

Green Chemistry and Sustainability

Name

Institutional Affiliation

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Question 1: Tools used in adopting the principles of Green Chemistry in developing new reactions

- Green chemistry aims at minimizing the generation of harmful substances through the design of chemical products and progressions. The concept was first formulated in the 1990s about 20 years ago. Since then, it has been adopted internationally through the creation of literally hundreds of programs for both Governmental and Non-governmental initiatives.

- The program is approved worldwide for leading programs located in U.S.A, United Kingdom, and Italy. These may be conducted through the use of catalysis, applied in the form of –homogenous, heterogeneous, organ catalysis and bio catalysis. In this lecture review, the primarily concepts essential when dealing with principles of green and sustainable chemistry are well discussed.

- These includes atoms and the E-factor as well as the general context of efficiency in organic synthesis (Edgar, Koroluk, Golmakani & Dicks, 2014). Furthermore, the tutorial further explains the importance of waste elimination and minimization through widespread application the green chemistry. The primary role of this program is fostering the significance of green and sustainable design. Below are some of the early programs conducted in the same area;

- i. US Presidential Green Chemistry Award carried out in 1995

- ii. Green Chemistry Institute formed in 1997

- iii. Edition of the Green Chemistry journal in 1999

- Subsequently, the key aspect of Green Chemistry is the focus on the concept of design. The design may be defined as the systematic planning and conception of ideas. Chemists create twelve rules to help them achieve the international goal of sustainability (Graham, Jones, Schaller & McIntee, 2014).

- Green chemistry is mainly characterized by proper planning of chemical synthesis as well as molecular design which helps in reducing adverse consequence. Proper planning and design assist one in achieving synergies and not merely trade-offs. The mandate of Green chemistry is to assist in striving sustainability at the molecular level.

- Taking into consideration that because of that goal it is widely applied in all industrial sectors. In Green Chemistry, we have three main frameworks which must be taking into consideration and are summarized as

- Life-cycle in Green Chemistry design which cuts across all the stages

- The one that seeks to create the inherent in chemical products and processes to reduce their hazardous effects

- Green Chemistry that works as a cohesive system with the principles of design criteria.

- However, the twelve principles of Green Chemistry are design principles or guidelines that provide one with a framework for sustainable design (Overton & Randles, 2015). The world Commission on Environment and Development was given the mandate of working on a report on the perspective ways, sustainable and environmentally friendly development on our ecosystems scaled to 2000 and after that.

- The report publication depicted on the sustainability of the environment without compromising the ability of future generations while striving to meet our needs as well as for the future generation. Subsequently, in succeeding two decades, the concepts of these sustainability has become the center of focus when taking industry as well as society as a whole into consideration.

- The concept of Green Chemistry may be embodied and summarized as twelve principles Below are some of the available tools that maybe used in adopting the principles of Green Chemistry for developing new reaction or products

- Waste prevention in subsequent of its remediation
- Atom efficiency
- Less poisonous chemicals
- Designing of safer products
- Design of efficient energy
- Harmless solvents and auxiliaries
- Environmental friendly renewable raw materials
- Shorter synthesis
- Design products for degradation
- Catalytic rather than stoichiometric reagents
- Analytical methodologies for pollution prevention
- Inherently safer processes

Question 2: Ways of improving Green chemistry in the synthesis of a material

- The first principle of Green Chemistry is waste prevention and management in product processing. In the most occasion where there is the generation of materials of less value in the market, or the ones that require a significant amount of energy while giving low income to the company may be considered as a loss.

- Waste can take many forms and can have the major impact on the environment as well as society as a whole. These may include its toxicity, quantity, and mode of deposition. The concept of waste prevention and E-Factor was first introduced in 1992 by Roger Sheldon R. From then, the idea has been accepted worldwide as the Environment Impact Factor and is being used across all sectors in processing industries (Clark, 2016).

- Atom Economy aims at maximizing the use of raw ingredients in ensuring that the end products contain the maximum required some atoms from the reactants. Atomic Efficiency is defined as the ratio of the molecular mass of the desired product over the molecular weights of all the necessary reactants in a given reaction.

- Atom Economy is just a theoretical value predestined to quickly assess how efficient a reaction will be. Imitation toolbar of carbon-based chemists has improved by a significant amount from the past decade. A chemist has been able to develop more reactions from the real green reaction.

- The ultimate in efficient is mostly used in organic synthesis to harness the total amount of energy required to synthesize fuels and chemicals in a sustainable manner from carbon dioxide and water in green chemistry (Dodson, Summerton, Hunt & Clark, 2015).

- Safer solvents and Auxiliaries: In most ideal situations, it will not be advisable to include an auxiliary as this may require effort and energy to remove it from a designated system. Hence effort have been devoted to develop a solvent less system. The idea was reinforced and put in place to ensure that industrial waste are dissolve in a solvent account. Depending on the properties of the reagents used, the approach that one maybe employ as well as redesigned chemistry to allow the reaction to proceed without the original solvent.
- Designing of safer chemicals: Industries and companies need to design chemical products which preserve efficacy of the functions while minimizing the toxicity.
- Design for Energy Efficiency: Energy is a fundamental requirement in any chemical process. The plant operator should ensure that energy used in any production should be recognized for their impact on environmental and economic impact and minimized where possible.
- Twenty years back then it as evident that a new prototype for efficiency in organic synthesis was needed. The new prototype included the introduction of the principles of green chemistry as well as the underlying concepts of waste minimization, Environment Impact Factor, and atom efficiency that is used to provide an answer related to the Green Chemistry. With time most industries and the society as a whole.
- Two, the extensive reduction in the waste generation have achieved through the use of stoichiometric reagents with greener catalytic alternatives. Furthermore, chemists are now working on green chemistry to come up with designs which are environmentally friendly and are more efficient.

References

- Edgar, L. J., Koroluk, K. J., Golmakani, M., & Dicks, A. P. (2014). Green chemistry decision-making in an upper-level undergraduate organic laboratory. *Journal of Chemical Education*, 91(7), 1040-1043.
- Graham, K. J., Jones, T. N., Schaller, C. P., & McIntee, E. J. (2014). Implementing a Student-Designed Green Chemistry Laboratory Project in Organic Chemistry. *Journal of Chemical Education*, 91(11), 1895-1900.
- Overton, T. L., & Randles, C. A. (2015). Beyond problem-based learning: using dynamic PBL in chemistry. *Chemistry Education Research and Practice*, 16(2), 251-259.
- Dodson, J. R., Summerton, L., Hunt, A. J., & Clark, J. H. (2015). Green Chemistry Education at the University of York: 15 years of experience.
- Clark, J. H. (2016). *Green and Sustainable Chemistry: An Introduction*.