control mosquito hatchlings. Clarke dispatched Natular in the U.S. market in December 2008. Natular, a spinosad based mosquito larvicide that gives superb control in sea-going conditions. It is multiple times less harmful than the organophosphate elective, doesn't endure in the climate and isn't poisonous to natural life.
 10. Green Dry Cleaning of Clothes Perchloroethylene (PERC), $\text{Cl}_2\text{C}=\text{CCl}_2$ is normally being utilized as a dissolvable for cleaning. It is presently realized that PERC taints ground water and is a presumed cancer-causing agent. An innovation, known as Micell innovation created by Joseph De Simons, Timothy Romark, and James McClain utilized fluid CO_2 and a surfactant for cleaning garments, consequently supplanting PERC. Cleaning machines have now been created utilizing this method. Micell Technology has additionally advanced a metal cleaning framework that utilizes CO_2 and a surfactant consequently killing the need of halogenated solvents.
 11. Versatile Bleaching Agents is normal information paper is made from wood (which contains around 70% polysaccharides and around 30% lignin). For great quality paper, the lignin should be totally eliminated. At first, lignin is taken out by putting little chipped pieces wood into a shower of sodium hydroxide (NaOH) and sodium sulfide (Na_2S). By this interaction around 80-90% of lignin is deteriorated. The excess lignin was so far eliminated through response with chlorine gas (Cl_2). The utilization of chlorine moves all the lignin (to give great quality white paper) however aims natural issues. Chlorine additionally responds with sweet-smelling rings of the lignin to deliver dioxins, for example, 2,3,4-tetrachlorodioxin and chlorinated furans. These mixtures are expected cancer-causing agents and cause other medical conditions. These halogenated items discover their direction into the natural pecking order lastly into items, pork, hamburger and fish. Considering this, utilization of chlorine has been debilitate. In this way, chlorine dioxide was utilized. Other dyeing specialists like hydrogen peroxide (H_2O_2), ozone (O_3) or oxygen (O_2) likewise didn't give this the ideal outcomes. A flexible specialist has been created by Terrence Collins of Camegie Mellon University. It includes the utilization of H_2O_2 as a fading specialist within the sight of certain activators referred to as TAML activators that as impetuses which advance the change of H_2O_2 into hydroxyl extremists that are associated with oxidation (fading). The reactant of TAML activators permit H_2O_2 to separate more lignin in a more limited time and at much lower temperature. These dyeing specialists discover use in clothing and results in lesser utilization of water.

Industrial interest in green chemistry

Many forward-looking organizations are accepting Green Chemistry, not exclusively to secure the climate and to make great advertising, yet in addition since it is frequently useful to the main concern it is additionally assessed to cost US ventures between \$ 100 and \$ 150 billion every year to agree with ecological guidelines. What's more, tidying up unsafe waste locales will cost many billions of dollars. In many organizations, the expense of managing natural guidelines regularly surpasses their use for research. Bigger organizations financial plan near \$ 1 billion every year for natural consistence. Assuming an organization can essentially diminish this use, these assets can be spent in more useful regions and result in a worked on primary concern. Consequently, Green Chemistry (contamination avoidance) isn't just useful for the climate yet additionally for industry.

Green chemistry in education

Persuading scientific experts to think in a harmless to the ecosystem way starts with schooling. Remembering Green Chemistry for science instruction was first advanced in 1994. Hardly any Green science reading material have additionally been distributed. Graduates, post alumni, instructors and scientists will discover these books of huge use. Both Environmental Protection Agency (EPA) and American Chemical Agency (ACS) have perceived the significance of carrying Green Chemistry to the study hall and the research facility. Together they have dispatched a critical mission to foster Green Chemistry instructive

materials and to support the 'greening' of the science educational program. Understudy association in Green Chemistry standards and practices is vital for the incorporation the ecologically harmless advances in scholarly community and industry. ACS Student Affiliate Chapters might be perceived as "green" sections by participating in no less than three Green Chemistry exercises during the scholastic year. Ideas for these exercises include: Hosting a Green Chemistry speaker

- Organizing an interdisciplinary Green Chemistry workshop on campus.
- Working with a local company on a Green Chemistry project.
- Developing a Green Chemistry activity with a local school.
- Converting a current laboratory experiment into a greener one.
- Organizing a Green Chemistry poster sessions on campus.
- Distributing a Green Chemistry Newsletter to the local community.
- Designing a green Chemistry web page.

