Recent Advances and Applications in Modern Synthetic Chemistry

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SCIENG PUBLICATIONS

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APPLICATION OF GREEN CHEMISTRY

DR. SACHIN AATMARAM KHISTE*[1], MUKESH SHANKARRAO KADAM[2], DR. MAHENDRA N. LOKHANDE[3]

[1]Vaishnavi Mahavidyalay Wadwani, Dist. Beed, (M. S.) India,
[2]LGM ACS College Mandangad, (M. S.) India,
[3]Avvaiyar Govt. Coolege for Wowen Karaikal, (M. S.) India,
*Corresponding Author: Dr. Sachin Aatmaram Khiste, Email: ksachinraje@gmail.com.

ABSTRACT
Green chemistry is a branch of chemical engineering and chemistry concerned with the development of products and processes that reduce or eliminate the usage of harmful compounds which is also known as sustainable chemistry, whereas environmental chemistry is related with the effects of damaging chemicals on the environment, green chemistry is concerned with chemistry's environmental impact, such as reducing the use of non-renewable resources and developing technical solutions.

KEYWORDS: Sustainable Chemistry, Use of Green Chemistry, Environmental Chemistry.

INTRODUCTION

USES OF GREEN CHEMISTRY

Governments and scientific communities all around the world know that green chemistry and engineering not only contributes to a cleaner more sustainable environment but it is also economically advantageous and has several social benefits. These advantages motivate firms and governments to invest in the development of environmentally friendly products and processes. Since 1996 the United States has given out an annual prize the Presidential Green Chemistry Challenge Award to recognize and reward major contributions in Green Chemistry. The successes in green chemistry listed below demonstrate how it affects a wide range of areas from pharmaceuticals to house wares and provides a route to a better future (Schnitzer *et. al.* 2007, Peters *et. al.* 2016, Nixon *et. al.* 1971).

1. LAB TO THE FIELD

The Nobel Prize in Chemistry was granted in 2005 for the discovery of metathesis a catalytic chemical process with broad industrial use. It saves a lot of energy and has the potential to minimize greenhouse gas emissions in a lot of operations. At normal temperatures & pressures, the process is stable and it may be used with greener solvents to produce less hazardous waste. Elegance Renewable Sciences earned the Presidential Green Chemistry Challenge Award in 2012 for breaking down natural oils and recombining the pieces into high-performance compounds via metathesis. The company creates specialty chemicals for a variety of applications, including highly concentrated cold-water detergents that clean more effectively while using less energy (Clark *et. al.* 2012).

2. MEDICINE

The pharmaceutical industry is always looking for new ways to manufacture drugs with fewer hazardous side effects and to use less toxic manufacturing procedures Merck and Codexis collaborated to create the active ingredient in Januvia TM, a type 2 diabetes treatment, is a second-generation green synthesis of sitagliptin. This partnership resulted in an enzymatic process that eliminates the requirement for a metal catalyst while reducing waste, increasing yield and improving safety early research suggests that the new biocatalysts could also be used to make other medications. Simvastatin a medicine that was previously known by the brand name Zocor is a popular treatment for high cholesterol. The conventional multistep procedure for producing this drug utilized a lot of dangerous reagents and generated a lot of toxic waste in the process. Professor Yi Tang of the University of California developed a synthesis employing a low-cost feedstock and a modified enzyme. Both the enzyme and the chemical procedure were refined by Codexis a biocatalysts business. The end solution significantly minimizes risk waste is cost-effective and matches client needs (Kim *et. al.* 2008).

Pharmaceutical firms have ability to get better their ecological concert by utilizing green chemistry awareness. It is working to develop novel medication delivery techniques that are less harmful, more useful, and efficient, and could potentially benefit millions of people.

Phosphonamidite: a solid-phase mixture of antisense oligonucleotides that has been modified to be traditional to green chemistry principles by eliminating the formation and use of toxic materials and recycling such as solid support and amidites materials, thereby improving atom economy and cost-efficiency (Anastas*et. al.* 2000).

3. PLASTICS

Several firms have been working on developing renewable biodegradable polymers. Food containers are made from a polymer called polylactic acid or polylactide which is obtained by condensation of lactic acid with loss of water, which is marketed as Ingeo by Nature Works of Minnetonka Minnesota. Microorganisms convert corn-starch into a resin that is just as strong as the stiff petroleum-based plastic now used for containers like water bottles and yoghurt pots according to Nature Works experts. The company is pursuing agricultural waste as a source of raw material. Eco flex is a biodegradable polyester film manufactured by BASF. They are producing and marketing Ecovio entirely biodegradable bags comprised of this film, cassava starch and calcium carbonate. In industrial composting systems the bags totally decompose into water, CO_2 and biomass according to the Biodegradable Products Institute. Tea-resistant, puncture-resistant, waterproof, printed and elastic bags are available. Kitchen and yard garbage will swiftly breakdown in municipal composting systems if these bags are used instead of regular plastic bags (M. Kirchhoff *et. al.* 2002).

