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CONTRIBUTION OF GREEN CHEMISTRY INEVERYDAY LIFE, A REVIEW

Dr.Meenu[1],Dr.Meenu Dua[2] and Dr.Meenakshi Sharma[3]
[1]Associate Professor (Chemistry), K.L.P. College, Rewari, Haryana, India
[1]Corresponding Author (E-mail: ghai.meenu@ymail.com)
[2]Associate Professor (Chemistry), K.L. Mehta Dayanand College for Women, Faridabad, Haryana, India
[3]Associate Professor (Chemistry), Raffles University, Neemrana, Rajasthan, India

Abstract
"Green chemistry can be defined as the design of chemical products and processes that decrease or eliminate the use or generation of toxic and hazardous substances" - USEPA. The review article highlights the efforts of green chemistry, how the principles of green chemistry are helping the mankind towards sustainable and healthy environment on global level. Research based on green chemistry evolves eco-friendly methods for the preparation of packing peanuts, thermal receipts without toxic ink, advanced vanadium redox flow battery, eco-friendly dry cleaning, eco-friendly paints, medicines etc. Still it may take very long and great efforts to apply designs based on the green chemistry principles in each and every field. But Green Chemistry is a great and much required contribution towards making our mother earth and environment sustainable.

Key words: Hazardous substances, principles of green chemistry, packing peanuts, thermal receipts.

Introduction

"Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of toxic and hazardous substances"- USEPA. Some people may think remediation and Green Chemistry as similar terms, but these are different. Remediation may be termed as separation of hazardous chemicals from the environment whereas green chemistry refers to non-production of the hazardous substances from the very start. The green technology is the term that is used for a technology which involves reduction or elimination of harmful substances [1].IUPAC defines green chemistry as "The invention, design, and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances" [2]. Paul Anastas, known as the "Father of green chemistry" and John C. Warner co-authored a book, Green Chemistry: Theory and Practice, in 1998. The book includes twelve principles of Green Chemistry. These principles acted as a motivation and guide to the Academic and industrial scientists towards green chemistry movement [3]."Green Chemistry might be seen as the field in Chemistry which directly responds to the requests of humankind. Green Chemistry is a future-oriented approach to nurture the research in the chemical sciences with society and its needs"[4]. "Green Chemistry is a good key for students to look around the scientific disciplines and to decide how and where to go forward. At the same time, the interaction with their experienced peers is necessary to initiate good research practices and select useful practical solutions and to disseminate confidence in Science in their respective countries" [4].

Twelve Principles of Green Chemistry [5]

Twelve principles of Green Chemistry introduced by Paul Anastas and John Warnerthat provide the guidance for the process design for chemical production favouring biodegradable reagents,

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efficiencyand safe transformationhave been briefly summarised in the **Figure**.

Chemical process are now tried and preferred to be designed green whenever possible as per literature. Laboratories have been trying green methods for synthesizing and have been successful in many ways. Similarly many of the materials that are commonly used in daily lifehave also been tried to get synthesized using green methods, the efforts towards sustainable environment. Few of these are highlighted by reviewing the literature.

1. Packing peanuts or packing noodles that are utilized as packaging material for protecting breakable articles are generally made from the foam that is non-biodegradable. But Green Packaging or environment friendly packaging is proposed to be prepared naturally from plants and can be recycled and biodegradable [6]. Preparation follow Green Chemistry principles and Green Technology [7]. Packing peanuts have been prepared from renewable plant starch which can be converted to compost.Similarly starch, chitosan and cellulose that are edible biopolymers can be used to get films or coatings for applying on food surface and to wrap food products [8].