Global education and recognition of green chemistry

(A) Education: Many institutions offer course and degrees on Green Chemistry. Examples from across the globe are Denmark's Technical University, and several in the US, e.g. at the Universities of Massachusetts-Boston, Michigan, and Oregon. A masters level course in Green Technology, has been introduced by the Institute of Chemical Technology, India. In the UK at the University of York University of Leicester, Department of Chemistry and MRes in Green Chemistry at Imperial College London. In Spain different universities like the

Universitat Jaume I or the Universidad de Navarra, offer Green Chemistry master courses. There are also websites focusing on green chemistry, such as the Michigan Green Chemistry Clearinghouse at www.migreenchemistry.org. Apart from its Green Chemistry Master courses the Zurich University of Applied Sciences ZHAW presents an exposition and web page "Making chemistry green" for a

broader public, illustrating the 12 principles.

(B) Awards: Several scientific societies have created awards to encourage research in green chemistry.

1. Australia's Green Chemistry Challenge Awards overseen by The Royal Australian Chemical Institute (RACI).
2. The Canadian Green Chemistry Medal.
3. In Italy, Green Chemistry activities center on an inter-university consortium known as INCA.
4. In Japan, The Green & Sustainable Chemistry Network oversees the GSC awards program.
5. In the United Kingdom, the Green Chemical Technology Awards are given by Crystal Faraday.
6. In the US, the Presidential Green Chemistry Challenge Awards recognize individuals and businesses.

(C) Scientific Journals Specialized in Green Chemistry: Several scientific international journals which are specialized in the field of green chemistry.

1. Green Chemistry (RSC)
2. Green Chemistry Letters and Reviews (Open Access) (Taylor & Francis)
3. Chem Sus Chem (Wiley)
4. ACS Sustainable Chemistry & Engineering (ACS)

9. Conclusion

Green science is certainly not another part of science. It is another philosophical methodology that through application and expansion of the standards of green science can add to maintainable turn of events. Incredible endeavors are as yet embraced to plan an ideal cycle that beginnings from non-dirtying materials. Unmistakably the test for the future compound industry depends on creation of more secure items and cycles planned by using novel thoughts in basic examination. Besides, the achievement of green science relies upon the preparation and training of another age of physicists. Understudy at all levels must be acquainted with the act of green science. At last, with respect to the job of schooling in green science:



Fig 2: "The Biggest Challenge Of Green Chemistry Is To Use Its Rules In Practice"

References

1. Sakhare DT. Green Chemistry and Sustainable Development, International Journal for Innovative Research in Multidisciplinary field. 2021, 196-202.
2. Singh A, Sharma R, Anand KM, Khan SP, Sachan NK. Food- drug interaction, International Journal of Pharmaceutical & Chemical Science. 2012;1(1):264-279
3. Lancaster M. Education in Chemistry. 2000;27(2):40-46.
4. Singh A, Sharma R, Anand KM, Khan SP, Sachan NK, Ashwini Kumar Singh. CYP450 Mediated-Drug Interaction, Journal of Pharmacy Research. 2012;5(2).
5. Anastas P, Warner JC. Green Chemistry: Theory and Practice, Oxford Science Publications, Oxford. 1998.
6. Anastas PT, Warner JC. Green Chem. Theory and Practice, Oxford Univ. Press, New York. 1998.
7. Namienik J, Wardencki W. Solvent less sample preparation techniques in environmental analysis. J. High Resol. Chromatogr. 2000;23:297.
8. Sato K, Aoki M, Noyori R. A Green Route to Adipic Acid: Direct Oxidation of Cyclohexenes with 30 percent hydrogen peroxide. Science. 1998;281:1646.
9. Singh A, Sharma R, Anand KM, Khan SP, Sachan NK. Food drug interaction, International Journal of Pharmaceutical & Chemical Science. 2012;1(1):264-279.
10. Bardley D, Dyson P, Welton T. Room temperature ionic liquids. Chem. Rev. 2000;9(5):18.
11. Romano U, Garbassi F. The environmental issue. A challenge for new generation polyolefins. Pure Appl. Chem. 2000;72:1383.
12. Nicolas N, Benvegnu T, Plusquellec D. Surfactants from renewable resources. Actualite Chimique 2002;70:11-12.
13. Stashenko EE, Puertas AM, Salgar W, Del Gado W, Martinez JR. Solidphase micro extraction with on fibrederivatization applied to the analysis of volatile carbonyl compounds. J. Chromatogr. A 2000;886:175.
14. Acardi A, Bianchi G, Di Giuseppe S, Marinel Li F. Gold catalysis in the reaction of 1,3- dicarbonyls with nucleophiles. Green Chemistry. 2003;5(1):64.
15. Scott G. Green polymers. Polym. Degrad. Stab 2000;68(1):1.
16. Tundo P, Selva M, Memoli S. Dimethylcarbonate as a green reagent. ACS Symp. Ser, 767 Green Chemical Syntheses and Processes 2000; 87. PT Anastas, IT Horvath. Innovations and Green Chemistry, Chem. Rev. 2007;107:216.