4. PAPER INDUSTRIES

The paper is made of wood, so there are no bleaching agents. The wood is most likely composed of 70% carbohydrates and 30% lignin. To make good quality paper, the amount of lignin in the wood must be eliminated. Sodium hydroxide, sodium sulfide and chlorine gas are among the chemicals used to remove lignin. On the other hand, it contributes to environmental damage and a slew of other issues. The reaction of lignin breakdown with chlorine produces a variety of other toxic compounds. Tetrachloropdioxin and Chlorinated furans are examples of dioxins and furans generated. They are the by-products of lignin's aromatic rings reacting with chlorine. These products cause a variety of health issues, including cancer. Other agents, such as H_2O_2, O_3, or O_2, likewise failed to provide the required results. Camegie Mellon University's Terrence Collins has created a flexible agent. The bleaching agent is hydrogen peroxide, which is used in the presence of several activators known as Tetra Amido Macrocyclic Ligands [TAMLs] (Hall *et. al.* 1999, Tundo *et. al.* 1998).

5. PAINT

Oil-based alkyd (which is polyester resin improved by addition of component and fatty acids) paints emit a lot of volatile organic compounds (VOCs). These volatile molecules evaporate when the paint dries, cures and many of them have one or more environmental repercussions. Procter & Gamble Cook Composites of Polymers created a soya oil and sugar blend to replace fossil-fuel-derived paint resins and solvents, which resulted in a 50% reduction in harmful volatiles. These bios based Sefose oils are used in Chempol MPS paint compositions to substitute petroleum-based solvents resulting in paint that is safer to use and produces less harmful waste. Sherwin-Williams developed low-VOC water-based acrylic alkyd paints from recycled soda bottle plastic (PET), acrylics, and soybean oil. These paints combine the benefits of alkyds with acrylics' low VOC content. According to the company, Sherwin-Williams generated enough of these new paints in 2010 to reduce over 800,000 pounds of VOCs (Yogesh *et. al.* 2001).

6. CHEMICALS

Chemicals derived from glucose: These chemical compounds are a group of chemicals that can be mass-produced on a large scale to meet international demand. Glucose can be used as a substitute for compounds product. The strategies of Biotechnology are employed to manage the manufacturing of fragrant chemicals, which include catechol, hydroquinone, and adipic acid, all of which are important but can be manufactured. Benzene is the first substance utilized for these materials, and substituting glucose for benzene can help reduce the use of other harmful chemicals.

Polysaccharides are a class of molecules that comprise a wide range of packaging. They have their own set of perilous repercussions; chemicals of various types can be used. Polysaccharide as a feedstock must be used as a starting material because it is a significantly more environmentally friendly feedstock. These are organic and can be used in place of petroleum feedstock since they are renewable or feasible. On the other hand, these have no long-term damage to the environment or human health. The production of halide-free aromatic amines entails the following steps: Traditional aromatic amine production involves reacting benzene with chlorine using nitrogen then nucleophilic substitution of chlorine takes place with a new group. Tetramethyl ammonium salts are formed by heating nitrobenzene and aniline in the presence of tetramethyl ammonium hydroxides. The method does not use halogenation intermediates (Wardencki *et. al.* 2004).

7. CHIPS FOR COMPUTERS

To produce computer chips a lot of chemicals, a lot of water and a lot of energy are required. The industrial estimate of chemicals and fossil fuels required to build a computer chip was a 630:1 ratio that means 630 times the chip's weight in source materials is required to make only one chip. In 2003 research when compared to the 2:1 ratio used in the production of an automobile this is a significant difference.

Los Alamos National Laboratory scientists have created a procedure that uses supercritical carbon dioxide in one of the chip preparation phases considerably reducing the amount of chemicals, energy and water required. Richard Wool the former director of the University of Delaware's ACRES i.e., Affordable Composites from Renewable Sources programme discovered a means to build computer chips out of chicken feathers; the feather protein keratin was employed to create a fibre that is both light and robust enough to withstand mechanical and thermal loads. As a result, a feather-based printed circuit board can work twice as fast as standard circuit boards. Although commercialization of this technique is still in the works, the research has led to various applications of feathers as a source material such as biofuel (Jessop *et. al.* 1999, Hjeresen *et. al.* 2000).

8. CLEANING AGENT

In the present time, the use of alum salt to treat industrial and municipal waste water is common. Alumina had been suggested as a poor choice for this purpose since it increases harmful ions in discharge water and may induce Alzheimer's disease. So, agricultural waste that is discharged, such as tamarind seeds and kernel powder, acts as a capable agent to clean industrial and municipal waste water. The kernel powder is harmless, more environmentally friendly and less expensive compare to alum. For the tests, four different flocculants were used: kernel powder, tamarind seeds, starch and alum mixture. Slurries are made by mixing the additives with a measured amount of clay, sand, and water (Jessop *et. al.*1999, Hjeresen *et. al.* 2000).

CONCLUSION

Chemistry has created a plethora of useful products from pharmaceuticals, and it not only produces the desired product but also produces dangerous and undesirable waste. This has become a significant concern for environmental sustainability, necessitating the development of more efficient methods to eliminate these errors. Synthesizing non-harmful products is a challenge for the future industries. Green chemistry gives a strong foundation for overcoming these hazardous pollutants. It brings up a wide range of research opportunities for the development of more efficient reaction processes that reduce waste while increasing the target product yield. Green chemistry, on the other hand, is insufficient to mitigate these effects. It necessitates the use of Poul T. Anastas and J.C. Warner's twelve green chemistry principles. They contribute to making the planet a greener place. It is possible to acquire reliable and exact findings of analysis by employing suitable sample preparations. Massive efforts are still being made to create a superior process that starts with pollution-free raw materials, produces no secondary products, and does not require the use of solvents for purification, isolation, or chemical conversion. It is critical to make green chemistry principles obvious to students in order to achieve better results.

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