2. Thermal receipts without toxic bisphenol-A (BPA) and bisphenol-S (BPS) inks have been printed for tickets, tags, labels etc. Thermal paper technology was patented jointly by The DowChemical Company and Koehler. It is an alternative for conventional thermal papers that used to expose seller as well as end user to toxic image forming chemicals. This new thermal printing technology depend solely on the collapse of air voids in the paper coating during printing. Polymer properties are so designed that a physical change, rather than a chemicalreaction, creates the image. The costs is reduced by creating records that do not fade, even under shining sunlight, thereby allowing the original document to be preserved for long term storage. The paper is well-suited with thermal printers currently in commercial use around the world [9].

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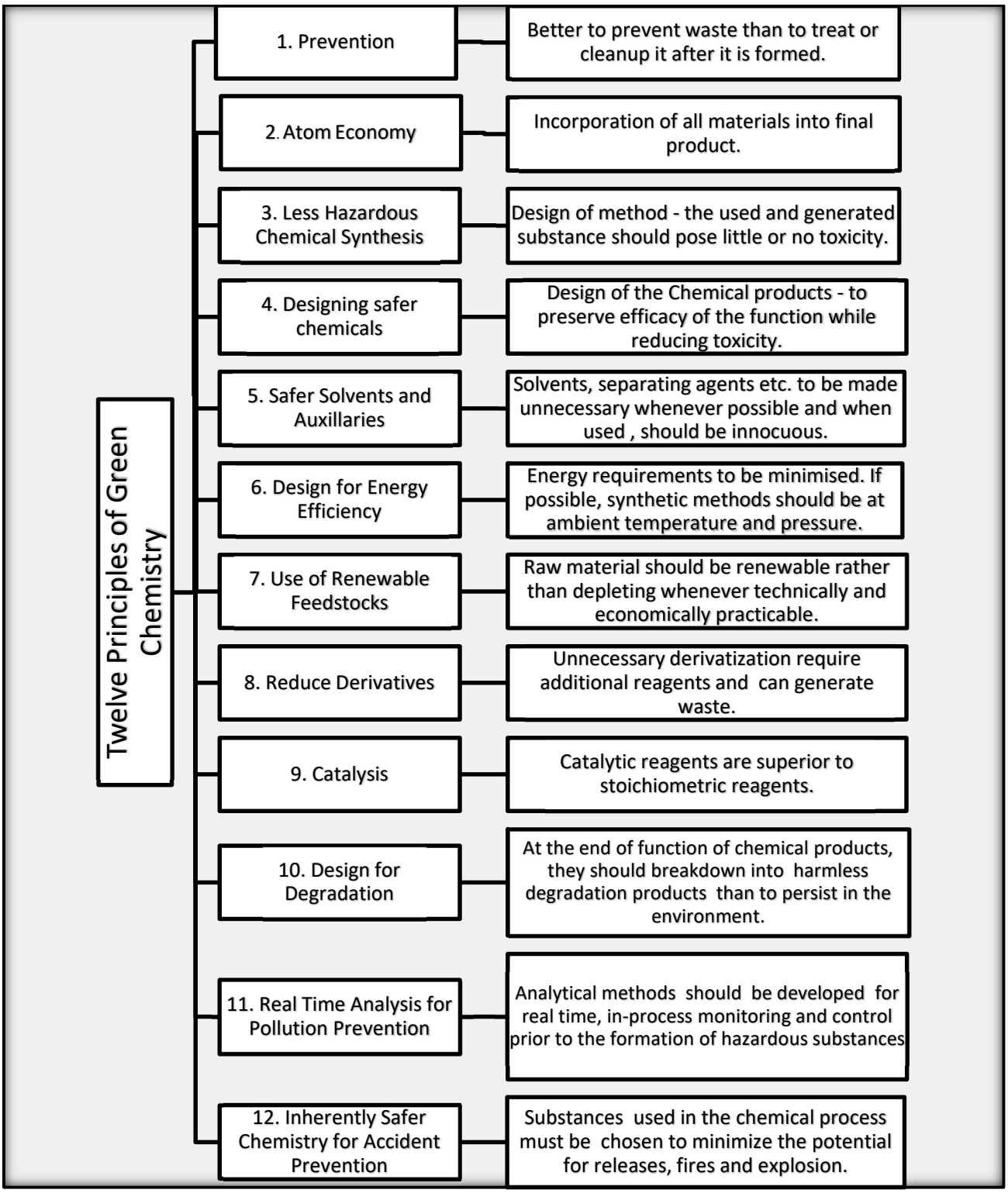

