International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | | Impact Factor: 4.988| Monthly Peer Reviewed Journal |

| Volume 3, Issue 2, February 2020 |

A Study on the Role of Green Chemistry in Daily Life

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ABSTRACT: Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal.

Green chemistry:

- Prevents pollution at the molecular level
- Is a philosophy that applies to all areas of chemistry, not a single discipline of chemistry
- Applies innovative scientific solutions to real-world environmental problems
- Results in source reduction because it prevents the generation of pollution
- Reduces the negative impacts of chemical products and processes on human health and the environment
- Lessens and sometimes eliminates hazard from existing products and processes
- Designs chemical products and processes to reduce their intrinsic hazards

KEYWORDS-green,chemistry,pollution,hazard,environment,health

I. INTRODUCTION

Green chemistry reduces pollution at its source by minimizing or eliminating the hazards of chemical feedstocks, reagents, solvents, and products.

This is unlike cleaning up pollution (also called remediation), which involves treating waste streams (end-of-the-pipe treatment) or cleanup of environmental spills and other releases. Remediation may include separating hazardous chemicals from other materials, then treating them so they are no longer hazardous or concentrating them for safe disposal. Most remediation activities do not involve green chemistry. Remediation removes hazardous materials from the environment; on the other hand, green chemistry keeps the hazardous materials out of the environment in the first place.[1,2,3]

If a technology reduces or eliminates the hazardous chemicals used to clean up environmental contaminants, this technology would qualify as a green chemistry technology. One example is replacing a hazardous sorbent [chemical] used to capture mercury from the air for safe disposal with an effective, but nonhazardous sorbent. Using the nonhazardous sorbent means that the hazardous sorbent is never manufactured and so the remediation technology meets the definition of green chemistry.

II. DISCUSSION

Green chemistry's 12 principles

These principles demonstrate the breadth of the concept of green chemistry:

1. Prevent waste: Design chemical syntheses to prevent waste. Leave no waste to treat or clean up.

2. Maximize atom economy: Design syntheses so that the final product contains the maximum proportion of the starting materials. Waste few or no atoms.

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3. Design less hazardous chemical syntheses: Design syntheses to use and generate substances with little or no toxicity to either humans or the environment.

4. Design safer chemicals and products: Design chemical products that are fully effective yet have little or no toxicity.

5. Use safer solvents and reaction conditions: Avoid using solvents, separation agents, or other auxiliary chemicals. If you must use these chemicals, use safer ones.

6. Increase energy efficiency: Run chemical reactions at room temperature and pressure whenever possible.[5,7,8]

7. Use renewable feedstocks: Use starting materials (also known as feedstocks) that are renewable rather than depletable. The source of renewable feedstocks is often agricultural products or the wastes of other processes; the source of depletable feedstocks is often fossil fuels (petroleum, natural gas, or coal) or mining operations.

8. Avoid chemical derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.

9. Use catalysts, not stoichiometric reagents: Minimize waste by using catalytic reactions. Catalysts are effective in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and carry out a reaction only once.

10. Design chemicals and products to degrade after use: Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.

11. Analyze in real time to prevent pollution: Include in-process, real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.

12. Minimize the potential for accidents: Design chemicals and their physical forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and re**leases to the environment.**

III. RESULTS

Green chemistry's roots in the Pollution Prevention Act of 1990

To stop creating pollution in the first place became America's official policy in 1990 with the Federal Pollution Prevention Act .[23]

The law defines source reduction as any practice that:

- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal.
- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.[9,10,11]

The term "source reduction" includes:

- Modifications to equipment or technology
- Modifications to process or procedures
- Modifications, reformulation or redesign of products
- Substitution of raw materials
- Improvements in housekeeping, maintenance, training, or inventory control

Section 2 of the Pollution Prevention Act establishes a pollution prevention hierarchy, saying:

- The Congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible;
- Pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible;
- Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; an
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.[20,21,22]

Green chemistry aims to design and produce cost-competitive chemical products and processes that attain the highest level of the pollution-prevention hierarchy by reducing pollution at its source.

IV. CONCLUSIONS

For those who are creating and using green chemistry, the hierarchy looks like this:

1. Source Reduction and Prevention of Chemical Hazards
    - Designing chemical products to be less hazardous to human health and the environment*
    - Making chemical products from feedstocks, reagents, and solvents that are less hazardous to human health and the environment*
    - Designing syntheses and other processes with reduced or even no chemical waste
    - Designing syntheses and other processes that use less energy or less water
    - Using feedstocks derived from annually renewable resources or from abundant waste[12,13,15]
    - Designing chemical products for reuse or recycling
    - Reusing or recycling chemicals
2. Treating chemicals to render them less hazardous before disposal
3. Disposing of untreated chemicals safely and only if other options are not feasible

*Chemicals that are less hazardous to human health and the environment are:

- Less toxic to organisms
- Less damaging to ecosystems[17,18,19]
- Not persistent or bioaccumulative in organisms or the environment
- Inherently safer to handle and use because they are not flammable or explosive

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