Figure. Twelve Principles of Green Chemistry

3. Advanced vanadium redox flow battery, which is an alternative for Lithium -ion battery. The battery allows more access to stored energy, lasts longer and works in a broad temperature range(-40 to 120 °F). Li-ion batteries degrade over time and have limited cycle life. These operate between 20 to 80%

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capacity. As the vanadium electrolyte is water-based and does not degrade, the batteries are non-flammable and recyclable [10].

4. Liquid carbon dioxide can be used for dry cleaning. CO_2 produced by industries can be captured and liquefied under pressure. Organic solvents, halogenated solvents or soapy water conventionally used for the purpose are not environment friendly. Green cleaning with liquid CO_2 along with surfactant using micelle technology minimize the waste generated [11]. Moreover greenhouse gas can be utilized, reducing carbon in the environment.

5. Volatile organic compounds (VOCs) are given off by oil based alkyd (synthetic polyester resin) paints that impact environment. Soya oil and sugar mixture created by Procter& Gamble and Cook Composites and Polymers replaced these fossil fuel based paints and solvents. Recycled soda bottle plastic, acrylics, and soybean oil were used by Sherwin-Williams to develop water-based acrylic alkyd paints with low VOCs [12].

6. Pharmaceutical industries have also been trying to follow green chemistry protocols. Greener Reaction Conditions Award was given to Merck and Codexis by U.S. Environmental Protection Agency, 2010 for synthesizing a new diabetes drug, Januvia [13].

7. Bio bleaching is an eco-friendly approach that reduces consumption of chemicals for paper making. Chemicals such as H_2SO_4, Cl_2, ClO_2, NaOH, and H_2O_2 are usedin making pulp and bleaching process.These put a lot of pressure on environment. The research has proposed the use of microbial enzymes such as xylanases, pectinases, laccases, manganese peroxidases, and lignin peroxidases for the pre-treatment of pulp known as pre-bleaching or Bio bleaching. It results in the superior quality of pulp along with lesser consumption of chlorine-based chemicals and lesser generation of adsorbable organic halides [14].

8. A number of studies reveal Eco-friendly edible plates, spoons and bowls using different combinations such as spinach concentrate, Rice flour, Sorghum flour for plates [15], Whole wheat flour, Sorghum flour, Rice flour for spoons [16], Wheat bran, Wheat flour, Canola seed Oil, salt, rooibos tea for bowls [17]. This cutlery is bio degradable and a good replacement of plastic cutlery. Pineapple peel, Pomegranate peel, Orange peel, Jackfruit seed flour, Flax seed powder were also used to make edible bowl [18]. Though edible but it can absorb moisture, become soggy and microbial attack is possible due to nutritional contents. Therefore shelf life is very less though biodegradable. Also the cost of raw material and processing is too high as compared to plastic cutlery.

We too can contribute a lot practising green chemistry in our lives. Avoiding paper napkins and using cloth napkins, using water instead of toilet napkins, reusing plastic bottles of drinks, using cloth for wrapping instead of aluminium foil, using pressure cookers for cooking leads to save energy, reusing old clothes for different purposes like dusters, in making shopping bagsor charity, efficiently using electricity and many more ways in different fields can save energy and decrease carbon footprint. Reduce and Reuse is the best contribution of mankind towards green chemistry for sustainable environment.

Conclusion

Continuous Research and efforts in various fields following the principles of green chemistry will lead us towards clean environment and conservation of resources. Still it may take a long time to apply designs of synthesis and applications to each and every field as per green chemistry. This is because

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some times it may have very high cost of implementation. Results may be uncertain and alternate technology may or may not be evolved. Still the efforts must be continued to achieve the goal of green chemistry to protect ecosystem from chemical destruction, hazardous waste, global warming and ozone depletion. Green Chemistry is a great and much required contribution towards making our mother earth and environment sustainable.

References

1. https://www.epa.gov/greenchemistry/basics-green-chemistry.
2. Pure Appl. Chem., 2000, Vol. 72, No. 7, pp. 1207–1228.
3. https://www.acs.org/greenchemistry/what-is-green-chemistry/history-of-green-chemistry.
4. Prof. Pietro Tundo Venice, Chair of ICGCSD, February 19th, 2020, Green Chemistry and IUPAC, Statement, Interdivisional Committee on Green Chemistry for Sustainable Development, ICGCSD, *IUPAC*, 1-3.
https://iupac.org/wp-content/uploads/2021/03/ICGCSD-Statement_Tundo_Feb2020.pdf
5. Paul Anastasand Nicolas Eghbali, 2010, Green Chemistry: Principles and Practice, *Chem.Soc. Rev*. 39, 301-312.
6. Zhang G., Zhao Z. Green Packaging Management of Logistics Enterprises. *Phys. Procedia*. 2012; 24:900–905. doi: 10.1016/j.phpro.2012.02.135.
7. Singh G., Pandey N. 2018, The Determinants of Green Packaging That Influence Buyers' Willingness to Pay a Price Premium, *Australas. Mark. J*., 26, 221–230. doi: 10.1016/j.ausmj.2018.06.001
8. Pavlath A.E., Orts W. Edible Films and Coatings: Why, What, and How? In: Huber K.C., Embuscado M.E., editors. Edible Films and Coatings for Food Applications,*Springer*, New York, NY, USA: 2009. pp. 1–23.
9. Papierfabrik August Koehler SE, Green Chemistry Challenge: 2017 Designing Greener Chemicals Award, The Dow Chemical Company, Green Chemistry, EPA. https://www.epa.gov/greenchemistry/green-chemistry-challenge-2017-designing-greener-chemicals-award
10. The UniSystemTM: An Advanced Vanadium Redox Flow Battery for Grid-Scale Energy Storage, UniEnergy Technologies LLC, Green Chemistry Challenge: 2017 Small Business Award, Green Chemistry, EPA
https://www.epa.gov/greenchemistry/green-chemistry-challenge-2017-small-business-award
11. Gina Stewart, 2004, Dry cleaning with liquid carbon dioxide, in Joseph M DeSimone and William Tumas (eds), *Green Chemistry using liquid and supercritical carbon dioxide*, 215-227,New York, Oxford Academic.
12. https://www.acs.org/greenchemistry/what-is-green-chemistry/examples.html
13. Mohit Mishra, Mansi Sharma, Ragini Dubey, Pooja Kumari, VikasRanjan, Jaya Pandey, 2021, Green synthesis interventions of pharmaceutical industries for sustainable development, *Current Research in Green and Sustainable Chemistry*, 4, 100174.
14. Amit Kumar, 2021, Biobleaching: An eco-friendly approach to reduce chemical consumption and pollutants generation, *Physical Sciences Reviews*, 6(4).
15.Sood S, Deepshikha. 2018, Development and Quality Evaluation of Edible Plate. ARC J Nutri Growth, 4(2),1-4.

ISSN:1624-1940
DOI 10.6084/m9.figshare.26310329
http://magellanes.com/

16.Rashid MS. Edible cutleries as sustainable substitute for plastic cutleries.
17.Poonia A, Yadav P. 2017, Trends in Edible Cutlery and Tableware. Beverage and Food, 44 (10).
18.Vyshali P, Serena PB. 2022, Development of an edible and biodegradable tableware using fruit wastes-an alternative to plastic tableware,*Int J Food Nutr Sci.*, 11, 85-90.